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ABSTRACT

This book was designed to help administrators, teachers, staff, parents, governing boards, teacher educators, and students to decide what children need to learn about computers and information handling; how these new objectives fit into the curriculum in mathematics, science, language arts, and social studies; how to use computers in classrooms; and what resources are needed and where to get them. Suggestions on how the book can assist each intended audience are followed by background information on why computer literacy is important. An overview discusses the scope and sequence of objectives for computer literacy in grades K-8, including purpose, definition, goals, and organization. Focus is on six strands of literacy: (1) using and developing procedures; (2) using computer programs; (3) fundamental concepts about computers; (4) computer applications; (5) impact of computers on society; and (6) writing computer programs. Four chapters then provide detailed descriptions of sample activities for grades K-8, including objectives, materials, time needed, classroom management, and teacher instructions. Some student handouts and transparencies are suggested. An appendix provides extensive reference lists of programs, publishers, and learning materials. (LMM)

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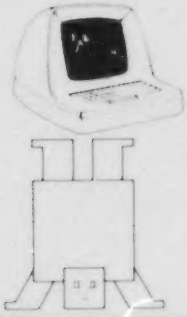
Learning Activities for Computer Literacy

Beverly Hunter



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My Students Use Computers

learning activities for computer literacy

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To Edmund C. Berkeley, for having the wisdom and foresight in 1949 to publish a computer literacy book "intended for everyone," entitled *GIANT BRAINS or Machines That Think;* and for dedicating his career to encouraging socially responsible uses of computer technology.

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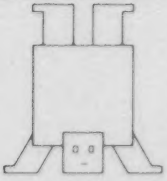
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Over two hundred people directly contributed the ideas and information contained in this book.

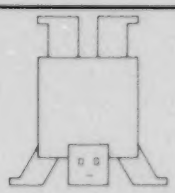
Catherine Morgan originally pointed out to me the need for a scope and sequence of computer literacy objectives to be infused into the regular curriculum. David Moursund and Dan Klassen contributed to the proposal stages of the project. Robert Seidel and Carol Hargan at HumRRO were instrumental in getting the project underway. Andrew Molnar and Dorothy Deringer at the National Science Foundation's Science Education Directorate provided continuing encouragement and inspiration for our work.

Each member of our Panel of Experts (even those who don't believe in objectives) worked through several iterations of lists of hundreds of candidate objectives. Dick Ricketts was especially helpful in clarifying goals and objectives.

Dan Watt, Dave Moursund and Kay Morgan contributed major aspects of the procedural thinking objectives and activities. Robert Taylor, Dan Watt, and Molly Watt contributed a strong emphasis on learning processes and social interaction in the classroom — class management, peer instruction, discovery learning, play, debugging.

Sylvia Charp, Richard Lavine and Jean Rice provided much wisdom about what is and is not feasible to do in schools. Ronald Anderson, Karen Billings, William Kraus and Barbara Kurshan brought to the project major sources of learning materials. Jane Gawronski, Richard Diem, and Phyllis Marcuccio provided priorities in math, social studies and science respectively.

Beverly Sangston, Ann Cummins, Pat Cutlip and Sue Moats made it possible for over seventy persons in the Montgomery County Public Schools to contribute to the development of objectives and lesson plans, and then for the pilot schools to try out draft lessons. They coped with the myriad day-to-day problems involved in hardware and software acquisition, budgeting, teacher training, coordination, and politics.



Donald Dearborn made possible the participation of principals, teachers and students in four Alexandria City Schools, in pilot testing draft lesson plans and gathering data on results.

Erica Lodish and Jean Judd pioneered new roles for the library/media center in supporting computer activities in schools. Over 100 classroom teachers in six pilot schools cheerfully tried out rough-draft lesson plans, and then went on to invent more useful ones.

The Learning Company, Apple Computer Inc., the Minnesota Educational Computing Consortium, and the National Science Teachers Association provided computer programs and other learning materials.

Doris Stein, the project secretary, contributed to efficient operation of many meetings and conferences.

Cindy and Shawn Hunter (then ages 13 and 11) previewed and critiqued dozens of computer programs. Hal Hunter suffered the loss of his wife to a word processor with quiet grace.

Carol King and her competent colleagues at Reston Publishing Co. made it possible for this book to come into being.

A Commodore CBM computer with WordPro 4 word processing software ma le it possible to develop and revise dozens of drafts of manuscript and lesson plans.

Beverly Hunter
March 1983

Three years ago, Apples were still for eating and PETs were for cuddling in the world of most elementary and junior high school students and teachers in Montgomery County, Maryland. In 1980, when the Human Resources Research Organization staff and Montgomery County teachers and administrators began cooperating in a computer literacy curriculum project, approximately 40 microcomputers had already made their way into scattered classrooms in our 165 elementary, middle, and junior high schools. They were used only by identified gifted and talented students. Today all K – 8 students and teachers in our schools have some access to microcomputers. Within a 3-year period about 400 microcomputers were acquired from funding commitments by the Board of Education and individual school parent teacher associations, for use in kindergarten through eighth grade classrooms.

In 1980, the school system had begun planning its immediate and long-range needs for equipment, training, software evaluation and acquisition, and curriculum development. This phenomenon has been mirrored in school districts nationwide. First the equipment arrives because educators and parents know that we must teach students to use computers if they are to survive and thrive in our information-based, computer-dependent society. Introduction of teachers to the computer follows. About half of our K – 8 teachers have received 45 hours of training in the past 2 years through in-service courses provided by the school system. Training for administrators and media specialists has been initiated this year.

Through this process, teachers and administrators become acutely aware of the need for quality software and a computer literacy curriculum. Montgomery County has had the extreme good fortune of facing the educational demands of the '80s with support from Beverly Hunter, Project Director for the National Science Foundation's grant to develop Computer Literacy Guides for Elementary and Junior High Schools.

Foreword



My Students Use Computers reflects the lessons learned in this cooperative effort to infuse computers into the classroom. It contains a set of computer literacy objectives designed to integrate computer use and activities into the regular K – 8 curriculum wherever appropriate, so that the computer becomes a valued tool for both teaching and learning. The book also lists selected software and resources for classroom use.

These objectives are the result of a cooperative, ongoing process involving curriculum developers and classroom teachers. Written by theorists and expert consultants, tested by teachers and students in the classroom, revised according to practical experiences — the objectives reflect both what is desirable and what is possible. They include a balance of functional skills and general knowledge which lead to an attitude of confidence in communicating both with and about computers. They point the way to teaching students in the classroom to use computers for the same purposes that computers are used in the "real" world: for word processing, storing information in data bases, problemsolving, calculating, learning new concepts, and simulating information for decisionmaking. They focus on the computer as a powerful tool to be explored and exploited and as a patient teacher to be engaged and enjoyed.

The objectives and suggested lesson plans in *My Students Use Computers* have been tried out by elementary and junior high school teachers in both Montgomery County, Maryland, and Alexandria, Virginia. During the pilot experience, efforts were made to validate their grade level placement and to assess the feasibility of their implementation in schools that have limited access to computers and staff with minimal computer training. These activities provide a beginning for teachers and school system administrators seeking a framework and a direction for computer literacy education in grades K – 8. Teachers use these activities as models for developing additional computer literacy experiences for their students. The process of infusing computer-related skills into the regular curriculum is proceeding in Montgomery County through summer curriculum workshops by the science, math, social studies, language arts, and special education coordinators, specialists, and teachers. Full implementation of this computer literacy curriculum in all classrooms is projected to occur within 5 years.

Our experiences in Montgomery County reinforce the concept that computer literacy education is a process, not an event. It is with this in mind that I commend this book to all educators interested in preparing today's students for the 21st century, the century in which they will spend their adult lives.

Beverly Sangston
March 1983

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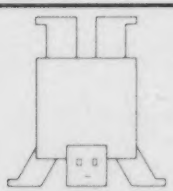
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This work is supported by the National Science Foundation Development in Science (DISE) program, Grant Number SED79-23684. Dr. Dorothy Deringer is the Program Manager for this project.

My Students Use Computers is designed to help any person who is concerned about the use of computers in the education of children in school, in grades K through 8. The purpose of the book is to help administrators, teachers, staff, parents, governing boards, teachers of teachers, and students to decide

- ☐ What the children need to learn about computers and information handling
- ☐ How these new objectives fit into the curriculum in mathematics, science, language arts, and social studies
- ☐ How to use computers in classrooms
- ☐ What resources are needed and where to get them

This book is an abbreviated version of *My Students Use Computers: Computer Literacy in the K – 8 Curriculum*. It does not contain the "Implementation Guide" (Chapter 8) discussed below; mention of this guide has been made for purposes of reference.

SCHOOL-BOARD MEMBERS AND SCHOOL DISTRICT EXECUTIVES

The book will assist in formulating goals, policies, and plans for integrating computer-related skills and knowledge into the schools. Chapter 2, "Should Children Use Computers in School?", provides background on the reasons why computer literacy is important. Chapter 3, "Overview of the Curriculum," explains the approach and objectives recommended for grades K through 8. Chapter 8, "Implementation Guide," discusses four categories of implementation: administrative and policy issues, the role of the library media center, staff development, and equipment.

Who Uses This Book?



SUBJECT-AREA SUPERVISORS AND CURRICULUM COORDINATORS

Chapters 3 through 7 provide a scope and sequence of objectives for grades K through 8, and show how these objectives might support the curriculum in math, science, social studies and language arts. Use these chapters to help decide on a realistic plan for integrating computer activities into your subject areas, to assist teachers, and to guide local curriculum development work.

SCHOOL PRINCIPALS AND TEACHERS

Principals and teachers can incorporate computer-related skills and knowledge into the classroom, whether or not the school now has computers. Chapter 3 provides a scope and sequence of objectives. Chapters 4 through 7 provide detailed lesson plans for teaching computer skills and knowledge in the context of math, science, social studies, and language arts. The Appendix provides a reference list of all the books, periodicals, and publishers that are referred to throughout the book.

LIBRARY MEDIA SPECIALISTS

The library media center can play a central role in a computer-literate school. Roles of the library media center are discussed in Chapter 8, "Implementation Guide." The Appendix provides a reference list of all the books, periodicals, and publishers that are referred to throughout the book.

COMPUTER COORDINATORS

All chapters of this book are relevant to the work of computer coordinators. The coordinator helps teachers and administrators to implement the plans in this book by helping to acquire the needed equipment, software, and educational materials. The coordinator helps to arrange for needed in-service education discussed in Chapter 8.

TEACHERS OF TEACHERS

This book can help in making decisions about what teachers need to learn about and with computers; it is also an aid in planning teacher training courses and workshops. The curriculum plan (Chapters 3 to 7) can be used to revise preservice courses to better reflect computer-related methods and content. The sample lesson plans and the section on "Staff Development" in Chapter 8 will help in planning and conducting in-service courses and workshops for teachers.

PARENTS

Parents who are concerned about the need to include computer-related activities in the school curriculum can use the chapter "Should Children Learn About Computers in School?" to help organize presentations and discussions with school district officials. The curriculum Chapters 3 to 7 provide many ideas about how parents' particular talents, skills, and knowledge can be used as a resource for the classroom teacher or library media specialist.

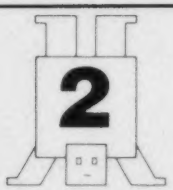
Many educators answer this question affirmatively. Others have philosophical or practical objections. Certainly everyone will agree that schools need to make some adaptations to the Computer Age. However, there is no consensus about what kinds of adaptations need to be made. Hundreds of educators and technologists have contributed ideas included in this book; each has a somewhat different answer to the questions, "Should children learn about and use computers?", "Why should children learn about computers?", "What should children learn to do with computers?", and "How shall they learn?"

Society is rapidly and fundamentally changing in its structure and activities. Many of the changes are rooted in new ways of generating, storing, communicating, and using information. We are shifting from the Industrial Age to the Information Age. In part, this means that more and more of us are handling information more and more of the time.

Computer and communications technologies are the dramatic and visible signs of the information revolution. Thus, "computer literacy" has become the focus for many educators seeking to adapt schools to the new age. Increasingly, parents, teachers, and children believe that by learning about computers and by learning how to use computers, they will be better prepared to survive and to enjoy economic well-being in the changing world.

Some people believe that the computer offers new opportunities for children and their teachers to be creative, to throw off the drudgery of the old curriculum, to invent new ideas and new means of expression, and to tackle more interesting and complex problems.

Should Children Use Computers in School?



Some believe that all children — and adults — must learn to take control of the machines before the machines take control of them. According to this view, computer literacy is a matter of self-defense.

Educational equity is a key reason for addressing computer literacy in grades K through 8. If all students are to benefit, computer studies cannot be only a high school elective.

Some educators do not support computer-literacy goals for grades K through 8. Some believe that computers are just another distraction in the classroom. Some insist that it is impossible to train teachers to use and teach about computers competently. Others fear that the continued use of computers in schools will result in a population that can't add or subtract. Some people believe that computers are a fad, like language labs and classroom TV, that will never seriously affect education. Still another objection to including computers in the curriculum is that the technology is changing too fast to allow time for curriculum development and refinement.

An even more serious concern is that children will have less human interaction if they begin to spend substantial amounts of time at the computer. A related fear is that children who learn to interact with computers will come to value precise communications more than the intuitive and ambiguous communications that exist within the arts and humanities.

The philosophy underlying this book is that schools have no choice but to adapt to the Information Age. Learning about computers is a part of that adaptation, but only a part. The more fundamental need is for children to learn to handle information, to solve problems, to communicate with people, and to understand the changes that are taking place in their society. If computers are the powerful intellectual tools they are claimed to be, then they should help in the achievement of these goals. This book takes the position that computer-related objectives and activities must be integrated into the curriculum in mathematics, social studies, science, and language arts.

This integration will not be accomplished in one year or one project or one curriculum revision. Rather, it is an ongoing process. This book provides a framework for that process. It provides a common set of objectives with which administrators, staff, teachers, and curriculum specialists can work. The specifics of implementation will vary from school to school, from subject area to subject area, from teacher to teacher, and from year to year. But all the changes will be within a coherent framework and sequence, so that every year students will be able to build on the skills and knowledge they have gained earlier. Basic concepts of problem solving, information handling, and social issues will be reinforced and applied in many different ways throughout the curriculum in science, math, social studies, and the language arts.

When computer literacy is viewed in this way — as a means, not as an end — then the legitimate fears of anti-technologists can be taken into account in school curriculum changes. The computer can become a vehicle for more, rather than less, interaction among students and teachers. Similarly, if computer-related activities are designed to support the regular curriculum, they won't distract from it but will, rather, enhance it. When the focus is on the fundamentals of information handling and problem solving rather than on the bits and bytes of computer hardware, there is less risk of the development of curricula that are obsolete before they are used.

In sum, the answer to the question "Should children use and learn about computers in school?" must be a qualified "yes." The qualification is that the computer is only a focal point for the many curriculum changes that must be made in response to the changing world. Our job is to establish a process of change that will take advantage of computers to accomplish the important purposes of schools.

RECOMMENDED READING

The Computer in the School: Tutor, Tool, Tutee, ed. Robert P. Taylor; Teachers College Press, Columbia University, 1981. This book is a collection of articles by five pioneers in educational computing: Alfred Bork, Thomas Dwyer, Arthur Luehrmann, Seymour Papert, and Patrick Suppes. The articles provides a rich background on accomplishments of the past and visions of the future.

Computer Literacy: Issues and Directions for 1985, ed. Robert J. Seidel, Ronald E. Anderson, and Beverly Hunter; Academic Press, 1982. This book contains the proceedings of a conference sponsored by the National Science Foundation, at which sixty experts were invited to express opinions and report research findings related to national goals for computer literacy.

The Micro Millennium, by Christopher Evans; Viking Press, 1979. This book provides a perspective on the computer revolution. It provides visions of the future of world society as a result of the impact of information technology.

Practical Guide to Computers in Education, by P. Coburn et al.; Addison-Wesley, 1982. This book provides a lively, honest portrayal of the state of computers in schools in the early 1980s.

This chapter describes a scope and sequence of objectives. The scope and sequence provides a common frame of reference for all members of the school community. It is a tool to aid in planning, curriculum development, staff development, and classroom instruction.

PURPOSE

Our purpose is to develop universal computer literacy — the skills and knowledge needed by all citizens to survive and thrive in a society that is dependent on technology for handling information and solving complex problems. This curriculum is not designed to produce computer specialists or to encourage students to choose computer-related careers.

DEFINITION

Exactly what is "computer literacy"? Its general definition is, "whatever a person needs to be able to do with computers and know about computers in order to function in an information-based society." This definition points out that the particular skills and knowledge needed will vary from person to person and from time to time.

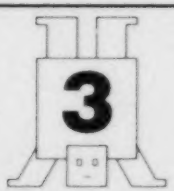
For students in grades K through 8, "computer literacy" means "the ability to use suitably programmed computers in appropriate ways to assist in learning, handling information, and solving problems; and the ability to make informed judgments about social and ethical issues involving computer and communication systems."

GOALS

The goals of the curriculum are to

- ☐ Encourage teachers and students to use and create computer applications that are helpful in teaching, learning, managing information, and solving problems in all subject areas

Overview of the Curriculum



- ☐ Help students and teachers to develop a sense of control over computers and to learn a variety of tools and techniques for exercising that control
- ☐ Help students and teachers learn to develop problem-solving procedures — procedures that people can use with and without the aid of computers
- ☐ Encourage students and teachers to behave in an ethical and responsible manner in relation to the computers and information systems they use
- ☐ Help students and teachers to evaluate advantages, disadvantages, and limitations of particular computer applications
- ☐ Help teachers and students to become aware of ways in which computers affect groups and individuals, thereby helping to prepare students for responsible citizenship
- ☐ Help students and teachers to become aware of information-handling and problem-solving skills that are important in a variety of careers

HOW THE CURRICULUM IS ORGANIZED

The scope and sequence of objectives is organized into six "strands."* The strands are:

1. Using and developing procedures
2. Using computer programs
3. Fundamental concepts about computers
4. Computer applications
5. Impact of computers on society
6. Writing computer programs

Each strand includes a sequence of objectives to be achieved throughout grades K to 8. The objectives are suggested for introduction at particular grade levels. Teachers and students apply and build upon these skills throughout succeeding grades.

The strands are interrelated. Many classroom activities address a combination of objectives from two or more strands. (Figure 3 – 1 illustrates an overview of the strands and objectives by grade level.)

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*A "strand" is a developmental sequence of skill and knowledge objectives.

STRAND 1: USING AND DEVELOPING PROCEDURES

A procedure is a step-by-step description of how to do something. A procedure is a specific set of instructions that must be carried out in exactly the specified sequence. A procedure might be spoken, written, acted out, or depicted with pictures or flowcharts or other symbols. (Computer scientists and mathematicians prefer the term "algorithm" to describe a finite, step-by-step set of directions designed to solve a particular problem. "Procedures" as used in this book includes algorithms.)

The ability to use and to develop procedures is central to computer literacy, information handling, and problem solving. People do many things without being conscious of a procedure, but *computers cannot function without procedures to follow.*

We need procedures in order to handle large amounts of information in systematic ways and in order to solve problems. Therefore we need procedural thinking skills whether we are using a computer, a calculator, a pencil and paper, or any other tool to aid in the process. Writing this book, for example, involved handling information from thousands of sources — collecting it, storing it, organizing it, and presenting it in usable form. We invented many procedures for performing these tasks. Some of the procedures involved computers (storing reference information on the computer files; writing and editing text on a word processor), and some procedures involved organizing paper documents in cardboard boxes.

Students will use and learn procedure-related concepts in three stages:

1. *Describing a familiar activity in terms of procedures.* In this case, students will use the familiar activity to illustrate the *idea* of procedures. They will learn to make descriptions at the appropriate level of detail, completely describing the activity in the correct sequence of steps. They will also learn that procedures must be carried out literally.
2. *Using procedures and related concepts to solve problems that are meaningful and important.* In this case, a procedure is a useful tool for solving a problem in math, social studies, science, language arts, or everyday life.
3. *Developing procedures to solve new problems.* At this stage students are acquiring the important intellectual tools that enable them to break a problem into manageable subproblems and develop step-by-step methods for solution.

Students can begin procedure-related skills and concepts before they have access to a computer and before they learn computer program-

Strands	Grades K - 2	Grades 3 - 4	Grades 5 - 6	Grades 7 - 8
	TEACH STUDENTS TO:			
Procedures	• Follow a procedure for a familiar task • Modify a procedure • Show different procedures can produce the same outcome • Find and correct errors in a procedure • Describe procedures used to perform a task	• Help to develop a procedure involving repetition, decision making, and variables • Find and correct errors in a procedure • Develop a procedure, demonstrate that is works • Use procedures to perform new tasks	• Apply procedures skills to new problems • Note differences between procedures for people and procedures for computers • Break problem into subproblems: plan procedures and subprocedures • Develop procedures for organizing data	• Apply procedures skills to new problems • Choose the best aid for solving a problem: calculator, computer, pencil?
Using Programs	• Use computer drills and games • Operate equipment; load and run programs • Recognize the computer needs instruction	• Read documentation that describes programs and tells how to use them • Select and operate programs without teacher's help • Select and use a program to solve a specific problem	• Use simulations as an aid in learning • Demonstrate learning from a simulation • Retrieve information from a computer data base • Apply skills in using equipment, programs and documentation	• Use word processor to improve writing • Use more complex simulations • Use new methods to retrieve information
Fundamentals	• Understand that computer instructions are contained in a program	• Understand that the computer is a general purpose machine	• Recognize tasks for which computer speed is needed • Recognize tasks requiring repetition • Recognize tasks requiring large amounts of data	• Apply knowledge of fundamentals to new situations

Applications	• Discover computer applications in homes and neighborhoods	• Know about computer applications in school and local government • Compare fictional and real computers	• Understand 1 or more ways information retrieval is used in diverse fields • Understand how scientists might use computers	• Recognize uses of Word Processor • Recognize uses of computer in business and manufacturing • Recognize use of computer systems in large organizations • Recognize main components of computer systems
Impact	• Follow rules for using equipment and programs	• Follow rules for using equipment and programs	• Understand reasons to restrict access to data bases and programs • Understand advantages and disadvantages of particular uses of information retrieval	• Become aware of new social issues created by computers • Appreciate social dependence on computers • Understand effects of computer failures • Understand the kinds of computer skills needed in diverse careers • Become aware of computer professions
Writing Computer Programs	(Note: For grades K – 6, objectives and activities related to computer programming are reflected in the Procedures, Using Programs, and Fundamentals strands.)			• Modify programs • Code programs • Write documentation • Test and debug programs • Plan and develop programs

Figure 3 – 1 □ Overview of strands and grade levels

ming. A major advantage of this approach is that it allows students to focus on the basic concepts involved in procedures without being distracted by the syntax of a computer programming language. They can understand better how they as human beings solve problems, and how explicit, formal procedures can be useful tools for learning and for solving problems. In a classroom in which a computer is being used, it is still important to use "people procedures" as well as computer procedures. Students develop a clearer understanding of the differences between the way the computer does something and the way a person does the thing. They also develop a sense of the limitations and peculiarities of the computer.

Many tasks can be used as vehicles for learning about procedures. A number of examples are provided in this book — for example, sorting, alphabetizing, making change using coins, finding books in a library, charting and graphing data, planning a class project, organizing a report, looking up information in a reference book, analyzing data from an opinion survey, solving a new kind of math problem.

In the classroom, students are often asked to follow a set of instructions for accomplishing a task. This book suggests that students be asked to plan and develop their own careful, detailed sets of instructions for accomplishing tasks; to test their procedures; and to make corrections in them.

Students may also express their procedures in the form of computer programs. Lesson plans are provided for using the programming language Logo to learn how to write procedures for a computer.

Objectives

In grades K to 2, students will learn to

1. Execute a procedure (follow step-by-step instructions) for a familiar task (or for a new task), and be able to show the end result of having executed it
2. Modify a procedure to make it accomplish a new (similar) task, and give the new procedure a name
3. Demonstrate that different procedures can be used to obtain the same outcome
4. Find and correct errors (such as the wrong sequence of instructions) in a procedure that involves fewer than ten steps and does not involve decision making
5. Describe the procedures they have used to perform a task

6. Help in developing a written procedure for accomplishing a task that is already familiar

In grades 3 and 4, students will learn to

7. Help develop a procedure that involves:
   a. Repetition
   b. Decision making based upon conditions
   c. Variable inputs
8. Find and correct errors in a procedure that involves:
   a. Repetition
   b. Decision making based upon conditions
   c. Variable inputs
9. Develop independently a procedure that can be executed by a person to perform a task, and give the procedure a name; also demonstrate that the procedure accomplished the intended results

In grades 5 and 6, students will learn to

10. Identify some differences between a procedure to be executed by a person and a procedure to be executed by a computer
11. Break a given problem into subproblems and plan a structured set of procedures and subprocedures for solving the problem
12. Develop a procedure for organizing data in a way that is needed to analyze or solve a problem and present the solution (for example, putting data in alphabetic or numeric order, extracting and summarizing data, and tabulating, graphing, or charting data)

In grades 7 and 8, students will learn to

13. Solve a problem by several different means — with the aid of pencil and paper, with a calculator, with a prewritten computer program, or with a new program (taking into account such factors as amount of data used, processed, or stored in solving the problem; whether or not a problem is quantifiable; and whether or not a suitable program exists)

Sample Activities

In Chapters 4 through 7, lesson plans are provided for sample activities to support the Procedures objectives. A summary of these activity titles is shown in Table 3 – 1, "Sample Activities for Procedures Strand."

Table 3 – 1 ☐ Sample activities for Procedures strand

Chapter 4: Grades K – 2

ACTIVITY NAME: ZEEP007 THE ROBOT
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS, SOCIAL STUDIES, LOGIC
PROCEDURES OBJECTIVES: 1, 3, 4

ACTIVITY NAME: BIG TRAK
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS, SOCIAL STUDIES
PROCEDURES OBJECTIVES: 1, 2, 3, 4, 5, 6

ACTIVITY NAME: GRID LOCATIONS
SUBJECT: MATH
PROCEDURES OBJECTIVES: 1

ACTIVITY NAME: SERIAL ORDERING OF OBJECTS
SUBJECT: SCIENCE
PROCEDURES OBJECTIVES: 3

ACTIVITY NAME: DOES IT FLOAT?
SUBJECT: SCIENCE
PROCEDURES OBJECTIVES: 1, 2, 4, 5

ACTIVITY NAME: WHICH CAME FIRST – THE CHICKEN OR THE EGG?
SUBJECT: SCIENCE
PROCEDURES OBJECTIVES: 1, 2, 4

ACTIVITY NAME: USING THE ART CENTER
SUBJECT: ART, CLASSROOM MANAGEMENT
PROCEDURES OBJECTIVES: 1, 4, 5, 6

ACTIVITY NAME: ALPHABETICAL ORDER
SUBJECT: LANGUAGE ARTS
PROCEDURES OBJECTIVES: 1, 4, 5, 6

Chapter 5: Grades 3 & 4

ACTIVITY NAME: ZEEP007 AND THE DISHES
SUBJECT: ANY
PROCEDURES OBJECTIVES: 5, 6, 8, 9

ACTIVITY NAME: LOGO LESSON 1 – TURTLE PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 1a

ACTIVITY NAME: LOGO LESSON 2 – MODIFY PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 2

ACTIVITY NAME: LOGO LESSON 3 – DIFFERENT PROCEDURES, SAME TASK
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 3, 5

ACTIVITY NAME: LOGO LESSON 4 – DESIGNING PROCEDURES
SUBJECT: ANY, SCIENCE, MATH, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 5, 6

ACTIVITY NAME: LOGO LESSON 5 – REPEAT COMMAND
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 7a, 8a

ACTIVITY NAME: PHASES OF THE MOON
SUBJECT: SCIENCE
PROCEDURES OBJECTIVES: 5, 9

ACTIVITY NAME: DEVELOPING A PROCEDURE FOR COPYING A DIAGRAM
SUBJECT: MATH
PROCEDURES OBJECTIVES: 5, 6

Table 3–1 ☐ cont'd

ACTIVITY NAME: DEVELOPING PROCEDURES FOR GEOMETRIC PATTERNS
SUBJECT: MATH
PROCEDURES OBJECTIVES: 5, 7, 8, 9

ACTIVITY NAME: PATTERN BLOCKS PROCEDURES – EQUIVALENT FRACTIONS
SUBJECT: MATH
PROCEDURES OBJECTIVES: 5, 9

ACTIVITY NAME: GIVING DIRECTIONS
SUBJECT: SOCIAL STUDIES, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 3, 4, 9

ACTIVITY NAME: DRAGONS' DEN
SUBJECT: SOCIAL STUDIES, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 9

Chapter 6: Grades 5 & 6

ACTIVITY NAME: ZEEP007 AND THE PAINT
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS, LOGIC
PROCEDURES OBJECTIVES: 7, 8, 11

ACTIVITY NAME: LOGO LESSON 6 – VARIABLES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 7c, 8c

ACTIVITY NAME: LOGO LESSON 7 – VARIABLES AND LOOPS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 7a, 7b, 7c, 8a, 8b, 8c

ACTIVITY NAME: LOGO LESSON 8 – CONDITIONAL LOOPS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 7, 8

ACTIVITY NAME: LOGO LESSON 9 – SMALLER THAN ONE
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 7, 8

ACTIVITY NAME: PROCEDURES FOR SOLVING MATH PROBLEMS
SUBJECT: MATH
PROCEDURES OBJECTIVES: 7, 8, 9

ACTIVITY NAME: USING PATTERN BLOCKS FOR ADDING AND SUBTRACTING FRACTIONS
SUBJECT: MATH
PROCEDURES OBJECTIVES: 9

ACTIVITY NAME: SEMCALC
SUBJECT: MATH
PROCEDURES OBJECTIVES: 13

ACTIVITY NAME: BUMBLE PLOT
SUBJECT: MATH
PROCEDURES OBJECTIVES: 13

ACTIVITY NAME: ENERGY SURVEY
SUBJECT: SCIENCE, MATH
PROCEDURES OBJECTIVES: 12

Table 3–1 ☐ cont'd

Chapter 7: Grades 7 & 8

ACTIVITY NAME: ZEEP007 MOWING LAWNS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 11

ACTIVITY NAME: LINE UP
SUBJECT: ANY, MATH, LANGUAGE ARTS
PROCEDURES OBJECTIVES: 3, 6, 9, 12

ACTIVITY NAME: COMPARING AFRICAN COUNTRIES
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: ALL

ACTIVITY NAME: GRAPHING DATA
SUBJECT: SCIENCE, MATH
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: STATES DATA BASE
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: SEARCH AND UPDATE
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: UPDATE – LAND AREA AND ALTITUDE
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: RETRIEVAL – SELECTING, SORTING, REPORTING
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: UPDATE – STATES POPULATIONS
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

ACTIVITY NAME: EXPLORING THE DATA BASE
SUBJECT: SOCIAL STUDIES
PROCEDURES OBJECTIVES: 12

The lesson plans help teachers and students to get started. After using a few of these sample activities, teachers and students go on to apply these ideas to their own classroom tasks and problems.

The following are some tips on teaching procedural thinking skills:

1. Each activity should include class discussion of the vocabulary to be used in the procedure. It is important to agree upon a limited, clearly defined vocabulary. Suggestions are provided in the lesson plans.
2. Allow students to develop "buggy" procedures, and discover the bugs themselves through testing of the procedure.

Common bugs in students' procedures include the following:

- Initial conditions not stated (e.g., Which way am I facing? How many did we start with?)
- Vocabulary not defined
- Steps left out

- Steps incomplete (e.g., "forward how far")
- Steps in wrong sequence
- No test for completion of task (infinite loops)
- No name for the procedure

3. Make sure students receive help learning to test procedures. Several techniques are suggested in the lesson plans; for example:
   - The teacher acts out the instructions exactly as specified, thus demonstrating the bugs as well as demonstrating what it means to carry out instructions exactly as specified.
   - A student who was not present in the classroom while the procedure was being developed is asked to follow the procedure exactly as written. Does the student do as the class intended? Does the student understand the instructions? Does the student produce the intended result?
4. At the outset of the class session, the teacher should provide (or get the students to define) very clear and explicit descriptions of the intended outcome of the procedure. (For example, the end product might be a list on the chalkboard of fractional names for one whole.)
5. Provide opportunities for students to experiment in a concrete way, using physical objects and actions, before they are asked to develop formal, verbal procedures. For example, in one activity the students develop a procedure for controlling the behavior of an electronic toy. They need to "play" with the toy before they are ready to develop a procedure for solving an assigned problem.

STRAND 2: USING COMPUTER PROGRAMS

To become computer-literate, children must use computer programs. It is important for them to use a variety of different kinds of programs. The computer is a general-purpose machine, and this concept is easily learned by experiencing many uses of computers.

Programs used by the students should serve three main purposes, in addition to familiarizing them with a variety of applications. The programs should:

1. Aid the students in acquiring skills, knowledge, and attitudes that are prescribed for the curriculum in science, mathematics, social studies, and language arts. That is, the programs should be useful to the students in learning.

2. Help and encourage students to select programs that are useful and appropriate for tasks that they need to perform. Students should be able to read (appropriately written) program documentation to aid in selecting and operating the programs and equipment. This is an aspect of "taking control" over computers.
3. Teach students to act in a responsible and ethical manner toward equipment, information, and programs that are shared by many persons.

Many teachers also report that using computer programs provides a new level of motivation for learning among their students.

Objectives

In grades K to 2, students will learn to

1. Use computer programs such as drills and games as an aid in learning assigned skills in math, science, social studies, and language arts
2. Operate devices and issue commands needed to use available programs. Devices might include keyboard, computer or terminal, paddle or joystick, tape cassette, disk drive, floppy disk, telephone or modem. Commands might include those needed to load, run, list, and stop a program.
3. Recognize that the computer must be given instructions in order to operate, and that the instructions are contained in a program*
4. Follow rules of law and ethics while using computers and computer programs (for example, students will protect equipment from damage or loss; they will not destroy another person's data or programs, nor intentionally disrupt operation of system software; and they will follow rules for scheduling and sharing equipment and programs)*

In grades 3 and 4, students will learn to

5. Read and comprehend program documentation that tells the following:
   - Name of the program
   - Purpose of the program

*Using Programs objectives 3 and 4 are repeated from Fundamentals 1 and Impact 1. They are repeated here in order to emphasize the developmental importance of these skills and concepts in the Using Programs sequence.

- How to use the program
- Data and equipment needed to use the program

6. Use documentation to select a program appropriate to aid in a given task, and to operate the program without teacher assistance
7. Select and use a program that helps to solve an assigned problem

In grades 5 and 6, students will learn to

8. Use a computer simulation as an aid in learning about a topic of study
9. Demonstrate understanding of the effects and interaction of selected variables in a simulation being used; and be able to describe some aspects of the real world that are included and omitted from the simulation being used
10. Retrieve selected information from a computer data base as an aid in an activity such as writing a term paper or preparing a science project

In grades 7 and 8, students will learn to

11. Use a word-processing program to aid in writing, revising, and perfecting a composition

Sample Activities

Chapters 4 through 7 provide lesson plans for activities in which students use computer programs for a variety of different purposes. Each lesson plan is based on the use of a particular program, but that program is intended to illustrate a *type* of program and a *type* of use by students. You need to acquire a comparable kind of program for your machine.

Table 3 – 2 lists lesson plans for using computer programs.

In keeping with the intent and purpose of this curriculum, the programs exemplify many uses of the computer as a tool. These program tools include shell programs the student uses to create his or her own lesson drills, games, and stories; programs for graphing and plotting data; data bases and information-retrieval programs; programs to aid in analyzing and solving math problems; simulations; word processors; and programs for building logic machines.

Table 3 – 2 ☐ Sample activities for Using Computer Programs strand

Chapter 4: Grades K – 2

ACTIVITY NAME: JUGGLES' RAINBOW
SUBJECT: ANY, LANGUAGE ARTS, MATH
USING PROGRAMS OBJECTIVES: 1, 2, 4

ACTIVITY NAME: MOPTOWN
SUBJECT: ANY, LOGIC
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4

ACTIVITY NAME: BUMBLE GAMES
SUBJECT: MATH
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4

Chapter 5: Grades 3 & 4

ACTIVITY NAME: MATH STRATEGY
SUBJECT: MATH
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4, 5, 6, 7

ACTIVITY NAME: COORDINATE GRID GAMES
SUBJECT: MATH
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4, 5, 6, 7

ACTIVITY NAME: SPELLING STRATEGY
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4, 5, 6, 7

ACTIVITY NAME: LOGIC GAMES
SUBJECT: ANY, LOGIC, MATH, SCIENCE, LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 5, 6

Chapter 6: Grades 5 & 6

ACTIVITY NAME: SEMCALC
SUBJECT: MATH
USING PROGRAMS OBJECTIVES: 7

ACTIVITY NAME: BUMBLE PLOT
SUBJECT: MATH
USING PROGRAMS OBJECTIVES: 7

ACTIVITY NAME: ROCKY'S BOOTS
SUBJECT: ANY, LOGIC, SCIENCE
USING PROGRAMS OBJECTIVES: 1, 2, 3, 4, 5

ACTIVITY NAME: LIGHT BOX
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 5, 7

ACTIVITY NAME: ENERGY SURVEY
SUBJECT: SCIENCE, MATH
USING PROGRAMS OBJECTIVES: 7

ACTIVITY NAME: MAKE YOUR OWN ADVENTURE STORY
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 5

ACTIVITY NAME: QUAKES
SUBJECT: SCIENCE, MATH
USING PROGRAMS OBJECTIVES: 8, 9

ACTIVITY NAME: GEOGRAPHY SEARCH
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 8, 9

ACTIVITY NAME: PLANETS DATA BASE
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 10

Table 3–2 ☐ cont'd

Chapter 7: Grades 7 & 8

ACTIVITY NAME: SCIENTISTS AT ODELL LAKE
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 8, 9

ACTIVITY NAME: GEOLOGY SEARCH
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 8, 9

ACTIVITY NAME: GRAPHING DATA
SUBJECT: SCIENCE, MATH
USING PROGRAMS OBJECTIVES: 7

ACTIVITY NAME: PERSONAL ENERGY AUDIT
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 7, 10

ACTIVITY NAME: EXAMPLE TELLSTAR LESSONS
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 6, 7, 10

ACTIVITY NAME: USING TELLSTAR
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 6, 7, 10

ACTIVITY NAME: EXPERIMENTS WITH THE SKY
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 6, 7, 10

ACTIVITY NAME: SKY PROJECTS
SUBJECT: SCIENCE
USING PROGRAMS OBJECTIVES: 6, 7, 10

ACTIVITY NAME: STATES DATA BASE
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: SEARCH AND UPDATE
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: UPDATE – LAND AREA AND ALTITUDE
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: RETRIEVAL – SELECTING, SORTING, REPORTING
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: UPDATE – STATES POPULATIONS
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: EXPLORING THE DATA BASE
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

ACTIVITY NAME: EXAMPLE WORD-PROCESSING LESSONS
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 11

ACTIVITY NAME: USING APPLEWRITER
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 11

ACTIVITY NAME: APPLEWRITER EXPERIMENTS
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 11

ACTIVITY NAME: APPLEWRITER PROJECTS
SUBJECT: LANGUAGE ARTS
USING PROGRAMS OBJECTIVES: 11

ACTIVITY NAME: ELECTRONIC MONEY
SUBJECT: SOCIAL STUDIES
USING PROGRAMS OBJECTIVES: 10

More and more useful program tools are becoming available from commercial publishers and suppliers. Chapter 8 contains a section on evaluation and selection of programs. Lists of review journals and evaluation instruments are provided in the Appendix.

Recommended Reading

Microcomputer Courseware for the Classroom: Selecting, Organizing, and Using Instructional Software, by Ann Lathrop and Bobby Goodson; Addison-Wesley, 1982.

STRAND 3: FUNDAMENTAL CONCEPTS ABOUT COMPUTERS

There are a few fundamental concepts about computers that are important for everyone to understand:

- ☐ The computer requires instructions in order to operate.
- ☐ The computer is a general-purpose machine.
- ☐ Computers operate at very high speeds.
- ☐ The computer is able to perform many repetitions of the same operation in exactly the same way.
- ☐ The computer is able to process large amounts of data.

In order to understand these fundamental characteristics, students must be able to visualize tasks or procedures that would involve many steps, large amounts of data, and require high speeds of execution. Introduction of these ideas enables us to introduce — in science, mathematics, and social studies — problems of realistic complexity that are being addressed in these disciplines in the "real world."

Objectives

In grades K to 2 (or as soon as they begin to use the computer), students will learn to

1. Recognize that the computer must be given instructions in order to operate, and that the instructions are contained in a program

In grades 3 and 4, students will learn to

2. Recognize that the classroom computer is a general-purpose device that can operate under many different programs

In grades 5 and 6, students will learn to

3. Give examples of tasks for which the computer's speed is necessary or advantageous; and be able to compare the speed of human beings to the speed of computers in performing such tasks
4. Give examples of tasks that require many repetitions of the same operations and explain why a computer is useful for carrying out such tasks
5. Give examples of tasks that require processing of large amounts of data and explain why a computer is useful for carrying out such tasks

In grades 7 and 8, students will apply their understanding of these concepts in many new situations. Understanding of the Fundamental Concepts is prerequisite to objectives and activities in all the other strands at the junior high school level.

Sample Activities

The fundamental concepts are introduced and reinforced in the context of other activities. For example, when students first use a computer program, they learn that the computer must be given instructions in the form of a program.

Table 3 – 3 provides a list of the activities from Chapters 4 through 6 that provide good opportunities for addressing these fundamental concepts.

Table 3 – 3 ☐ Sample activities for Fundamentals strand

Chapter 4: Grades K – 2

ACTIVITY NAME: BIG TRAK
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS, SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: JUGGLES' RAINBOW
SUBJECT: ANY, LANGUAGE ARTS, MATH
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: MOPTOWN
SUBJECT: ANY, LOGIC
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: BUMBLE GAMES
SUBJECT: MATH
FUNDAMENTALS OBJECTIVES: 1

Chapter 5: Grades 3 & 4

ACTIVITY NAME: SAMPLE LOGO LESSONS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 1 – TURTLE PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1

Table 3–3 ☐ cont'd

ACTIVITY NAME: LOGO LESSON 2 – MODIFY PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 3 – DIFFERENT PROCEDURES, SAME TASK
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 4 – DESIGNING PROCEDURES
SUBJECT: ANY, SCIENCE, MATH, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 5 – REPEAT COMMAND
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1, 4

ACTIVITY NAME: MATH STRATEGY
SUBJECT: MATH
FUNDAMENTALS OBJECTIVES: 1, 2

ACTIVITY NAME: SPELLING STRATEGY
SUBJECT: LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 1, 2

ACTIVITY NAME: LITTLE PROFESSOR
SUBJECT: MATH
FUNDAMENTALS OBJECTIVES: 2

Chapter 6: Grades 5 & 6

ACTIVITY NAME: ZEEP007 AND THE PAINT
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 4

ACTIVITY NAME: LOGO LESSON 7 – VARIABLES AND LOOPS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
FUNDAMENTALS OBJECTIVES: 4

ACTIVITY NAME: SEMCALC
SUBJECT: MATH
FUNDAMENTALS OBJECTIVES: 3

ACTIVITY NAME: LIGHT BOX
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 4

ACTIVITY NAME: PLANETS DATA BASE
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 5

Chapter 7: Grades 7 & 8

ACTIVITY NAME: GRAPHING DATA
SUBJECT: MATH, SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 5

ACTIVITY NAME: GRAPHING DATA
SUBJECT: SCIENCE, MATH
FUNDAMENTALS OBJECTIVES: 3, 5

ACTIVITY NAME: PERSONAL ENERGY AUDIT
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 5

ACTIVITY NAME: EXAMPLE TELLSTAR LESSONS
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 5

ACTIVITY NAME: USING TELLSTAR
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 5

ACTIVITY NAME: EXPERIMENTS WITH THE SKY
SUBJECT: SCIENCE
FUNDAMENTALS OBJECTIVES: 3, 5

Table 3–3 ☐ cont'd

ACTIVITY NAME: STATES DATA BASE
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

ACTIVITY NAME: SEARCH AND UPDATE
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

ACTIVITY NAME: UPDATE – LAND AREA AND ALTITUDE
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

ACTIVITY NAME: RETRIEVAL – SELECTING, SORTING, REPORTING
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

ACTIVITY NAME: UPDATE – STATES POPULATIONS
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

ACTIVITY NAME: EXPLORING THE DATA BASE
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 3, 4, 5

ACTIVITY NAME: JUNK MAIL
SUBJECT: LANGUAGE ARTS, SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 3, 4, 5

ACTIVITY NAME: ELECTRONIC MONEY
SUBJECT: SOCIAL STUDIES
FUNDAMENTALS OBJECTIVES: 5

Recommended Reading

Bits 'n Bytes About Computing: A Computer Literacy Primer, by Rachelle S. Heller and C. Dianne Martin; Computer Science Press, 1982. Written for teachers, this book explains computer fundamentals and suggests activities for teaching these in the classroom.

Computers are Fun, by Jean Rice and Sandy O'Connor; Denison, 1981. Written for primary students, this book introduces computer fundamentals.

My Friend the Computer, by Jean Rice; Denison, 1981. Written for middle grades students, this book introduces computer fundamentals.

Illustrated Computer Science Dictionary for Young People, by Donald D. Spencer; Camelot Publishing Co., 1982. This is a reference source on computer terminology for students.

STRAND 4: COMPUTER APPLICATIONS

Computers are used in thousands of ways by different individuals and organizations. These uses are called "applications" or "computer-based systems." A "system" is an organized grouping of people, methods, machines, and materials collected together to accomplish a set of specific objectives. Applications and systems have certain characteristics, which include the following:

- ☐ All applications and systems involve people, who develop, operate, and interact with each other and with the machines.
- ☐ All applications and systems operate on *data* which are usually stored in some organized way, in a form the computer can understand.
- ☐ All systems have *inputs*. Inputs include both instructions and data that can come into the system from many different people and places.
- ☐ All systems have *outputs*. Outputs include both information and instructions to people and to other machines.
- ☐ The various people and machines involved in the system must have some means of *communicating* with each other.
- ☐ The people and machines involved in the system must follow carefully designed *procedures* that specify the sequence of actions to be taken.

The objectives in the Applications strand are designed to help students build a conceptual framework that includes these concepts and components. They do this by using a variety of computer applications and by learning about similar applications in the neighborhood, business, government, science, and other fields of endeavor.

Objectives

In grades K to 2, students will learn to

1. Describe computer applications in the home and neighborhood, in terms of the following:
   - Who uses the computer and where
   - What information the person gives the computer
   - What information the computer gives the person
   - How the person uses this information

In grades 3 and 4, students will learn to

2. Describe a computer application found in the school, local government, or local business, in terms of the following:
   - Who uses the computer
   - What information (input) the person gives the computer
   - What information (output) the computer gives the person
   - How the person uses the information

- Locations of the people and machines
- Communication links between the people and machines in the system
- Kinds of information stored in the computer data base

3. Describe similarities and differences between imaginary computers found in fiction and real computers

In grades 5 and 6, students will learn to

4. Describe one or more ways in which information retrieval is used in fields such as science, law enforcement, and education
5. Describe one or more computer applications used by scientists, including:
   - What the scientist is studying
   - What kind of information the computer provides to the scientist
   - How the scientist uses the information
   - What kinds of data are input to the computer

In grades 7 and 8, students will learn to

6. Describe one or more ways in which word processing is used in fields such as business, government, and journalism
7. Describe one or more computer applications in fields such as business, banking, manufacturing, transportation, the military
8. Describe a computer system used in a large organization, in terms of the following:
   - Several different users and their locations
   - Kinds of information provided to different users
   - Several sources of data that are input to the system
   - Some of the kinds of data contained in the data base
   - How users and computers communicate with each other
   - Some of the kinds of programs that run the system
   - Possible sources of errors in the system
9. Recognize that a system involves interaction among the following:
   - people
   - hardware
   - procedures
   - software
   - documentation
   - communications lines
   - data

Sample Activities

Applications objectives are closely interrelated with the objectives for Using Programs. For example, students can more easily understand information-retrieval applications in the "real world" after they have used a computerized data base themselves.

Table 3 – 4 lists sample activities from Chapters 4 through 7, which address Applications strand objectives.

Table 3 – 4 ☐ Sample activities for Applications strand

Chapter 4: Grades K – 2

ACTIVITY NAME: COMPUTERIZED SUPERMARKET
SUBJECT: SOCIAL STUDIES
APPLICATIONS OBJECTIVES: 1

Chapter 5: Grades 3 & 4

ACTIVITY NAME: BULLETIN BOARD
SUBJECT: SOCIAL STUDIES, ART
APPLICATIONS OBJECTIVES: 2

ACTIVITY NAME: THE AWAKENING
SUBJECT: LANGUAGE ARTS
APPLICATIONS OBJECTIVES: 3

ACTIVITY NAME: THE FUN THEY HAD
SUBJECT: LANGUAGE ARTS
APPLICATIONS OBJECTIVES: 3

Chapter 6: Grades 5 & 6

ACTIVITY NAME: LIGHT BOX
SUBJECT: SCIENCE
APPLICATIONS OBJECTIVES: 5

ACTIVITY NAME: ENERGY SURVEY
SUBJECT: SCIENCE MATH
APPLICATIONS OBJECTIVES: 5

ACTIVITY NAME: DATA BASES AND PRIVACY
SUBJECT: ANY, LANGUAGE ARTS, SOCIAL STUDIES
APPLICATIONS OBJECTIVES: 4

Chapter 7: Grades 7 & 8

ACTIVITY NAME: SCIENTISTS AT ODELL LAKE
SUBJECT: SCIENCE
APPLICATIONS OBJECTIVES: 5

ACTIVITY NAME: GRAPHING DATA
SUBJECT: MATH, SCIENCE
APPLICATIONS OBJECTIVES: 5

ACTIVITY NAME: PERSONAL ENERGY AUDIT
SUBJECT: SCIENCE
APPLICATIONS OBJECTIVES: 4

ACTIVITY NAME: EXPERIMENTS WITH THE SKY
SUBJECT: SCIENCE
APPLICATIONS OBJECTIVES: 5

Table 3–4 ☐ cont'd

ACTIVITY NAME: SKY PROJECTS
SUBJECT: SCIENCE
APPLICATIONS OBJECTIVES: 5

ACTIVITY NAME: SAMPLE WORD-PROCESSING LESSONS
SUBJECT: LANGUAGE ARTS
APPLICATIONS OBJECTIVES: 6

ACTIVITY NAME: USING APPLEWRITER
SUBJECT: LANGUAGE ARTS
APPLICATIONS OBJECTIVES: 6

ACTIVITY NAME: JUNK MAIL
SUBJECT: LANGUAGE ARTS, SOCIAL STUDIES
APPLICATIONS OBJECTIVES: 6

ACTIVITY NAME: SCHOOL CASE STUDY
SUBJECT: SOCIAL STUDIES
APPLICATIONS OBJECTIVES: 8

ACTIVITY NAME: ELECTRONIC MONEY
SUBJECT: SOCIAL STUDIES
APPLICATIONS OBJECTIVES: 7

Recommended Reading

What Computers Can Do, by Donald Spencer; Camelot Publishing Co., 1982. This book provides information on a wide variety of computer applications, and is written at a junior high school level.

STRAND 5: IMPACT OF COMPUTERS ON SOCIETY

Computers are having, and will have, more powerful effects on society and individuals than any of us yet know how to imagine or predict. Our only hope for making wise and beneficial uses of the technology and avoiding some of the potential disasters is to have an educated citizenry with an attitude of responsibility and a sense of control.

Activities and objectives in the Impact strand help teachers and students to understand some of the ways in which computer-based systems may affect individuals and groups. Students will learn to evaluate both advantages and disadvantages of particular computer systems and applications. They will become aware of computer-related skills and experiences that are needed in a variety of careers.

Throughout the curriculum, the importance of ethical and responsible behavior in relation to information and machines is stressed. These are resources shared by many people. Using them properly is analogous to learning to obey motor-vehicle laws and developing safe, responsible driving habits when one is learning to drive a car.

Objectives

In grades K to 2 (or when they begin to use the computer), students will learn to

1. Follow the rules of law and ethics in using computers and computer programs (for example, they will not damage equipment,

destroy another person's data or programs, copy programs that are copyrighted, steal another person's identification code or password, or intentionally disrupt operation of system software)

In grades 3 and 4 students will continue to learn such rules, and the reasons for them, as they are introduced to different kinds of programs. In grades 5 and 6 (in connection with the information storage and retrieval section), students will learn to

2. Explain reasons for restricting and controlling access to computer systems, data bases, and programs through use of such techniques as identification codes and passwords (examples of such reasons: to prevent crime, to protect personal privacy, to keep the data base free of errors, and to protect authors' copyrights)
3. List both advantages and disadvantages of particular information-retrieval applications they have used or studied; for example:
   - *Advantages:* Information can be found quickly; many people can access the information at one time; data base can be updated as new information becomes available
   - *Disadvantages:* There may be errors in the data base that are not known; people may use the information in ways that are illegal or unfair to others; information may be put into standardized formats that cause important information to be lost or that can impose limits on what can be stored

In grades 7 and 8, students will learn to

4. Analyze a computer-related issue and locate information needed for the analysis. Issues might include, for example:
   - Blaming computer for errors and problems
   - Privacy
   - Computer crime
   - Automation and job displacement
   - Artificial intelligence
   - Control of information utilities and communications facilities

   Analysis might include:

   - Identifying and defining the issue
   - Identifying the parties in conflict
   - Identifying the positions of the parties in conflict
   - Identifying the issues requiring further facts for clarification

5. Identify or recognize some factors that both contribute to and are supported by our increasing dependence on computer-based systems (for example: increasing size and complexity of government and business organizations; increasing complexity of the problems society is addressing; increasing level of education; increasing amounts of information generated and communicated; reductions in cost and size of computers; increases in the speed and storage capacity of computers; improvements in the way people communicate with computers; marketing by the computer industry)
6. Describe ways in which people might be affected if a computer system failed to operate properly, thus recognizing the importance of safeguards such as backup systems (examples of computer failures that would affect people are: billing errors, air traffic control failures, payroll delays or errors, medical misdiagnosis or mistreatment)
7. Describe some computer-related skills needed by people in careers outside the computer industry (for example: entering data into computers, making inquiries into data bases, specifying requirements for computer processing of data, operating computer-based laboratory equipment, operating word-processing equipment, using computer-based design aids)
8. Describe examples of careers directly involved in the computer and data-processing industries (for example: programming, computer design and engineering, maintaining electronic equipment, systems analysis)

Sample Activities

Table 3 – 5 lists sample activities from Chapters 4 through 7, which can be used to address Impact objectives.

Table 3 – 5 ☐ Sample activities for Impact strand

Chapter 4: Grades K – 2

ACTIVITY NAME: JUGGLES' RAINBOW SUBJECT: ANY, LANGUAGE ARTS, MATH IMPACT OBJECTIVES: 1	ACTIVITY NAME: BUMBLE GAMES SUBJECT: MATH IMPACT OBJECTIVES: 1
ACTIVITY NAME: MOPTOWN SUBJECT: ANY, LOGIC IMPACT OBJECTIVES: 1	

Table 3–5 ☐ cont'd

Chapter 5: Grades 3 & 4

ACTIVITY NAME: LOGO LESSON 1 – TURTLE PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 2 – MODIFY PROCEDURES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 3 – DIFFERENT PROCEDURES, SAME TASK
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 4 – DESIGNING PROCEDURES
SUBJECT: ANY, SCIENCE, MATH, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 5 – REPEAT COMMAND
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: MATH STRATEGY
SUBJECT: MATH
IMPACT OBJECTIVES: 1

ACTIVITY NAME: COORDINATE GRID GAMES
SUBJECT: MATH
IMPACT OBJECTIVES: 1

ACTIVITY NAME: SPELLING STRATEGY
SUBJECT: LANGUAGE ARTS
IMPACT OBJECTIVES: 1

Chapter 6: Grades 5 & 6

ACTIVITY NAME: LOGO LESSON 6 – VARIABLES
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 7 – VARIABLES AND LOOPS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 8 – CONDITIONAL LOOPS
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: LOGO LESSON 9 – SMALLER THAN ONE
SUBJECT: ANY, MATH, SCIENCE, LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: BUMBLE PLOT
SUBJECT: MATH
IMPACT OBJECTIVES: 1

ACTIVITY NAME: ROCKY'S BOOTS
SUBJECT: ANY, LOGIC, SCIENCE
IMPACT OBJECTIVES: 1

ACTIVITY NAME: GEOGRAPHY SEARCH
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1

Table 3–5 ☐ cont'd

ACTIVITY NAME: PLANETS DATA BASE
SUBJECT: SCIENCE
IMPACT OBJECTIVES: 1, 3

ACTIVITY NAME: DATA BASES AND PRIVACY
SUBJECT: ANY, LANGUAGE ARTS, SOCIAL STUDIES
IMPACT OBJECTIVES: 2, 3

Chapter 7: Grades 7 & 8

ACTIVITY NAME: PERSONAL ENERGY AUDIT
SUBJECT: SCIENCE
IMPACT OBJECTIVES: 1, 3

ACTIVITY NAME: USING TELLSTAR
SUBJECT: SCIENCE
IMPACT OBJECTIVES: 1

ACTIVITY NAME: EXPERIMENTS WITH THE SKY
SUBJECT: SCIENCE
IMPACT OBJECTIVES: 1

ACTIVITY NAME: SKY PROJECTS
SUBJECT: SCIENCE
IMPACT OBJECTIVES: 1

ACTIVITY NAME: STATES DATA BASE
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1

ACTIVITY NAME: SEARCH AND UPDATE
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1

ACTIVITY NAME: UPDATE – LAND AREA AND ALTITUDE
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1

ACTIVITY NAME: RETRIEVAL – SELECTING, SORTING, REPORTING
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1, 2, 3

ACTIVITY NAME: UPDATE – STATES POPULATIONS
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1

ACTIVITY NAME: EXPLORING THE DATA BASE
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1, 2, 3

ACTIVITY NAME: EXAMPLE WORD PROCESSING LESSONS
SUBJECT: LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: USING APPLEWRITER
SUBJECT: LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: APPLEWRITER EXPERIMENTS
SUBJECT: LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: APPLEWRITER PROJECTS
SUBJECT: LANGUAGE ARTS
IMPACT OBJECTIVES: 1

ACTIVITY NAME: TIME LINE
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 5

ACTIVITY NAME: COMPUTERS AND ETHICS
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1, 4

ACTIVITY NAME: COMPUTERS AND CRIME
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 1, 4

Table 3–5 ☐ cont'd

ACTIVITY NAME: THE COMPUTER DID IT!
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 4

ACTIVITY NAME: OPINION SURVEY ON EDUCATIONAL PROGRAMS
SUBJECT: SOCIAL STUDIES, LANGUAGE ARTS
IMPACT OBJECTIVES: 4

ACTIVITY NAME: ELECTRONIC MONEY
SUBJECT: SOCIAL STUDIES
IMPACT OBJECTIVES: 2, 5, 6

ACTIVITY NAME: THE FEELING OF POWER
SUBJECT: LANGUAGE ARTS, SOCIAL STUDIES
IMPACT OBJECTIVES: 4

STRAND 6: WRITING COMPUTER PROGRAMS

Because computer technology and applications are in a state of rapid change, there is as yet no consensus among technologists and educators regarding the purposes, objectives, or methods for teaching computer programming to all children. Rather, there is a diversity of strongly held views. This book provides the following guidance:

- ☐ A set of objectives, which can be addressed through use of different programming languages
- ☐ A discussion of alternative languages (BASIC, Logo, PILOT, Pascal), in Chapter 7
- ☐ Sample lesson plans in Chapters 5 and 6 for using the language Logo to learn and apply procedural thinking skills
- ☐ Lists of candidate materials for learning and teaching in the four different languages suggested (Chapter 7)
- ☐ The recommendation that introductory programming be treated as a separate course or unit before attempting to integrate the application of these skills into math, science, social studies, and language arts; integration of programming skills into other subject areas requires that students be able to apply programming skills already acquired

The objectives for the Writing Computer Programs strand have been placed at the seventh and eighth grade level in this curriculum plan. It is the case that some schools provide programming instruction at earlier grade levels, and that some students benefit from this experience. The reasons for placing the programming objectives at the junior high level in this curriculum are as follows:

- ☐ The skills in procedural thinking and in using programs which are introduced and applied in grades K – 6 are considered prerequisite to efficient learning of useful programming skills.

- ☐ If all students have been developing procedural thinking skills in grades K – 6, there is a greater likelihood that *all* students will have a successful experience with computer programming by the 7th or 8th grade.
- ☐ Many schools find it to be more convenient administratively to provide a programming course or unit at the junior high level than at the elementary grades.

Objectives

Students will learn to

1. Modify a program to use as an aid in learning or problem solving
2. Translate a given procedure into a computer program, using appropriate instructions to do the following:
   - Format numeric and string data
   - Accept input from keyboard or other device
   - Format and display output on a video display, printer, or other device
   - Perform logical operations
   - Perform arithmetic operations
   - Manipulate data
3. Write a program in a form and style that will assist others in finding and correcting errors, using the program, and modifying the program
4. Test and debug any program they write, and check results for correctness; also be able to use test data, error messages, and intermediate results as aids in debugging
5. Follow an orderly set of steps in planning and developing a program to solve a particular problem (for example: defining the problem and related assumptions; breaking the problem into subproblems; preparing test data; developing in English or schematic diagrams a set of procedures and subprocedures to solve the problem; checking for errors in logic; translating procedures into a programming language; inputting, editing, and testing the program; locating and correcting errors; preparing instructions for users of the program; using the program)

Sample Activities

Lesson plans for using Logo (Procedures strand) are included in Chapters 5 and 6.

Learning materials for programming objectives are discussed in Chapter 7.

ABOUT THE LESSON PLANS

Chapters 4 through 7 include ninety lesson plans describing example classroom activities. Most, but not all, of the objectives in the scope and sequence are supported by one or more lesson plans in appropriate subject areas and grade levels.

The sample activities are just that — examples. Teachers tailor them to suit the needs of their students, their curriculum, and the equipment and software available to them. As more and more software and other learning materials become available, more activities can be incorporated into the curriculum. Many teachers invent more activities.

Some activities, particularly in the Procedures strand, require no equipment and minimal preparation. Others, particularly in the Using Programs strand, require equipment, software, and preparation on the part of the teacher.

Table 3 – 6 lists sample lesson plans appropriate for math classes. Table 3 – 7 lists lesson plans for science. Table 3 – 8 lists lesson plans that are appropriate for language arts. Table 3 – 9 lists social studies lesson plans.

Some of the lessons are interdisciplinary, and thus they are shown on more than one list.

Table 3 – 6 ☐ Lesson plans appropriate for math classes

Chapter 4: Grades K – 2

ZEEP007 THE ROBOT
STUDENTS GIVE INSTRUCTIONS TO THEIR IMAGINARY ROBOT FRIEND ZEEP, TEST AND DEBUG THE PROCEDURES

BIG TRAK
STUDENTS DEVELOP AND TEST PROCEDURES FOR BIG TRAK PROGRAMMABLE TOY TO EXECUTE

GRID LOCATIONS
STUDENTS USE PROCEDURE TO LEARN NEW MATH SKILL

JUGGLES' RAINBOW
STUDENTS USE PROGRAM TO LEARN READING AND MATH READINESS SKILLS

BUMBLE GAMES
STUDENTS PLAY GAMES FINDING NUMBERS IN 4 × 4 GRIDS

Table 3–6 ☐ cont'd

Chapter 5: Grades 3 & 4

SAMPLE LOGO LESSONS
A SERIES OF LESSONS IN WHICH STUDENTS TRANSLATE PROCEDURES INTO PROGRAMS IN THE LOGO LANGUAGE

LOGO LESSON 1: TURTLE PROCEDURES
STUDENTS LEARN TO WRITE A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 2: MODIFY PROCEDURES
STUDENTS MODIFY A LOGO PROCEDURE TO MAKE IT ACCOMPLISH A NEW TASK

LOGO LESSON 3: DIFFERENT PROCEDURES, SAME TASK
STUDENTS CREATE A DIFFERENT LOGO PROGRAM TO ACCOMPLISH SAME TASK

LOGO LESSON 4: DESIGNING PROCEDURES
STUDENTS PLAN, ENTER, AND DEBUG A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 5: REPEAT COMMAND
STUDENTS LEARN TO USE THE LOGO REPEAT COMMAND FOR REPETITIVE OPERATIONS

DEVELOPING A PROCEDURE FOR COPYING A DIAGRAM
STUDENTS DEVELOP A PROCEDURE FOR COPYING A DIAGRAM ONTO A GRID, USING "OVER AND UP" COORDINATES

DEVELOPING PROCEDURES FOR GEOMETRIC PATTERNS
STUDENTS USE PATTERN BLOCKS TO BUILD GEOMETRIC DESIGNS WITH REPETITIVE PATTERNS, AND PROCEDURE FOR CONSTRUCTING THE SAME DESIGN

PATTERN BLOCKS PROCEDURES – EQUIVALENT FRACTIONS
STUDENTS DEVELOP AND USE PROCEDURES TO HELP THEM LEARN FRACTIONS WITH PATTERN BLOCKS

MATH STRATEGY
STUDENTS CREATE THEIR OWN MATH DRILLS USING A PROGRAM THAT TEACHES THEM TO VISUALIZE EQUATIONS

COORDINATE GRID GAMES
STUDENTS USE COMPUTER PROGRAM "BUMBLE DOTS" TO PLOT X, Y COORDINATE POINTS ON GRID TO CREATE PICTURES AND GRAPHS

LOGIC GAMES
STUDENTS FOLLOW WRITTEN DIRECTIONS FOR USING COMPUTER AND SOLVING LOGIC PUZZLES, USING COMPUTER PROGRAM "GERTRUDE'S SECRETS"

LITTLE PROFESSOR
STUDENTS COMPARE CAPABILITIES AND LIMITATIONS OF A SPECIAL-PURPOSE COMPUTER LIKE LITTLE PROFESSOR TO A GENERAL-PURPOSE COMPUTER

Table 3–6 ☐ cont'd

Chapter 6: Grades 5 & 6

ZEEP007 AND THE PAINT
STUDENTS FIND THE BUGS IN A PROCEDURE THAT TELLS ZEEP HOW TO PAINT A ROOM

LOGO LESSON 6: VARIABLES
STUDENTS LEARN TO USE VARIABLES IN LOGO PROCEDURES

LOGO LESSON 7: VARIABLES AND LOOPS
STUDENTS LEARN TO USE VARIABLES TO CONTROL LOOPS IN THE LOGO LANGUAGE

LOGO LESSON 8: CONDITIONAL LOOPS
STUDENTS LEARN TO WRITE CONDITIONAL LOOPS IN LOGO LANGUAGE

LOGO LESSON 9: SMALLER THAN ONE
STUDENTS LEARN EFFECTS OF USING DECIMAL NUMBERS LESS THAN ONE IN A LOGO PROCEDURE

PROCEDURES FOR SOLVING MATH PROBLEMS
STUDENTS SOLVE A PROBLEM AND THEN DEVELOP A PROCEDURE FOR SOLVING IT; THERE ARE SIX STEPS IN THE SOLUTION, AND TWO ALTERNATIVE SOLUTIONS

USING PATTERN BLOCKS FOR ADDING AND SUBTRACTING FRACTIONS
STUDENTS USE PROCEDURES AND PATTERN BLOCKS TO DISCOVER HOW TO ADD AND SUBTRACT FRACTIONS

SEMCALC
STUDENTS USE PROGRAM SEMCALC TO HELP THEM SOLVE MATH PROBLEMS

BUMBLE PLOT
STUDENTS USE PLOTTING PROGRAM TO CREATE GRAPHS AND PICTURES ON COMPUTER

ENERGY SURVEY
STUDENTS USE COMPUTER PROGRAM TO HELP GRAPH DATA THEY HAVE GATHERED IN A SURVEY OF OPINIONS ON ENERGY TOPICS

QUAKES
STUDENTS USE COMPUTER SIMULATION PROGRAM TO PRACTICE SKILLS IN LOCATING EPICENTER OF AN EARTHQUAKE

Chapter 7: Grades 7 & 8

ZEEP007 MOWING LAWNS
STUDENTS BREAK PROBLEM INTO SUBPROBLEMS AND DEVELOP PROCEDURE FOR ZEEP THE ROBOT TO MOW THE LAWN

LINE UP
STUDENTS SOLVE PROBLEM "HOW MANY WAYS CAN 5 PEOPLE BE POSED IN A LINE FOR A PICTURE" AND DEVELOP A PROCEDURE FOR SOLVING THE PROBLEM

GRAPHING DATA
STUDENTS USE COMPUTER SOFTWARE TO PLOT DATA THEY HAVE COLLECTED IN EXPERIMENTS IN THE LABORATORY

GRAPHING DATA
STUDENTS USE COMPUTER PROGRAM TO DISPLAY VARIOUS GRAPHS OF DATA THEY HAVE COLLECTED IN A LAB

Table 3 – 7 ☐ Lesson plans appropriate for science classes

Chapter 2: Grades K to 2

ZEEP007 THE ROBOT
STUDENTS GIVE INSTRUCTIONS TO THEIR IMAGINARY ROBOT FRIEND ZEEP, TEST AND DEBUG THE PROCEDURES

BIG TRAK
STUDENTS DEVELOP AND TEST PROCEDURES FOR BIG TRAK TOY TO EXECUTE

SERIAL ORDERING OF OBJECTS
STUDENTS DEMONSTRATE DIFFERENT PROCEDURES FOR ORDERING OBJECTS

DOES IT FLOAT?
STUDENTS DEVELOP AND USE PROCEDURE TO DETERMINE WHICH OBJECTS FLOAT IN WATER

WHICH CAME FIRST – THE CHICKEN OR THE EGG?
STUDENTS USE SEQUENCE OF STEPS IN A PROCEDURE TO DRAW SEQUENCE OF LIFE STAGES OF AN ANIMAL

Chapter 5: Grades 3 & 4

SAMPLE LOGO LESSONS
A SERIES OF LESSONS IN WHICH STUDENTS TRANSLATE PROCEDURES INTO PROGRAMS IN THE LOGO LANGUAGE

LOGO LESSON 1: TURTLE PROCEDURES
STUDENTS LEARN TO WRITE A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 2: MODIFY PROCEDURES
STUDENTS MODIFY A LOGO PROCEDURE TO MAKE IT ACCOMPLISH A NEW TASK

LOGO LESSON 3: DIFFERENT PROCEDURES, SAME TASK
STUDENTS CREATE A DIFFERENT LOGO PROGRAM TO ACCOMPLISH SAME TASK

LOGO LESSON 4: DESIGNING PROCEDURES
STUDENT PLANS, ENTERS, AND DEBUGS A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 5: REPEAT COMMAND
STUDENTS LEARN TO USE THE LOGO REPEAT COMMAND FOR REPETITIVE OPERATIONS

PHASES OF THE MOON
STUDENTS DEVELOP AND TEST A PROCEDURE FOR DESCRIBING PHASES OF THE MOON

LOGIC GAMES
STUDENTS FOLLOW WRITTEN DIRECTIONS FOR USING COMPUTER AND SOLVING LOGIC PUZZLES, USING COMPUTER PROGRAM "GERTRUDE'S SECRETS"

LOGO LESSON 6: VARIABLES
STUDENTS LEARN TO USE VARIABLES IN LOGO PROCEDURES

Table 3–7 ☐ cont'd

Chapter 6: Grades 5 & 6

ZEEP007 AND THE PAINT
STUDENTS FIND THE BUGS IN A PROCEDURE THAT TELLS ZEEP HOW TO PAINT A ROOM

LOGO LESSON 7: VARIABLES AND LOOPS
STUDENTS LEARN TO USE VARIABLES TO CONTROL LOOPS IN THE LOGO LANGUAGE

LOGO LESSON 8: CONDITIONAL LOOPS
STUDENTS LEARN TO WRITE CONDITIONAL LOOPS IN LOGO LANGUAGE

LOGO LESSON 9: SMALLER THAN ONE
STUDENTS LEARN EFFECTS OF USING DECIMAL NUMBERS LESS THAN ONE IN A LOGO PROCEDURE

ROCKY'S BOOTS
STUDENTS BUILD COMPLEX MACHINES FROM LOGIC GATES INCLUDING AND, OR, AND NOT GATES, FLIPFLOPS, DELAYS, CLOCKS, AND OSCILLATORS

LIGHT BOX
STUDENTS PERFORM EXPERIMENTS USING COMPUTER PROGRAM THAT DISPLAYS GRAPH OF AMOUNT OF LIGHT REFLECTED BY DIFFERENT OBJECTS, VIA LAB INSTRUMENT

ENERGY SURVEY
STUDENTS USE COMPUTER PROGRAM TO HELP GRAPH DATA THEY HAVE GATHERED IN A SURVEY OF OPINIONS ON ENERGY TOPICS

QUAKES
STUDENTS USE COMPUTER SIMULATION PROGRAM TO PRACTICE SKILLS IN LOCATING EPICENTER OF AN EARTHQUAKE

PLANETS DATA BASE
STUDENTS USE A DATA BASE ON THE PLANETS TO INVESTIGATE INTERESTING QUESTIONS ABOUT THE PLANETS

Chapter 7: Grades 7 & 8

ZEEP007 MOWING LAWNS
STUDENTS BREAK PROBLEM INTO SUBPROBLEMS AND DEVELOP PROCEDURE FOR ZEEP THE ROBOT TO MOW THE LAWN

SCIENTISTS AT ODELL LAKE
STUDENTS ARE SCIENTISTS OBSERVING BEHAVIOR OF FISH IN A LAKE; THEY COLLECT DATA AND USE THE DATA TO CONSTRUCT A FOOD WEB

GEOLOGY SEARCH
STUDENTS INVESTIGATE CHARACTERISTICS OF ROCK FORMATIONS AND DECIDE TO DRILL FOR OIL IN PROBABLE LOCATIONS, WITH THE AID OF COMPUTER SIMULATION

GRAPHING DATA
STUDENTS USE COMPUTER SOFTWARE TO PLOT DATA THEY HAVE COLLECTED IN EXPERIMENTS IN THE LABORATORY

Table 3–7 ☐ cont'd

GRAPHING DATA
STUDENTS USE COMPUTER PROGRAM TO DISPLAY VARIOUS GRAPHS OF DATA THEY HAVE COLLECTED IN A LAB

PERSONAL ENERGY AUDIT
STUDENTS ENTER DATA INTO COMPUTER ON THEIR OWN ENERGY USAGE: RETRIEVE INFO ON ENERGY USED; COMPARE USE TO NATIONAL NORMS

Table 3 – 8 ☐ Lesson plans appropriate for language arts

Chapter 4: Grades K to 2

ZEEP007 THE ROBOT
STUDENTS GIVE INSTRUCTIONS TO THEIR IMAGINARY ROBOT FRIEND ZEEP, TEST AND DEBUG THE PROCEDURES

BIG TRAK
STUDENTS DEVELOP AND TEST PROCEDURES FOR BIG TRAK TOY TO EXECUTE

ALPHABETICAL ORDER
STUDENTS DEVELOP AND USE A PROCEDURE FOR ALPHABETIZING A LIST OF LETTERS OR WORDS

JUGGLES' RAINBOW
STUDENTS USE PROGRAM TO LEARN READING AND MATH READINESS SKILLS

Chapter 5: Grades 3 & 4

SAMPLE LOGO LESSONS
A SERIES OF LESSONS IN WHICH STUDENTS TRANSLATE PROCEDURES INTO PROGRAMS IN THE LOGO LANGUAGE

LOGO LESSON 1: TURTLE PROCEDURES
STUDENTS LEARN TO WRITE A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 2: MODIFY PROCEDURES
STUDENTS MODIFY A LOGO PROCEDURE TO MAKE IT ACCOMPLISH A NEW TASK

LOGO LESSON 3: DIFFERENT PROCEDURES, SAME TASK
STUDENTS CREATE A DIFFERENT LOGO PROGRAM TO ACCOMPLISH SAME TASK

LOGO LESSON 4: DESIGNING PROCEDURES
STUDENTS PLAN, ENTER, and DEBUG A PROCEDURE IN THE LOGO LANGUAGE

LOGO LESSON 5: REPEAT COMMAND
STUDENTS LEARN TO USE THE LOGO REPEAT COMMAND FOR REPETITIVE OPERATIONS

GIVING DIRECTIONS
STUDENTS LEARN TO GIVE PRECISE DIRECTIONS FOR GETTING FROM ONE PLACE TO ANOTHER, USING A MAP

DRAGON'S DEN
STUDENTS WRITE A PROCEDURE FOR GETTING TO A TREASURE HIDDEN IN A DRAGON'S DEN

SPELLING STRATEGY
STUDENTS CREATE THEIR OWN SPELLING LESSONS USING A PROGRAM THAT TEACHES THEM HOW TO VISUALIZE THE SPELLING OF A WORD

Table 3–8 ☐ cont'd

LOGIC GAMES
STUDENTS FOLLOW WRITTEN DIRECTIONS FOR USING COMPUTER AND SOLVING LOGIC PUZZLES, USING COMPUTER PROGRAM "GERTRUDE'S SECRETS"

THE AWAKENING
STUDENTS READ SCIENCE FICTION STORY AND COMPARE COMPUTERS IN THE STORY TO REAL COMPUTERS

THE FUN THEY HAD
STUDENTS READ SCIENCE FICTION STORY AND COMPARE COMPUTERS IN THE STORY TO REAL COMPUTERS

Chapter 6: Grades 5 & 6

ZEEP007 AND THE PAINT
STUDENTS FIND THE BUGS IN A PROCEDURE THAT TELLS ZEEP HOW TO PAINT A ROOM

LOGO LESSON 6: VARIABLES
STUDENTS LEARN TO USE VARIABLES IN LOGO PROCEDURES

LOGO LESSON 7: VARIABLES AND LOOPS
STUDENTS LEARN TO USE VARIABLES TO CONTROL LOOPS IN THE LOGO LANGUAGE

LOGO LESSON 8: CONDITIONAL LOOPS
STUDENTS LEARN TO WRITE CONDITIONAL LOOPS IN LOGO LANGUAGE

LOGO LESSON 9: SMALLER THAN ONE
STUDENTS LEARN EFFECTS OF USING DECIMAL NUMBERS LESS THAN ONE IN A LOGO PROCEDURE

MAKE YOUR OWN ADVENTURE STORY
STUDENTS WRITE ADVENTURE STORY WITH CHOICES FOR THE READER, AND ENTER THE STORY INTO A SHELL PROGRAM ON THE COMPUTER

DATA BASES AND PRIVACY
STUDENTS INVESTIGATE COMPUTERIZED RECORDS KEPT ON THEM AND PRIVACY ISSUES INVOLVED IN COMPUTERIZED RECORD KEEPING

Chapter 7: Grades 7 & 8

ZEEP007 MOWING LAWNS
STUDENTS BREAK PROBLEM INTO SUBPROBLEMS AND DEVELOP PROCEDURE FOR ZEEP THE ROBOT TO MOW THE LAWN

LINE UP
STUDENTS SOLVE PROBLEM "HOW MANY WAYS CAN 5 PEOPLE BE POSED IN A LINE FOR A PICTURE" AND DEVELOP A PROCEDURE FOR SOLVING THE PROBLEM

SAMPLE WORD-PROCESSING LESSONS
A SERIES OF LESSONS IN WHICH STUDENTS LEARN TO USE A WORD-PROCESSING PROGRAM TO IMPROVE THEIR CREATIVE WRITING SKILLS

USING APPLEWRITER
STUDENTS LEARN TO USE APPLEWRITER, AN EXAMPLE OF A WORD-PROCESSING PROGRAM

Table 3–8 ☐ cont'd

APPLEWRITER PROJECTS
STUDENTS WORKING IN SMALL GROUPS CREATE AND REVISE A COMPOSITION WITH THE HELP OF A WORD-PROCESSING PROGRAM

JUNK MAIL
STUDENTS EXAMINE JUNK MAIL AND EXPLAIN HOW IT IS PRODUCED USING A WORD-PROCESSING PROGRAM

APPLEWRITER EXPERIMENTS
STUDENTS USE WORD-PROCESSING PROGRAM TO EXPERIMENT WITH WRITING

OPINION SURVEY ON EDUCATIONAL PROGRAS
STUDENTS CONDUCT SURVEY OF USERS OF COMPUTER PROGRAMS IN THEIR SCHOOL AND TABULATE THE DATA

THE FEELING OF POWER
STUDENTS READ THE ASIMOV STORY "THE FEELING OF POWER" and INVESTIGATE RELATIONSHIP BETWEEN HUMAN ABILITIES AND COMPUTER POWER

Table 3 – 9 ☐ Lesson plans appropriate for social studies

Chapter 4: Grades K to 2

ZEEP007 THE ROBOT
STUDENTS GIVE INSTRUCTIONS TO THEIR IMAGINARY ROBOT FRIEND ZEEP, TEST AND DEBUG THE PROCEDURES

BIG TRAK
STUDENTS DEVELOP AND TEST PROCEDURES FOR BIG TRAK TOY TO EXECUTE

COMPUTERIZED SUPERMARKET
STUDENTS STUDY UNIVERSAL PRODUCT CODE, VISIT COMPUTERIZED SUPERMARKET

Chapter 5: Grades 3 & 4

GIVING DIRECTIONS
STUDENTS LEARN TO GIVE PRECISE DIRECTIONS FOR GETTING FROM ONE PLACE TO ANOTHER, USING A MAP

DRAGON'S DEN
STUDENTS WRITE A PROCEDURE FOR GETTING TO A TREASURE HIDDEN IN A DRAGON'S DEN

BULLETIN BOARD
STUDENTS CREATE A BULLETIN BOARD DESCRIBING USERS, INPUT, COMPUTER, AND OUTPUT FOR A COMPUTER SYSTEM IN LOCAL GOVERNMENT OR BUSINESS

Table 3–9 ☐ cont'd

Chapter 6: Grades 5 & 6

GEOGRAPHY SEARCH
STUDENTS WORK IN SMALL GROUPS, MAKING DECISIONS ON HOW TO NAVIGATE AN EARLY SAILING SHIP TO THE NEW WORLD

DATA BASES AND PRIVACY
STUDENTS INVESTIGATE COMPUTERIZED RECORDS KEPT ON THEM AND PRIVACY ISSUES INVOLVED IN COMPUTERIZED RECORD KEEPING

Chapter 7: Grades 7 & 8

COMPARING AFRICAN COUNTRIES
STUDENTS DEVELOP PROCEDURE FOR INVESTIGATING DIFFERENCES BETWEEN AFRICAN COUNTRIES HAVING LOWEST AND HIGHEST PER CAPITA INCOME

STATES DATA BASE
A SERIES OF LESSON PLANS IN WHICH STUDENTS BUILD AND USE A DATA BASE OF STATES TO EXPLORE INTERESTING QUESTIONS

SEARCH AND UPDATE
STUDENTS LEARN TO SEARCH AND RETRIEVE SELECTED DATA FROM THE STATES DATA BASE

UPDATE: LAND AREA AND ALTITUDE
STUDENTS UPDATE RECORDS IN THE STATES DATA BASE, ADDING INFORMATION ON LAND AREA AND ALTITUDE

RETRIEVAL: SELECTING, SORTING, REPORTING
STUDENTS LEARN TO RETRIEVE SELECTED DATA AND REQUEST SORTED REPORTS FROM THE INFORMATION-RETRIEVAL PROGRAM AND STATES DATA BASE

UPDATE: STATES POPULATIONS
STUDENTS UPDATE THE STATES DATA BASE WITH INFORMATION ON POPULATION GROWTH, DENSITY, AND LARGEST CITY

EXPLORING THE DATA BASE
STUDENTS USE THEIR STATES DATA BASE TO EXPLORE FACTS, IDEAS, AND RELATIONSHIPS ABOUT STATES

JUNK MAIL
STUDENTS EXAMINE JUNK MAIL AND EXPLAIN HOW IT IS PRODUCED USING A WORD-PROCESSING PROGRAM

TIME LINE
STUDENTS INVESTIGATE THE HISTORY OF COMPUTER TECHNOLOGY AND THE INCREASING PACE OF CHANGE IN THAT TECHNOLOGY

COMPUTERS AND ETHICS
STUDENTS LEARN ABOUT THE ETHICS AND LAW INVOLVED IN COPYRIGHT OF COMPUTER PROGRAMS

COMPUTERS AND CRIME
STUDENTS LEARN DEFINITIONS, EXAMPLES, KINDS OF COMPUTER CRIME, AND HOW IT AFFECTS SOCIETY

Table 3-9 ☐ cont'd

SCHOOL CASE STUDY
STUDENTS INVESTIGATE A COMPUTER APPLICATION OR SYSTEM USED IN THEIR SCHOOL OR SCHOOL DISTRICT

THE COMPUTER DID IT!
STUDENTS INVESTIGATE MEANING OF THE PHRASE "COMPUTER ERROR" AND LEARN WHO IS RESPONSIBLE FOR SUCH ERRORS

OPINION SURVEY ON EDUCATIONAL PROGRAMS
STUDENTS CONDUCT SURVEY OF USERS OF COMPUTER PROGRAMS IN THEIR SCHOOL AND TABULATE THE DATA

ELECTRONIC MONEY
STUDENTS LEARN ABOUT ELECTRONIC MONEY, USE A SIMULATED SYSTEM, AND DISCUSS ISSUES INVOLVED IN PRIVACY AND SYSTEM FAILURES

THE FEELING OF POWER
STUDENTS READ THE ASIMOV STORY "THE FEELING OF POWER" AND INVESTIGATE RELATIONSHIP BETWEEN HUMAN ABILITIES AND COMPUTER POWER

This chapter provides sample classroom activities for children in grades K through 2. Please read Chapter 3, "Overview of the Curriculum," for an explanation of the scope and sequence of objectives. Figure 4 – 1 summarizes the strands and objectives used for grades K through 2, and Table 4 – 1 lists sample activities by objective.

INTRODUCTION TO THE TEACHER

Procedures and computer programs are two very useful kinds of tools for primary-grade children and their teachers. It is easy to incorporate formal procedural thinking into these grades, because developing and using procedures is already an important aspect of the classroom activities. Students are constantly learning new procedures (for example, those involved in hanging up their coats, going to the lunchroom, using the art center).

In the procedural thinking activities you are formalizing and focusing the students' attention on the procedures themselves. Students become more aware of the step-by-step sequence of instructions which, when followed, enable them to perform a clearly defined task in a predictable and successful manner.

The children enjoy taking an active role in making up procedures. They enjoy the process of testing and debugging their procedures. "Buggy" procedures produce unpredicted and often funny outcomes.

You and your students will greatly benefit from procedures activities, whether or not you are using computers. After students begin to

Grades K – 2
objectives and activities



Strands	Objectives Grades K – 2
Procedures	• Follow a procedure for a familiar task • Modify a procedure • Show different procedures can produce the same outcome • Find and correct errors in a procedure • Describe procedures used to perform a task
Using Programs	• Use computer drills and games • Operate equipment; load and run programs • Recognize the computer needs instruction
Fundamentals	• Understand that computer instructions are contained in a program
Applications	• Discover computer applications in homes and neighborhoods
Impact	• Follow rules for using equipment and programs

(Note: For grades K – 6, objectives and activities related to computer programming are reflected in the Procedures, Using Programs, and Fundamentals strands.)

Figure 4 – 1 ☐ Grades K – 2: strands and objectives

use computer programs and computer toys such as Big Trak, they begin to see the importance and usefulness of procedures in relation to computers.

When to Introduce the Activities

It's best to introduce procedural thinking activities at the very beginning of the school year. This sets a tone and approach to everyday classroom management as well as academic subjects. After you have used some of the sample lesson plans in this chapter, you and your students will probably invent many other procedural thinking activities for accomplishing all sorts of classroom tasks.

Table 4 – 1 ☐ Sample activities by strands*

Grades K – 2 — sample activity	1 Procedures	2 Using Programs	3 Fundamentals	4 Applications	5 Impact
ZEEP007 the Robot	1,3,4				
Big Trak	1 – 6				
Grid Locations	1				
Serial Ordering of Objects	3,5				
Does It Float?	1,2,4,5				
Which Came First?	1,2,4				
Using Art Center	1,4,5,6				
Alphabetical Order	1,4,5,6				
Juggles' Rainbow		1 – 4	1		1
Moptown		1 – 4	1		1
Bumble Games		1 – 4	1		1
Computerized Supermarket				1	

*Objective numbers are shown in the cells of the matrix.

The Using Computer Programs activities can be brought in at any time in which the machines and appropriate programs are available. This is the time to introduce the fundamental concept that computers must be given instructions in order to operate; and to introduce rules for using the equipment and programs. Sample activity "Moptown" includes suggestions for doing this.

Your school library, media center, or computer resource center should have a collection of programs suitable for your students to use. Hundreds of programs are available. (See the Appendix, which contains lists of catalogs and addresses of suppliers.)



Ms. Milofsky helps kindergarteners use the computer while others watch and wait their turns (Travilah Elementary School, Montgomery County, MD)

Introduce students to a wide variety of programs so that they may experience diverse ways in which computers can be used.

Programs that can be used by two or three children at a time are good for encouraging interaction and verbal expression among children.

Introduce the study of "computer applications in your neighborhood" at relevant points in the school year, such as when students are learning about the following:

- ☐ How people in the family and community satisfy their needs and wants
- ☐ How tools and machines help people do their jobs
- ☐ Jobs in the community



A reading group and students using the computer share the teacher's attention in this second grade classroom (Travilah Elementary School, Montgomery County, MD)

- ☐ How the community is changing and how technology effects change
- ☐ How technology affects farms and ranches

Recommended Reading

Computers Are Fun (Teacher's Guide, Activity Book, and Student Book), by Jean Rice and Sandy O'Connor; T.S. Denison and Co., 1981.

"What Do Computers Do for Us?", in *Bits 'n Bytes About Computing*, by Rachelle S. Heller and C. Dianne Martin; Computer Science Press, 1982.

SAMPLE ACTIVITY ☐ ZEEP007 THE ROBOT

Objectives

Students give step-by-step instructions to an imaginary robot, ZEEP. They discover that a procedure is a sequence of carefully defined steps to accomplish a task, and that different procedures can be used to get the same result. Students find and correct errors in simple procedures. (Procedures 1, 3, 4)

Prerequisites

No prerequisites for this activity

Materials

No materials needed

Time for activity

One or more class periods

Teacher preparation

Read the section on the Procedures strand in Chapter 3 for tips on teaching procedural skills.

Teacher

1. Introduce the idea of ZEEP007 to the students in the following manner:

   > I have a friend named ZEEP007. ZEEP is a little robot. He looks something like R2D2 from *Star Wars*. ZEEP is a very nice, friendly fellow. He does chores for me. But he doesn't know how to do anything unless I tell him exactly how to do it. One day I gave ZEEP instructions to go to the kitchen and peel me a banana and bring it to me. Can you guess what he did? He brought me a banana peel! "ZEEP," I asked, "where is the banana?" "I followed your instructions," ZEEP said.

Have the students talk about robots they have seen in movies and TV. These robots seem to be very "smart," but they can only do what they have been told to do by the person who built them or instructed them.

Some questions to ask the class:

- What is a robot?" *(A machine.)*
- Does a robot have a brain?" *(No. People do. Animals do.)*
- "Who controls a robot?" *(Human beings.)*

2. Tell the students they are going to play ZEEP. One student will be ZEEP and the others will take turns giving ZEEP instructions. The first task will be to get ZEEP to go from his seat to the chalkboard and erase the chalkboard.

Have discussion about what ZEEP will understand. Does he understand "Walk to the chalkboard," or must he be told: "Take one step forward, turn right, etc."? Have students decide on a set of words that ZEEP understands, such as the following:

Stand
Turn *(halfway around, all the way around, etc.)*
Stop
Lift *(right arm, left arm, left foot, right foot)*
Grasp *(object)*
Move *(arm, hand, etc.)*
Front, back
Right, left
Up, down

Encourage the students to think out the first few steps in their procedure before giving any instructions to ZEEP. What will they tell him first? Second? etc.

3. Have a student volunteer to be ZEEP. Remind him or her that ZEEP only does exactly as told — no more, no less.

Have one student give the instructions to ZEEP; ZEEP should follow them exactly. Interrupt only if ZEEP isn't playing by the rules of the game. If ZEEP doesn't understand an instruction, perhaps he makes a strange noise or says in an electronic-sounding voice "I-DO-NOT-UNDERSTAND."

If students playing ZEEP are having difficulty with the idea of doing only and exactly as they are told, then the teacher should play the role of ZEEP in order to demonstrate that the instructions must be executed exactly.

The activity will be more instructive (and more fun) if there are errors, "bugs" in the procedures ZEEP tries to follow. So don't try to have the students get it right the first time.

Use the students' bugs as opportunities to discuss important ideas about procedures. For example, does ZEEP go on erasing and erasing without end? How does he (or she) know when to stop erasing the chalkboard? Does he get to go back to his seat, or is he left standing, facing the chalkboard? Does he keep the eraser in his hand, or is he instructed to put it back on the shelf?

4. After one procedure for getting ZEEP to do the task has worked successfully, challenge the students to come up with a different set of instructions that will accomplish the same task. Does it matter what order the instructions are given in? *(Sometimes yes, sometimes no.)*
5. Have students suggest another task for ZEEP, and carry out the activity as before.
6. Ask:
   - What have we learned about procedures? (A procedure is a set of instructions. *The steps must be clear. The instructions must be in the right order.*)

- What have we learned about robots? *(We must tell them exactly what to do.)*

Related activities

Variations of the ZEEP game can be used for classroom management procedures such as hanging up coats in the morning, going to lunch, getting to the bathroom, using the activity center, etc.

Other tasks include tying shoes, jumping rope, getting lunch money ready, putting library books on desk, copying from the chalkboard.

SAMPLE ACTIVITY ☐ BIG TRAK

Objectives

Students develop procedures for Big Trak, a programmable toy. (Procedures 1, 2, 3, 4, 5, 6)

Prerequisites

- ☐ Students should have participated in activities for Procedures objectives 1 through 6.
- ☐ Students should have had ample opportunity to play with Big Trak, so they are able to enter instructions and operate the toy.

Materials

- ☐ Big Trak toy made by Milton Bradley; supply of extra batteries
- ☐ Big chart summarizing Big Trak commands (see p. 57)

Time for activity

Two or more class periods

Teacher preparation

Become proficient in operating Big Trak

Teacher

1. Make sure all students have had enough play-time with the Big Trak toy to become familiar with its operations, and to discover what all the commands do. (See chart for a summary of commands.)

Big Trak has a few oddities that you should discuss with the class. It may pull slightly to the left or right rather than going in a straight line. The distance it travels per unit is approximately one length of Big Trak, but this will vary depending on the surface being used and the strength of the batteries.

2. Review the meaning of each of the commands and arguments with the class, so that all students understand the operations.

Review with students the idea of a "procedure" as a set of instructions for accomplishing a particular task.

COMMANDS

= MOVE FORWARD	= TURN LEFT	CLR = CLEAR OLD PROGRAM
= MOVE BACKWARD	= TURN RIGHT	GO = EXECUTE PROGRAM
HOLD = STOP		FIRE = FIRE LASER

ARGUMENTS

MOVEMENT	DIRECTION	SHOOTING
N = 1 LENGTH OF BIG TRAK	N = AMOUNT OF TURN	N = NUMBER OF SHOTS
TIME N = 1/10 SECOND		

FORMAT

	COMMAND	ARGUMENT
	CLR	
		10
E.G.	GO	

3. Have students act out the operation of Big Trak, in the same manner in which they acted out ZEEP007 procedures in an earlier lesson. Have one student play the role of Big Trak and another student give the instructions (verbally). Write the instructions in a list on the chalkboard as they are called out by the student. The other students should watch closely to make sure Big Trak is acting out the instructions exactly as told, and that all instructions given are valid Big Trak commands. If the student giving instructions gives an invalid command, the student playing Big Trak should say "I do not understand," and refuse to move.
4. Set up a task for Big Trak to do, such as that illustrated in Figure 4 – 2. For example, "We want Big Trak to go forward far enough to just reach the box (or wall); fire its lights at the wall three times, turn around, and come back to its original spot on the floor." Discuss the task with the class, so all students understand the requirement.

```
Big Trak Procedure: GO-AND-COME-BACK
CLR
FORWARD 8
FIRE 3
RIGHT 39 (instead of 30, because our Big Trak pulls slightly
to the left as it's moving forward)
FORWARD 8
GO
```

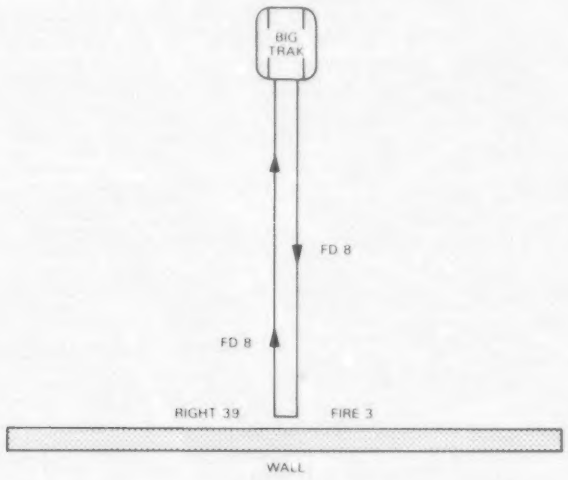


Figure 4 – 2 ☐ Big Trak procedure

5. The students should plan the procedure, while the teacher writes their instructions on the board. They should begin by giving the procedure a name. The students will test the procedure themselves, so there is no need for the teacher to evaluate their suggestions.
6. After the students are satisfied that their procedure will work, have one of them input the procedure *exactly as written* into Big Trak's keyboard, and press GO.

Ask:

- Does Big Trak do as we intended? If not, how shall we revise the procedure?
- Did we remember to begin our procedure with a CLR command to clear out the old program from memory?
- Did Big Trak go forward far enough, or should the amount of the turn be adjusted because Big Trak doesn't go in exactly a straight line?

7. After the procedure is debugged, and Big Trak does as intended, ask the students if there is a different procedure that would accomplish the same task. They might suggest that a left turn be substituted for the right turn (or vice versa). Or two FORWARD 4 commands might be substituted for the one FORWARD 8 command.

Have the students test the new procedure to see whether it accomplishes the original task. Debug as before.

8. Ask: "How might this procedure be modified to make Big Trak accomplish a slightly different task? Perhaps we could have it spin around in a circle after it gets halfway to its destination." Keeping the original procedure on the board, have students decide how to modify it to accomplish the new task. Test and debug as before.

Related activities

A pair of students can make up their own tasks and procedures for Big Trak and demonstrate them to the class. The students should explain to the class what the task is going to be, and then demonstrate Big Trak's execution of their procedure.

A more advanced activity is to have two (or more) Big Trak toys, and ask the students to program the toys to interact with each other in various ways, such as race, collide, go in opposite circles, etc.

Recommended reading

"The Road to Computer Literacy: A Programmable Toy Paves the Way," by R.E. Anderson; *Electronic Learning*, September/October 1981, pp. 50 – 51.

SAMPLE ACTIVITY ☐ GRID LOCATIONS

Objectives

Students use a procedure to help them to learn a new math skill: locating objects on a grid. (Procedures 1)

Prerequisites

- ☐ Ability to count from one to ten
- ☐ Understanding of "over" and "up"
- ☐ This activity might be introduced by having the students use "Find the Bumble," a program in the Bumble Games series. (See Sample Activity for Bumble Games in this chapter.)

Materials

Worksheet on overhead with moveable objects placed as shown on Figure 4–3

Time for activity

One class period

Teacher preparation

Make a handout for students, similar to the one shown in Figure 4 – 3 but with objects in different locations.

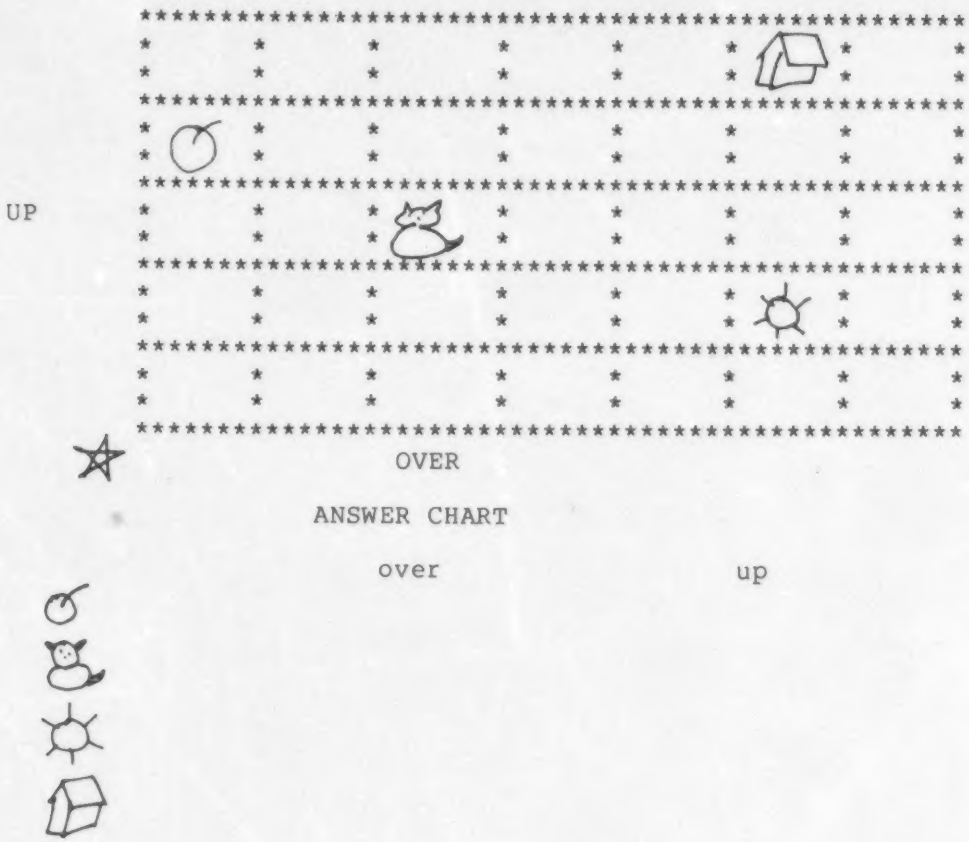


Figure 4 – 3 ☐ Grid locations (transparency master)

Teacher

1. Introduce the idea of using a procedure to learn a new skill.
2. State the following procedure, demonstrating each step on the overhead projector:

Procedure: "Over and Up"

1. Locate the lower left-hand corner of the grid.
2. Draw a star there.
3. Look at the answer chart for the first object.
4. See that object on the grid.
5. Count how many blocks over the object is on the grid.
6. Write the number over in the answer chart under the word "Over."
7. Count how many blocks up the object is.
8. Write the number up in the answer chart under the word "Up."
9. Find the next object on the answer chart.
10. Go to step 4.

3. Give each student a grid with the same objects placed in different blocks, and an answer sheet. Say each step, 1 to 8, in order, giving sufficient time for students to complete. Read steps 9 and 4 again. If the children can go through the procedure without further prompting, allow them to finish the sheet. Otherwise, go through the activity step by step for the second object.
4. After students have finished the exercise, discuss the procedure with them. Point out that this procedure has no end — it keeps telling you to find the next object on the answer chart, even when there aren't any more objects on the chart. Later in school they will learn how to make procedures that tell the user only to do the steps as long as he or she needs to do them.
5. Ask the following questions:
   - Will this procedure work if the grid has more objects on it? (*Yes.*)
   - Will the procedure work if the grid is 100 blocks up and 100 blocks over? (*Yes.*)
   - Can anyone think of a reason why we might want to be able to say how many blocks over and up an object is on a grid? (*Playing checkers; looking for something on a map.*)

Related activities

A computer program using graphic grids can provide a good practice exercise in this skill. An example is "Bumble Games," an activity in the Using Programs section of this chapter (p. 80).

Suggest to students that they look for "over and up" applications in daily life. You could find a book in a bookcase by telling how many books "over" and how many shelves "up" to look for it. You could describe the location of a box of cereal in a supermarket by telling how many boxes "over" and how many shelves "up" to look.

SAMPLE ACTIVITY ☐ SERIAL ORDERING OF OBJECTS

Objectives

Students describe procedures they use for ordering objects by size, color or shape; and note that different procedures can get the same result. (Procedures 3, 5)

Prerequisites

Experience in serially ordering collections of objects such as sticks, seashells, leaves, seeds, by some property such as length, size, light-to-dark, etc.

Experience in verbalizing the steps in a procedure, as in the Sample Activity ZEEP007.

Materials

- ☐ For each pair of students, a collection of ten similar objects that can be ordered by some property
- ☐ For the teacher, a collection of six objects — such as a paper clip, a nail, a tack, piece of chalk, pencil, match — placed on overhead projector

Time for activity

One class period

Teacher preparation

Assemble the collections of objects to be serially ordered.

Teacher

1. Start the activity as follows:

Today we're going to see how many different procedures we can invent for putting objects in order. The task of putting objects in some order is of course a simple one for you — one you have done many times. But today we will try to say in words the steps we follow when we put objects in order.

(Remind students of the work they have done before with procedures.)

I have here a tack, a paper clip, a pencil, a match, a piece of chalk, and a nail (*point to each object*). I want you to get out a piece of paper and show these objects in order, from

shortest to longest. You may write their names or you may draw the objects; either way is O.K.

2. After giving students sufficient time to complete this task, tell them that different people in the class probably used different procedures for solving this problem. Ask one student to describe and demonstrate on the overhead projector the method she or he used and the solution she or he got. For example, one student might say:

   First, I saw that the tack was the shortest, so I wrote *tack* first on my list. Then I saw that the pencil was the longest, so I put that last on my list. Then I saw that the nail was next longest, so I made it number 5.

Have other students come up and explain their methods. Encourage as many different methods as possible.

3. Pick the procedure of one of the students and have another student come up and attempt to follow it. This will require some refinement of the student's original statements. Then ask:
   - Does everyone understand the instruction?
   - Is the procedure complete?
   - Are any unnecessary steps included?
   - When the student is finished, is the product correct?
4. Have students pair up or join small groups, each group having its own collection of ten or more similar objects. Ask each group to develop a procedure for serially ordering the collection of objects. You might tell them what property to use in ordering — length, size, hardness, darkness, etc. Give them several minutes to work on this problem. Suggest that they test their procedures by having one person in the group tell the procedure step by step to another person in the group, who does exactly as told.

Discuss solutions: Did the students use the same procedure for ordering ten objects as they used earlier for six objects? Why or why not?

Ask: "How do you know if your solution is correct?"

Have a group of students describe their solution to the class and then ask the other groups to show the difference between their method and the first group's method.

SAMPLE ACTIVITY ☐ DOES IT FLOAT?

Objectives

Students practice skills in procedural thinking by developing a procedure for observing and recording which objects float. (Procedures 1, 2, 4, 5)

Prerequisites

Experience in verbalizing the steps in a procedure, as in Sample Activity ZEEP007.

This activity is a good follow-up to a science lesson on the subject of objects that float.

Materials

- ☐ Collection of objects, some of which will float, some of which will float if placed in water in a certain position, and some of which will sink
- ☐ Large pan, preferably transparent, with water
- ☐ Large piece of paper and markers for making a chart such as the one following.

Time for activity

One or more class periods

Teacher preparation

Assemble materials

Teacher

1. Introduce the activity to the students by having them look at the collection of objects and talk about which will float and which will sink.
2. Tell students that they are going to make a big chart that will tell about all of these objects — which ones float and which ones sink. Then explain that the class will make a procedure. Ask: "If we want to know which objects float and which ones sink, what will we do first?"

Have students suggest a first step, and have a student carry out the step, e.g., "Pick up an object from the pile and say whether you think it will float." Write the step on the chalkboard.

Ask the following questions:

- What happens next?" *(For example, "Put it in the water.")*
- What will we do next?" *(For example, "Watch it float.")*
- What next?" *(For example, "Write on the chart that it floats.")*

3. Continue working with the class to develop a procedure that will work reasonably well (it may have some bugs in it). Have students take turns following the procedure. For example, one child may choose an object, put it in the water, observe whether it floats or sinks, and report to the teacher, who writes the information on the big chart. Encourage students to follow the procedure exactly in the way agreed upon.

4. As students follow the procedure, work with them to help them recognize missing steps in their procedure. For example, if students keep on putting objects into the water and never take any out, the pan will become full of objects.

Ask: "Does our procedure handle cases in which an object appears first to float but later sinks? How long should we wait until we decide whether the object will float or not? Should we change our chart to show that an object first floated and then sank?"

Ask: "How do we know when we are done? Does our procedure tell when to stop?"

		Will it float?
Christian	block of wood	yes
Alice	paper cup	yes
Glen	lid	floats right side up—not upside down
Elizabeth	rubber band	yes
Vibol	paper clip	yes—sank later
Kim	damp sponge	yes
Lauren	egg shell	yes—sank later
Joni	wooden paper clip	yes
Nat	crayon	sank
Nathan	bolt to chair (metal)	will sink . . .did
Selena	soap	yes
Delton	plastic square	float—yes
Jack	metal lid	yes—right side up
Michael	metal lid	yes—it did
Jenniver	tennis ball	yes—it did
Glen	paper cup	yes—it did—but filled
LaRhonda	metal lid	with water and sank
Alice	plastic triangle	yes—it did
Joni	tennis ball	yes—it did
Nat	metal lid	yes—it did
Christian	paper cup	yes—but when it filled with water it sank
Selena	tennis ball	yes—even all wet
Khalim	plastic bear	yes—it did

Related activities

Develop a procedure for sorting objects that are and are not attracted by a magnet.

Develop a procedure for observing and recording what the classroom pet will and will not eat.

SAMPLE ACTIVITY ☐ WHICH CAME FIRST — THE CHICKEN OR THE EGG?

Objectives

Students become more familiar with the concept that a procedure involves a specific sequence of steps as they study animal life cycles. (Procedures 1, 2, 4)

Prerequisites

Students have had experience recognizing and discussing pictures (or real animals) showing various stages in their life cycles.

Materials

Pictures showing stages in life cycles of chickens, butterflies, frogs, etc.

Time for activity

One class period

Classroom management

Whole-class discussion and individual work

Teacher

1. Introduce the activity by reviewing with students the life cycles of animals they have studied. Read aloud a story about animal life cycles, such as *The Very Hungry Caterpillar*, by Eric Carle, published by Scholastic Book Services.
2. Discuss with students the idea that, in a procedure, the sequence, or order, of the steps is important — just as sequence in nature is important. Ask: "Can a hen turn into a chick? Can a butterfly become a caterpillar?"
3. Introduce the task and procedure to the students. They will do the following:
   - Choose an animal (hen, butterfly, frog, etc.)
   - Decide what that animal looks like when it is an egg
   - Draw a picture of the egg
   - Decide what the animal looks like next (chick, cocoon, etc.)
   - Draw a picture of that animal
   - And so forth, until a complete life cycle of the animal has been drawn
4. Call the class back together. Invite students to show and describe their drawings to the class. Ask:
   - Can you name the animal in the picture set?
   - What comes first in the sequence? Why?



Second grader displays his version of "Which Came First?"

- What comes next? Why?
- Compare drawings with other students' pictures of the same animal. Are they the same? Why or why not?

Related activities

Develop and use a procedure for identifying and drawing pictures of the life cycle of plants.

Ask students to notice events in daily life or in nature, where sequence of steps is important. Have them report examples to class: e.g. the order of the seasons of the year, or the order of night-dawn-day-sunset.

MORE IDEAS FOR SCIENCE ACTIVITIES

The teacher can prepare procedures to use in introducing the following science activities, or ask students to describe the procedures they used after the science activities have been conducted:



Which objects are attracted by a magnet? Ms. Cronin and her first graders work out a procedure for answering the question (Mt. Vernon Elementary School, Alexandria, VA)

- ☐ *Steps in growth from a seed to a mature plant.* Students draw pictures of their seeds and seedlings at different stages of growth, then place the pictures in the correct time-sequence order. Students describe the procedure they use to put their pictures in the correct sequence.
- ☐ *Categorize objects that are and are not attracted by a magnet.* Given a collection of objects of both types and a magnet, students describe the procedure they will use to classify which objects are and which are not attracted by the magnet, and present their findings.
- ☐ *Demonstrate that the position of an object in relation to a light source changes the appearance of the shadow.* After students have had some experience in doing this, they might be asked to describe a procedure for making a picture or graph that shows the difference in a shadow depending on the distance of the object from the single light source.

☐ *Describe effects of different amounts of water on germination of seeds.* With the teacher's help, the class might invent a procedure for observing and recording the effects of giving different pots of seeds different amounts of water.

SAMPLE ACTIVITY ☐ USING THE ART CENTER

Objectives

Students practice procedural thinking skills by applying them to a familiar classroom task. (Procedures 1, 4, 5, 6)

Prerequisites

Students have had experience using the classroom art center which the teacher has set up daily.

Students have been introduced to procedures ideas, as in Sample Activity "ZEEP007 the Robot".

Materials

- ☐ A place for teacher to write and/or draw (chalkboard, chart paper, etc.)
- ☐ Smock, newspaper, paintbrush, paint cup, paper

Time for activity

One or two class periods

Classroom management

Whole-class activity

Teacher preparation

Modify lesson plan to suit your normal classroom practice

Teacher

1. Introduce the activity and its purpose:

   So far this year I have been getting the art center ready for you to use each day. Most of you know what must be done to make the art center ready to use. Today we will talk about a *procedure* for getting the art center ready. When we have a procedure, then you can take turns using the procedure to do this job.

   Who remembers what a procedure is? *(Have students talk about what is needed in a procedure, what it does.)*

   What name might we give to this procedure? *(e.g., "Get the art center ready.")*

2. Have students suggest steps needed to get the art center ready. Accept all answers they give, in the order in which they give them. Write each suggestion on the chalkboard (either with words or symbols). For each step suggested by a student, ask for a reason why that step is needed.

Example: Steps in the Procedure

Procedure		Reason Why
1. Put newspaper on floor		Keep floor clean
2. Put on smock		Keep clothes clean
3. Put brushes in paint cups		To paint with
4. Take tops off paint cups		So we can paint
5. Put up paper to paint on		Keep picture in place
6. Check paint		Enough to paint with

3. Now have students discuss the sequence in which the steps must be done. Accept their suggestions, even if there is an error (students will have a chance to test whether or not their sequence works). Write the students' procedures on the chalkboard or chart paper.

Example: Incorrect sequence

1. Take tops off paint
2. Put brushes in
3. Check paint
4. Put on smock
5. Put up paper
6. Put newspaper on art center floor
7. Put newspaper on drying area

Example: Correct sequence

1. Put newspaper on art center floor
2. Put on smock
3. Take tops off paint cups
4. Put up paper to paint on
5. Put brushes in paint

6. Check paint
7. Put newspaper on drying area

Evaluation of solutions

When the group has decided on a procedure, ask for a volunteer to carry out the steps in the procedure, with the classmates looking on. As the volunteer follows the procedure, discuss each step with the class and whether its place in the sequence is logical and why or why not. Students should be able to identify a sequence error if it exists.

Related activities

Put procedure on a flowchart with pictures for kindergarten and with or without pictures for first and second grades.

Have students explore the possibility of a different sequence and the same results. (Same? Different?)

Mix the sequence of the steps in the procedure and have children put steps in the proper order.

Adapt this activity to other classroom procedures such as going to lunch or recess, putting toys away, etc.

SAMPLE ACTIVITY ☐ ALPHABETICAL ORDER

Objectives

Students learn how to alphabetize letters and how to use a step by step procedure for this new task. Students are shown that different procedures can get the same result. (Procedures 1, 4, 5, 6)

Prerequisites

- ☐ Students can verbally say the alphabet in order A to Z; they recognize the letters in isolation and as part of words.
- ☐ Students have had experience in developing and following procedures to accomplish tasks.

Materials

- ☐ Place for teacher to write and/or draw (chalkboard, chart paper, etc.)
- ☐ Big chart that shows letters of the alphabet in order

Time for activity

Preparation 10 minutes; two to three 20-minute lessons

Classroom management

Whole-class discussion and individual work

Teacher preparation

None



Ms. House works with her second graders on a procedure for putting a list in alphabetical order (MacArthur Elementary School, Alexandria, VA)

Teacher

1. On the board write five different letters and a list of blank lines:

   C -----
   A -----
   F -----
   B -----
   H -----

   Ask the students to name the letters. Explain that these letters are not in any special order, but that they can be put in the same order in which they occur in the alphabet.

2. Tell students that their task will be to make a new list that contains the same letters, but in alphabetical order:

   We are going to make a procedure for taking the letters from the first list and putting them into the new list in alphabetical order.

Note: It helps to use two different colors of chalk for the two lists, so students can refer to "the red list" or "the white list."

3. Review with students the idea of a *procedure* — a set of instructions for carrying out a task:

   We are going to use a procedure to put these letters in alphabetical order. What shall we call the procedure? (Have students suggest a name for the procedure, and write the name on the chalkboard.)

4. Ask students to volunteer ideas about what instruction comes first in a procedure for putting these letters into alphabetical order. For example, one student might say, "The letter A is first in the alphabet, so I will look for an A in the (red) list." Another might say, "I will erase the C that is on top of the list because C is not first in the alphabet."

5. As students suggest instruction, the teacher should carry out the instructions exactly as stated. Give the students a chance to point out any errors in the procedure. Try to get the students to think out the next steps that would have to follow from their suggestions. For example:

   If you erase the C from the top of the list, you'd better write it somewhere else so you don't lose it. If you look for an A in the list you have to do something with that A. What will you do with it? *(Put it at the beginning of the new list.)*

   Does your procedure tell you when you are finished with the task, or do you go on and on looking for more letters? (Emphasize this important idea about procedures — that they must have an END or STOP instruction.)

6. There are many different possible procedures for this activity. It would be nice to invent at least two of them, so that the students can get the idea that different procedures can be used to accomplish the same end. One possible solution is shown below.

Possible solution

Procedure: Alphabetizing a list of letters

1. Look through the first list, and decide which letter comes earliest in the alphabet.
2. Put a line through that letter on the first list.
3. Write that letter at the top of the new list.
4. Are all letters crossed off from the first list? If yes, *Stop*.

5. Look through the first list, and decide which letter comes next in the alphabet.
6. Put a line through that letter on the first list.
7. Write that letter next on the new list.
8. Go back to step 4.

---

7. After agreeing on a procedure, make sure that all of the students are able to use it and achieve the objective of putting the letters into alphabetical order. Test the students by having them apply the procedure to make a more difficult list, such as:

O J N A E P

Related activities

Have five or more students stand in a straight line in front of the class, holding up large cards with their names on them. Have the class develop a procedure to move the students to a new line that alphabetizes them by name. Or students could have any of the following on their cards:

- ☐ Collections of letters such as M, J, C, R, E
- ☐ Pictures and names of animals on them
- ☐ Collections of letters with duplicates, such as M, E, R, M, A, B, E

With more advanced students, discuss the repetition in the alphabetizing procedure. Point out that there are two levels of repetition in the sample procedure. (Refer to flowchart illustrated in Figure 4 – 4.)

MORE IDEAS FOR PROCEDURES ACTIVITIES

The teacher might prepare procedures to use in introducing the following activities, or ask students to describe a procedure to use after these activities are familiar to them:

- ☐ *Traveling to school* — What are the instructions for getting from home to school?
- ☐ *Planning a field trip* — Break the problem into parts for the students
- ☐ *Checking out books in the library*
- ☐ *Recipes* — The steps in making a cake
- ☐ *Buying lunch at school*

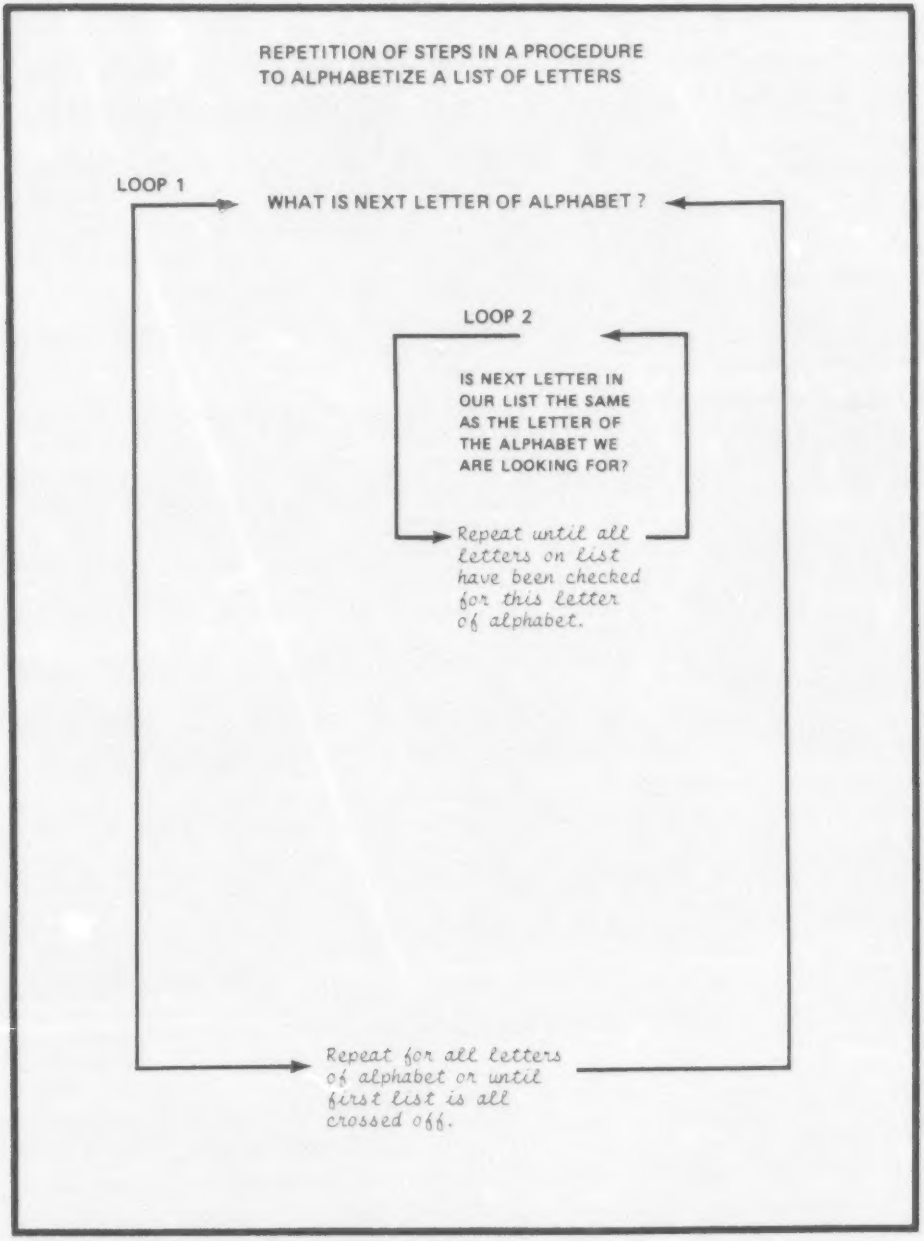


Figure 4 – 4 ☐ **Flowchart for alphabetizing**

SAMPLE ACTIVITY ☐ JUGGLES' RAINBOW

Objectives

Students are introduced to rules and procedures for operating equipment, loading and operating a program, and working with classmates on the computer. (Using Programs 1, 2, 3, 4; Fundamentals 1; Impact 1)

Prerequisites

No prerequisites for this activity

Materials

- ☐ Apple II computer with disk drive and color TV or color monitor
- ☐ Disk of "Juggles' Rainbow" games (published by The Learning Company)*
- ☐ Big chart showing steps in procedure for loading and starting the program

Program description

"Juggles' Rainbow" is a set of colorful games that provide practice in reading and math readiness skills such as relating horizontal to vertical planes; eyetracking left to right; recognizing shapes of the letters b, d, p, q; and recognizing opposites (above/below/left/right).

Classroom management

Individuals and pairs of students on the computer

Time for activity

Variable, over a period of several days

Teacher preparation

Obtain suitable program for this purpose. Become familiar with program operation. Make chart showing steps in operation. Modify lesson plan as appropriate to program you are using.

Teacher

1. Prepare the keyboard for "Juggles' Rainbow" by placing the long blue strip across the middle of the keyboard as shown in the manual and in the program.
2. Introduce the first program on the disk, "Juggles' Rainbow," to a selected group of three students who will later assist the other students in operating the program. Have prepared a large chart that shows in pictures the steps to follow, such as the following:

- -

(1) Take the disk out of its paper jacket, holding it with the label under your thumb.

(2) Put the disk into the slot in drive 1, holding your thumb side up.

*Addresses of publishers are in the Appendix.



These kindergarteners seem astonished at the rainbow they created with Juggles (Travilah Elementary School, Montgomery County, MD)

(3) Close the door on the disk drive.
(4) Turn on the computer.
(5) Wait for the program to load into the computer.
(6) When the picture menu comes on the screen, press the number 1 key.
(7) Play the game.
(8) Take the disk out of the drive. Keep thumb on label.
(9) When finished, turn off the computer.
(10) Put the disk back in paper jacket.

- -

Show the students how to play "Juggles' Rainbow."

3. Announce to the class the procedure and schedule by which all students will have a chance to play "Juggles' Rainbow" and learn to operate the computer. The original three students will take turns serving as assistants to show the other students the procedure.

4. After all of the students have had a chance to play the game, prepare the keyboard for "Juggles' Butterfly" as shown in the manual and in the program. Give the students a chance to play the games.
5. Similarly, prepare the keyboard for "Juggles' Windmill." At this point the students may be able to prepare the keyboard without teacher assistance.

Related activities

See sample activity "Moptown" for suggested discussions with the students about the computer, disk, programs, and rules.

SAMPLE ACTIVITY ☐ MOPTOWN

Objectives

Students use computer games to practice logic skills, and review rules for using computer equipment. They see that computers must be given step-by-step instructions and that these instructons are contained in a program. (Using Programs 1, 2, 3, 4; Fundamentals 1; Impact 1)

Prerequisites

No prerequisites for this activity

Materials

- ☐ Apple II computer with disk drive and color TV or monitor
- ☐ Disk of "Moptown" programs (published by Apple Computer's Special Delivery Software for $50)
- ☐ Big chart listing steps in procedure for loading and starting the program

Program description

"Moptown" is a set of eleven colorful logic games. When four keys are pressed, big-nosed Bibbits and crooked-tailed Gribbits appear on the screen. Sometimes they are tall, sometimes they are short. They may be fat or thin. They may be red or blue. The first games challenge young children to make a Moptown twin, find who is different at a Moptown house, and set up a Moptown parade. In other games players guess who can join the Moptown clubhouse, or guess a pattern to assign moppets to hotel rooms. Children learn logical thinking skills such as those tested on intelligence tests.

Classroom management

Small groups and whole class

Time for activity

Variable, over a period of days

Teacher preparation

Obtain suitable program for this purpose. Become familiar with operation of the program. Make chart showing steps in operation. Modify lesson plan as needed for program you are using.

Teacher

1. Introduce the first program on the disk, "Make My Twin," to a selected group of three students who will later assist the other students in operating the program. Have a large chart ready that shows in words or pictures the steps to follow, such as the following:

- -

(1) Take the disk out of its paper jacket, holding it with the label under your thumb.

(2) Put the disk into the slot in drive 1, holding your thumb side up.

(3) Close the door on the disk drive.

(4) Turn on the computer.

(5) Wait for the program to load into the computer.

(6) When the PROGRAM SELECTIONS comes on the screen, press the number 1 key and then the RETURN key.

(7) Play the game.

(8) When finished take the disk out of the drive. Keep thumb on label.

(9) Turn off the computer.

(10) Put disk back in paper jacket.

- -

Show the students how to play "Make My Twin."

2. Announce to the class the procedure and schedule by which all students will have a chance to play "Make My Twin" and learn to operate the computer. The original three students will take turns serving as assistants to show the other students the procedure.
3. After all students have had a chance to play the games, have a discussion with the whole class regarding the fundamental concepts involved. Ask:
   - How does the computer know what pictures to show on the screen? *(Gets instructions from the program.)*
   - Where is the program stored? *(On the disk.)*
   - What happens when we turn on the computer? *(Program loads from disk into the computer's memory.)*
   - Why is it important to hold the disk in a certain way? *(Have a student demonstrate holding and loading of disk.)*
   - Why do we need rules for using the machine?

Related activities

Show two or three students how to use other Moptown games, and have them serve as assistants to the other students.

SAMPLE ACTIVITY ☐ BUMBLE GAMES

Objectives

Students practice operating devices, issuing commands and using computer games to locate positions on an x, y coordinate grid. (Using Programs 1, 2, 3, 4)

Prerequisites

Students recognize numbers from 1 to 5; letters from A to E; understand concepts of "left," "right," "bigger," "smaller"

Materials

- ☐ Apple II computer with disk drive and color TV or monitor
- ☐ Disk of *Bumble Games* programs (published by The Learning Company)
- ☐ Big chart list steps in procedure for loading and starting the program

Program description

Bumble Games is a set of games for learning and practicing how to locate squares over and up on a 4 × 4 grid, continuing up to placing x, y coordinate dots on a 10 × 10 grid to create drawings.

Class management

Whole class and pairs of students on computer

Time for activity

Variable, over a period of several days

Teacher preparation

Obtain suitable program and become familiar with its operation. Set up computer equipment for demonstration so that all students can see screen.

Teacher

1. Use the game "Find the Bumble" as a whole-class demonstration for lessons in locating a square over and up on a 4 × 4 grid. To do this, you need to have one or two large color monitors or televisions connected to your computer, so that all children can see the screen easily.
2. After class demonstration and discussion of the concepts involved, assign students to use the games "Find the Bumble" and "Butterfly Hunt" on the Bumble Games disk. Review with students the procedures for using the computer and programs, including schedules and "fair use" rules.
3. "Find the Bumble" and "Butterfly Hunt" complement the Procedures activity "Grid Locations" in this chapter. Use the programs either to introduce or follow up the "Grid Locations" lesson.
4. See lesson plan for "Moptown" for suggestions on follow-up discussions with students about rules for using the computer and fundamental concepts about the computer.

Related Activities

Have students make up simple grid games to play with crayons and grid paper. Then discuss advantages and disadvantages of the computer programs versus the paper games for practicing grid skills.

SAMPLE ACTIVITY ☐ COMPUTERIZED SUPERMARKET

Objective

Students describe one or more ways in which people in the local neighborhood use computers, including who uses the computer, what information the person gives the computer, what information the computer gives the person, how this information is used by the person.

Students study use of the computer in a local supermarket, examining what information is given to the computer and what information is received. (Applications 1)

Prerequisites

There are no prerequisites, but the activity will be more meaningful if students have used a computer.

Classroom management

Whole-class activity; field trip

Time for activity

An hour or so for teacher to arrange for field trip to a local computerized supermarket; about four class periods including the field trip

Teacher

1. Ask each student to bring to class a grocery can or box, such as a cereal box, that has on it a coded bar mark (Universal Product Code).
2. In class, pass the items around and have the children find the coded bar mark on the items. Have students volunteer ideas about the bar code, what it means, what it is used for.

Explain that the bar marks are a code that a computer program can read and understand. The code tells such things as the name of the item and the company that makes it. Ask students if they have seen a supermarket checkout person slide the items over a lighted panel on the counter or slide a lighted wand over the bar code. Explain that the light is scanning the code and sending the coded information to a computer.

3. Tell students about the planned field trip, what they will do on the trip, and what they are expected to find out. For example, they will find out:
   - How the checkout person tells the machine to read the bar code
   - Where the bar-code information goes



- What the computer does with the information from the code
- What information comes back to the checkout person and to the customer
- Where and how this information comes back to checkout person and customer
- What the store manager does with the information stored in the computer

4. On the field trip, have students observe and talk with the store manager, checkout people, stock clerks. Have students observe checkout procedures, the stockroom procedures, the restocking of shelves, etc. Have them observe how information from the computer is used in these processes. They might collect samples of bar-code labels, cash-register printouts, inventory lists, etc.
5. After the field trip, have students discuss what they have learned about how the computer is used in the supermarket. Students might make up a game in which they invent and draw their own bar codes and decode them for each other.

Related activities

Children might visit a bank, and use the automated teller.

They can also visit a computerized library, and get a computer library card.

A visit can be made to a children's museum that has computer exhibits.

The children can learn how the computer controls traffic lights in town, and visit the computer center at the traffic department.

This chapter provides detailed lesson plans for sample classroom activities. The activities provide students with opportunities to practice and apply skills and knowledge they have learned, and to learn and apply new skills and knowledge specified in the objectives for grades 3 and 4. Please read Chapter 3, "Overview of the Curriculum," for an explanation of the strands and objectives.

Figure 5 – 1 summarizes strands and objectives for grades K through 4. Table 5 – 1 provides a cross-reference between sample activities and objectives for this chapter.

INTRODUCTION TO THE TEACHER

Procedures and computer programs are two very useful kinds of tools for third- and fourth-grade children and their teachers. It is easy to incorporate formal procedural thinking into these grades, because developing and using procedures is already an important aspect of the classroom activities. Students are constantly learning new procedures (for example, those involved in using the library, solving math problems, doing science experiments).

In the procedural thinking activities we are formalizing and focusing the students' attention on the procedures themselves. Students become more aware of the step-by-step sequence of instructions which, when followed, enable us to perform a clearly defined task in a predictable and successful manner.

The children enjoy taking an active role in making up procedures. They enjoy the process of testing and debugging their procedures. "Buggy" procedures produce unpredicted and often funny outcomes.

You and your students will greatly benefit from procedures activities, whether or not you are using computers. After students begin to use computer programs they begin to see the importance and usefulness of procedures in relation to computers.

Grades 3 – 4
objectives and activities



Strands	Objectives: Grades K – 2	Objectives: Grades 3 – 4
Procedures	• Follow a procedure for a familiar task • Modify a procedure • Show different procedures can produce the same outcome • Find and correct errors in a procedure • Describe procedures used to perform a task	• Help to develop a procedure involving repetition, decision making, and variables • Find and correct errors in a procedure • Develop a procedure, demonstrate that it works • Use procedures to perform new tasks
Using Programs	• Use computer drills and games • Operate equipment; load and run programs • Recognize the computer needs instruction	• Read documentation that describes programs and tells how to use them • Select and operate programs without teacher's help • Select and use a program to solve a specific problem
Fundamentals	• Understand that computer instructions are contained in a program	• Understand that the computer is a general purpose machine
Applications	• Discover computer applications in homes and neighborhoods	• Know about computer applications in school and local government • Compare fictional and real computers
Impact	• Follow rules for using equipment and programs	• Follow rules for using equipment and programs

(Note: For grades K – 6, objectives and activities related to computer programming are reflected in the Procedures, Using Programs, and Fundamentals strands.)

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Figure 5 – 1 □ Grades K – 4: strands and objectives

Table 5 – 1 ☐ Sample activities by strands*

Grades 3 & 4 — sample activity	1 Procedures	2 Using Programs	3 Fundamentals	4 Applications	5 Impact	6 Writing Computer Programs
ZEEP007 and the Dishes	5,6,8,9					
Logo Lesson 1: Turtle Procedures	1					2,4
Logo Lesson 2: Modify Procedures	2					2,4
Logo Lesson 3: Different Procedures, Same Task	3,5					2,4
Logo Lesson 4: Designing Procedures	5,6					2,4
Logo Lesson 5: Repeat Command	7a,8a					2,4
Phases of the Moon	5,9					
Developing a Procedure for Copying A Diagram	5,6					

Table 5–1 ☐ Cont'd

Developing Procedures for Geometric Patterns	5,7,8,9					
Pattern Blocks Procedures — Equivalent Fractions	5,9					
Giving Directions	3,4,9					
Dragon's Den	9					
Math Strategy		1,2,3, 4,5,6,7			1	
Coordinate Grid Games		1,2,3, 4,5,6,7			1	
Spelling Strategy		1,2,3, 4,5,6,7			1	
Logic Games		5,6			1	
Little Professor		1	2			
Bulletin Board				2		
The Awakening				3		
The Fun They Had				3		

*Objective numbers are shown in the cells of the matrix.

When to Introduce the Activities

It's best to introduce procedural thinking activities at the very beginning of the school year. This sets a tone and approach to everyday classroom management as well as academic subjects. After you have used some of the sample lesson plans in this chapter, you and your students will probably invent many other procedural thinking activities for accomplishing all sorts of classroom tasks.

If your students have not formally worked with procedures, begin with some of the introductory activities given in Chapter 4, such as "ZEEP007 the Robot," or "Big Trak."

The Using Computer Programs strand can be brought in at any time in which the machines and appropriate programs are available.

The Fundamentals and Applications strand activities in this chapter assume that your students have had experience using computer programs. Introduce these activities at points that are relevant and convenient for your curriculum.

About the Computer Programs

To achieve the Using Programs objectives, students should have access to an organized collection of well-documented programs.

Programs and documentation should be located in the classroom or library media center in an organized way so that students can become familiar with their location and the procedures for using them. Documentation should tell the name of the program, its purpose, how to use the program, and what data and equipment are needed in order to use the program.

Programs

Thousands of programs are commercially available. The examples selected for sample activities are only illustrative. Two of these, Math Strategies and Spelling Strategies, are examples of well-documented drill programs that can be easily modified by the students or teacher to present drill content relevant to the particular topics being studied in class. Game programs in the sample activity "Coordinate Grids" help student learn to use x, y coordinates and plot points on a grid. In the "Logic Games" example, students use programs not only for practice in logic but also to learn to follow written directions on their own for how to use and operate the program.

Students need to become proficient at using the keyboard. The more comfortably and easily they can use a keyboard, the more effectively they can use the computer for any application.

Try to find a good typing tutor program for the students to use. Although there are many typing tutors on the market, most are not designed specifically for children. You need to ensure that the students learn proper finger placement before they use the computer typing drills.

An example of a typing tutor that uses a game format is *MasterType*, published by Lightning Software. *MasterType* includes an authoring option to allow teacher or students to create lessons using words of their own choosing.

About Computers in Local Government

Plan your activities around the computer applications in your own local government and businesses — for example, police and fire departments, supermarkets, banks, library, telephone company.

Students will benefit more from learning about a few applications in some depth, rather than many applications very superficially. They will describe a computer application found in the school, local government, or local business, in terms of the following:

- Who uses the computer
- What information (input) the person gives the computer
- What information (output) the computer gives the person
- How the person uses the information
- Locations of the people and machines
- Communication links between the people and machines in the system
- Kinds of information stored in the computer data base

If your students are not familiar with the concepts of "user," "input," "output," "information," and communications between people and machines, then these ideas should be introduced at this time.

About Computers in Fiction

Computers have become an important subject in modern literature for both children and adults. It is important for children to know that the computers they meet in fiction may have little if any resemblance to real computers. Heighten the critical awareness of students, so that they do not inadvertently absorb computer information that is false.

At the same time, students should be encouraged to consider the real computer issues with which fiction deals. It may indeed be the writer of fantasy who accurately predicts the directions in which computer science may develop.

SAMPLE ACTIVITY ☐ ZEEP007 AND THE DISHES

Objectives

Students analyze directions given to the robot ZEEP, and find and correct errors in a procedure that involves repetition and decision making. (Procedures 5, 6, 8, 9)

Prerequisites

- ☐ Students need to have had experience in debugging procedures; an introduction to flowcharting is also helpful.
- ☐ "ZEEP007 the Robot," from Chapter 4, is a good introductory activity for students who have not studied procedures previously.

Materials

- ☐ Copy of the story "ZEEP007 and the Dishes" for each student*
- ☐ Chalkboard

Time for activity

Preparation 5 to 15 minutes; teaching 15 to 20 minutes; student work 20 to 25 minutes

Classroom management

Individual, partners, and total class

Teacher preparation

Make copies of the story "ZEEP007 and the Dishes" for all students

Teacher

1. Hand out copies of the story to the students, and review with them the idea of a procedure as a set of instructions for accomplishing a task.

Either have the students read the story silently to themselves or have a student read the story to the class.

2. After students have read the story, ask the class to discuss the problem. Ask: "Did ZEEP do as he was instructed? What is wrong with the instructions?" Point out that the instruction "repeat for all dishes" implies that ZEEP was supposed to go back to step one and repeat the entire procedure. Actually, we only want ZEEP to repeat part of the procedure, and we only want him to wash the dirty dishes. Ask: "Why did ZEEP try to wash every dish in the house? How can we tell him only to wash the dirty ones that are in the sink?"

You might depict the students' ideas in flowchart form on the chalkboard as the discussion continues.

3. Continue class discussion until all students appear to understand the problem. Depending on their understanding, either continue

*This story and all handouts for activities are found at the end of the chapter.

to develop a new, improved procedure as a class or invite students to work out their own individual solutions to the problem.

4. If students each write their own procedures, have them trade solutions with a partner. Each student will then try to follow the partner's procedure, acting out the steps. As partners find errors in each other's procedures, they should discuss these with their partner until a workable solution is found.
5. Have students report to the class on their solutions and the kinds of errors they made and corrected in their procedures.

Possible solutions

Procedure: ZEEP-WASH-DIRTY-DISHES

1. Plug the sink
2. Pour capful of detergent in sink
3. Fill sink with warm water
4. Pick up one dirty dish
5. Scrub dish with sponge
6. If dish is not clean, go to step 5
7. Put dish in drainer
8. If no more dirty dishes, STOP
9. Go to step 4.

Evaluating students' solutions

If students develop their own individual solutions, have their partners answer the following questions about their procedures:

- ☐ Does the procedure have a name?
- ☐ Can you understand each instruction?
- ☐ Can you follow the procedure?
- ☐ If ZEEP follows the procedure, will he wash the dishes correctly?

Related activities

Have students make up tasks for ZEEP to do. Have a student play the role of ZEEP, following the procedure developed by classmates.

Talk about the differences between ZEEP and a real computer. ZEEP understands many English words that computers usually don't under-

stand. Ask students: "What if ZEEP doesn't understand an instruction like 'fill sink with warm water'?" Suggest that maybe he would have to be given another procedure that tells how to fill the sink with warm water.

For students who have had more experience with procedures, the idea of a more elaborate and structured solution to "ZEEP007 and the dishes" problem might be introduced. The following is an example of a solution containing a main procedure and subprocedures (see transparency master — optional flowchart at the end of this chapter).

Procedure: ZEEP-WASH-THE-DISHES

1. Do GET-SINK-READY.
2. Do WASH-DIRTY-DISHES.
3. Do EMPTY-SINK.

Subprocedure: GET-SINK-READY

1. Put plug in sink.
2. Put one capful of dish detergent in the sink.
3. Fill sink with warm water.
4. END subprocedure.

Subprocedure: WASH-DIRTY-DISHES

1. If there are no more dirty dishes in the sink, go to step 9.
2. Pick up one dirty dish.
3. Scrub dish with sponge.
4. Look at the dish.
5. If dish is clean, go to step 7.
6. If dish is not clean, go to step 3.
7. Put dish in drainer.
8. Go to step 1.
9. END subprocedure.

Subprocedure: EMPTY-SINK

1. Pull the plug.
2. Put sponge on counter.
3. END subprocedure.

SAMPLE LOGO LESSONS*

The Logo language provides an ideal vehicle for allowing students to apply their skills in procedural thinking. On the following pages are a series of sample Logo lessons that address the first eight objectives of the Procedures strand.

Logo is usually used in an atmosphere of discovery and invention, in which students pursue projects of interest to them. In contrast, the activities provided here are more structured and didactic. Use these lessons as a supplement to other Logo activities, to help ensure that all students in the class have achieved the Procedures objectives.

In order to use these sample lessons with your students, you will first need to do the following (if you are not already using Logo in your classroom):

- ☐ Read about Logo. The best general reference is the book by Seymour Papert entitled *Mindstorms: Children, Computers, and Powerful Ideas*. (See the Recommended Reading list which follows.)
- ☐ Acquire Logo (or other graphics procedures language) software for your classroom computer. Several versions of Logo are available, for several different microcomputers. (See Logo references in the software section of the Appendix.)
- ☐ Learn how to use Logo on your computer. Become familiar with basic turtle commands, and learn to use the editor to create and edit simple procedures. Learn how to save and retrieve procedures from disk, so you'll be able to save students' work. You should be able to learn all of this in a one-day workshop or on a weekend at home. If possible, work with another teacher who has used Logo with children, or attend a workshop led by an experienced Logo teacher.
- ☐ Introduce your students to operation of Logo on your machine, so that they are able to perform the basic operations CLEARSCREEN, SHOWTURTLE, FORWARD, RIGHT, LEFT, and BACK.
- ☐ Assign students to work as partners, playing with these basic turtle operations. Each pair of students should have at least a total of an hour of hands-on experience in playing with these turtle commands before you begin the sample activity for Logo Lesson 1.

It's also a good idea to have students "play turtle," acting out the behavior of the turtle themselves.

---

*Note: These lessons may be modified to use other procedure-oriented graphics languages such as the turtle graphics in Atari PILOT or the Kidstuff turtle graphics for the PET. See references at the end of this section.

☐ Establish standard operating procedures for the use of Logo by students. The way it is managed will depend on the number of machines you have, where they are located, and whether you are able to connect additional screens to your computer for large-group demonstrations. Experiment with various arrangements for scheduling machine time, demonstrating to the class, physically locating the machine(s), choosing or assigning partners, saving students' procedures on disk, etc. Have these matters fairly well decided before beginning Logo Lesson 1.

Recommended reading: Logo

Logo for the Apple II, by Harold Abelson; BYTE/McGraw-Hill, 1982.

Bibliography of Logo Memos: MIT Press.

BYTE Magazine, August 1982 issue; BYTE/McGraw-Hill Publications.

Mindstorms: Children, Computers, and Powerful Ideas, by Seymour Papert; Basic Books, 1980.

Learning with Logo, by Daniel Watt; BYTE/McGraw-Hill, 1982.

References: Other graphics procedures languages

Atari PILOT; Atari, Inc.

Kidstuff Turtle Graphics for the PET; J. L. Hammett, Microcomputer Div.

SAMPLE ACTIVITY ☐ LOGO LESSON 1 — TURTLE PROCEDURES

Objectives

Students enter a Logo procedure into the computer and discover the result of executing the procedure. (Procedures 1; Writing Computer Programs 2, 4)

Prerequisites

☐ Students should have had experience playing with Logo, entering turtle commands CLEARSCREEN, FORWARD, and RIGHT.

☐ Students should be familiar with the general idea of a procedure as a set of instructions for performing a task

Materials

☐ Logo on the classroom computer(s)

☐ Logo manuals

☐ Chalkboard

Time for activity

Whole-class discussion 15 minutes; each pair of students on the computer 20 minutes

Classroom management

Whole-class and partners

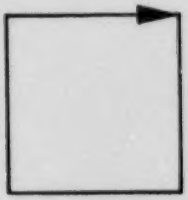
Teacher

1. Review with the students the fact that they have been giving the turtle commands that make it draw on the screen.

   Write the following on the board:

   ```
   CS
   FD 40
   RT 90
   FD 40
   RT 90
   FD 40
   RT 90
   FD 40
   ```

2. Ask a student to draw on the chalkboard what the turtle will do if it is given this series of commands. The student should draw (roughly) the resulting box, illustrated below:



3. Explain to the students as follows:

   We could call this set of instructions a *Procedure*, and give the procedure a name. What name? *(Agree on a name — e.g., "SQUARE.")*

   Today we will teach the turtle this procedure. Then any time we want turtle to draw a square, we can just tell the turtle, "SQUARE." *(Demonstrate to class on your machine if all can see.)*

4. Give students instruction on how to make a procedure on their Logo machine. For example:

   ```
   TO BOX
   CLEARSCREEN
   FORWARD 40
   RIGHT 90
   ```

```
FORWARD 40
RIGHT 90
FORWARD 40
RIGHT 90
FORWARD 40
END
```

5. Assign partners to make up a name for their own square procedure, enter their procedure in Logo, and demonstrate that their procedure works by telling the turtle to execute the procedure.

Related activities

Invite partners to invent their own procedure and demonstrate to another group that the procedure works.

Show students how to save their procedures on the disk and retrieve them.

Establish standard rules for saving students' procedures on the disk, caring for disks, etc.

SAMPLE ACTIVITY ☐ LOGO LESSON 2 — MODIFY PROCEDURES

Objectives

Students modify a Logo procedure to make it accomplish a new but similar task, and name the new procedure. (Procedures 2; Writing Computer Programs 2, 4)

Prerequisites

Logo lesson 1

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Whole-class discussion 15 minutes; each pair of students on the computer 20 minutes

Classroom management

Whole class and partners

Teacher

1. Review with students the fact that they have made a Logo procedure to draw a square. Have a student write the SQUARE procedure on the board.
2. Ask students: "Suppose we want a rectangle instead of a square? How can we modify this SQUARE procedure so that turtle will draw a rectangle?"

Have the students suggest ideas. As they do so, write the modifications over the SQUARE procedure:

```
RECTANGLE
TO ~~BOX~~
CLEARSCREEN
FORWARD 40
RIGHT 90
FORWARD ~~40~~ 80
RIGHT 90
FORWARD 40
RIGHT 90
FORWARD ~~40~~ 80
END
```

3. Assign partners to:
   - Write their square procedure on paper
   - Show how they will modify it to make a rectangle procedure
   - Give a name to their rectangle procedure
   - Enter their rectangle procedure in Logo
   - Demonstrate that their procedure works by telling turtle to execute the procedure

Related activities

Have students learn to use their Logo editor to modify the SQUARE procedure online rather than just entering a new RECTANGLE procedure.

Show students that they can save the SQUARE procedure on the disk, modify the SQUARE procedure that is in the computer memory to create a RECTANGLE procedure, and save the RECTANGLE. The end result of this process is a collection of two procedures which they can use any time they need a square or a rectangle.

SAMPLE ACTIVITY ☐ LOGO LESSON 3 — DIFFERENT PROCEDURES, SAME TASK

Objectives

Students demonstrate that different Logo procedures can produce the same drawing. (Procedures 3, 5; Writing Computer Programs 2, 4)

Prerequisites

- ☐ Logo lesson 2
- ☐ Students should know that a rectangle may be described by its length and width

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Whole-class discussion 20 minutes; each pair of students on the computer 20 minutes

Classroom management

Whole class and partners

Teacher

1. Review with students the fact that they have made a Logo procedure to draw a rectangle. Have a student write on the board the procedure she or he used to draw a rectangle. For example:

```
TO JANE
CLEARSCREEN
FORWARD 85
RIGHT 90
FORWARD 30
RIGHT 90
FORWARD 85
RIGHT 90
FORWARD 30
END
```

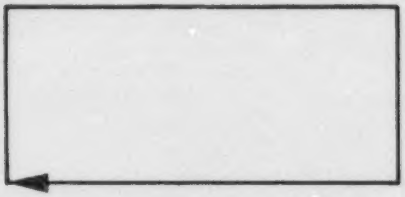
2. Explain to students that Jane's rectangle will look like this:



3. Tell the students: "Our task today will be to discover many different procedures that will cause the turtle to draw exactly the same rectangle." Then discuss with the class what we mean when we

say "exactly the same rectangle." The answer should be that we mean a rectangle that has the same length — 85 — and the same width — 30 — as Jane's rectangle has.

Draw a diferent rectangle (see below) and ask: "Is this the same rectangle?"



4. Have students suggest different procedures that will produce the same rectangle. For example:

```
TO LEFTRECT        TO MYRECT
CS                 CS
FD 85              FD 40
LEFT 90            FD 45
FD 30              RT 90
LEFT 90            FD 30
FD 85              RT 45
LEFT 90            RT 45
FD 30              FD 85
END                RT 90
                   FD 30
                   END
```

5. After two or three alternatives have been suggested and discussed, the students should all have ideas on a different procedure for the same rectangle.
6. Assign partners to do the following:
   - Invent their own (different) procedure for getting turtle to draw Jane's rectangle
   - Enter their procedure in Logo
   - Demonstrate to the class or to another group that their procedure produces the desired rectangle

Related activities

Conduct another discussion in which students describe their rectangle procedures and compare procedures.

SAMPLE ACTIVITY ☐ LOGO LESSON 4 — DESIGNING PROCEDURES

Objectives

Students learn the steps involved in planning and designing procedures and help to develop a Logo procedure to accomplish a specific task. (Procedures 5, 6; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 to 3

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

- ☐ Phase one — giving assignment to partners — 10 minutes; partners on the computer 20 minutes
- ☐ Phase two — class discussion — 30 minutes; partners on the computer 20 minutes

Classroom management

Whole class and partners, in two phases

Teacher

Phase one

1. Assign partners to work together on the computer to find out some information about the turtle and the screen. Partners should experiment with turtle commands to learn the following:
   - How far forward can turtle go from home position to the top edge of the screen?
   - When turtle reaches the top of the screen (and can still be seen there), have turtle make a RIGHT 90 turn. From there, how far forward does turtle go to the upper right-hand corner of the screen?
   - How many FORWARD does turtle go from the upper right corner to the lower right corner where he can still be seen?
   - How many FORWARD does turtle go from the lower right corner to the lower left corner?
   - What does turtle do if you give the following commands:

```
CLEARSCREEN
PENUP
FORWARD 20
PENDOWN
FORWARD 20
```

When partners work together on the computer, one should enter the commands on the keyboard and the other should take notes on paper to answer the questions that have been asked.

Phase two

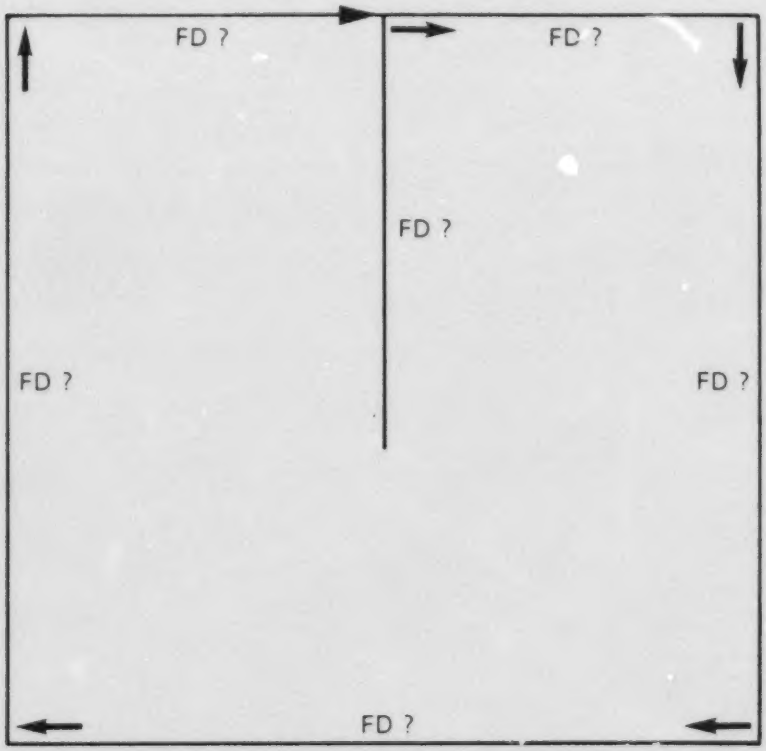
1. At this point, all students have had time to experiment with the turtle to find out the answers to the assigned questions.

Ask the class, "What did you find out?"

Draw on the board and ask students to tell how many forward it is from one point to another

Resolve any discrepancies in findings.

Discuss use of PENUP and PENDOWN.



2. Proceed by saying:

Now we have the information we need to design a procedure that will cause the turtle to draw a large rectangle all the way

around the edges of the screen. We will plan this procedure together.

What should we do first? *(Give procedure a name.)*

Next?

Work with class to develop a procedure such as the following to draw a border around the screen. If the students' suggestions seem to have some bugs in them, write them down anyway. Students will have a chance to test and debug the procedure.

Note: This procedure is for Apple Logo, a product of Logo Computer Systems Inc. Your Logo machine may be different.

```
TO BORDER
CS
PU
FD 120
PD
RT 90
FD 135
RT 90
FD 190
RT 90
FD 270
RT 90
FD 190
RT 90
FD 135
END
```

3. Ask for a pair of students to volunteer to test the procedure the class has just developed. After they have entered the procedure in Logo, have them demonstrate to the class what the procedure does. Is the result as intended? If not, work with the class to debug the procedure.

Related activities

Have partners go through this same process (as follows) for a drawing of their own design:

1. Experiment on the computer with turtle commands, creating a drawing you like.
2. Partner takes notes on paper of the commands that were used to create the drawing.

3. Partners work together to define a Logo procedure that will produce that drawing.
4. Partners demonstrate their procedure to the class or to another group.

SAMPLE ACTIVITY ☐ LOGO LESSON 5 — REPEAT COMMAND

Objectives

Students develop a procedure using the Logo command REPEAT, and debug the procedure. (Procedures 7a, 8a; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 through 4

Materials

- ☐ Logo on the classroom computers(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

- ☐ Phase one — giving assignment to partners 10 minutes; partners on the computer 20 minutes
- ☐ Phase two — class discussion 30 minutes; partners on the computer 20 minutes

Classroom management

Whole class and partners, in two phases

Teacher

Phase one

1. Assign partners to work together on the computer to experiment with using their SQUARE procedure to make designs. Use the following SQUARE:

```
TO SQUARE
FD 40
RT 90
FD 40
RT 90
FD 40
RT 90
FD 40
END
```

2. Ask the students to try out variations of the following sequence of commands:

```
CS
SQUARE
RIGHT 45
SQUARE
RIGHT 45
SQUARE
RIGHT 45
```

Suggest that the students try out different versions of this sequence, using different RIGHT or LEFT turns or different-sized squares.

Phase two

1. After all students have had an opportunity to experiment with variations of what we might call a "snowflake," invite a volunteer to write on the board a sequence of commands that makes a design he or she likes. For example:

```
CS
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
SQUARE
RT 30
```

Clearly, it will be easier to make such designs if students use the Logo command REPEAT. An Apple Logo procedure for the above, using REPEAT, is:

```
TO SNOWFLAKE
CS
REPEAT 12 [SQUARE RT 30]
END
```

2. Ask the class how a new SQUARE procedure can be made using the REPEAT command. For example:

```
TO SQUARE
REPEAT 4 [FD 40 RT 90]
END
```

3. Assign partners to develop their own designs and procedures using REPEAT and their squares or rectangles procedures.

Related activities

See the Sample Logo lessons in Chapter 6.

SAMPLE ACTIVITY ☐ PHASES OF THE MOON

Objectives

Students develop procedures for describing the phases of the moon and ask their classmates to execute these procedures. (Procedures 5, 9)

Prerequisites

- ☐ Students will already have applied Procedures objectives 1 through 6.
- ☐ Students must have had experience in describing a detailed set of instructions for accomplishing a task. If they have not, introduce the activity "ZEEP007 the Robot" from Chapter 4 as a preliminary activity to this one.
- ☐ Students must know the relationship of the sun, moon, and earth in producing the phases of the moon.

Materials

- ☐ Scissors
- ☐ Set of "phases of the moon" cards (at the end of this chapter) for each student
- ☐ Large piece of paper for each student

Time for activity

Preparation — copy the phases of the moon cards; lesson — about one class period

Classroom management

Students work individually and with partners; teacher works first with half the class

Recommended reading

Concepts in Science: Green (3), by Brandwein et al.; Harcourt, Brace & World.

Stem: Level 3 Addison-Wesley Science, by Rockcastle et al.; Addison-Wesley, 1980, pp. 166–75.

Teacher

1. If possible, work with just half the class first. These students will develop procedures which they will then try out on partners who are not involved in the first part of the lesson.

Pass out to each student in this group a copy of the "Phases of the Moon" sheet, a large sheet of paper, and a pair of scissors to cut the cards apart.

2. Remind students of the work they have done with Procedures activities. Tell them they will each prepare a procedure for doing a task. They will then give the instructions to a partner who has not been involved with the task before.

Ask the students to cut out the cards. Then assign them the following task:

> Draw the earth and the sun on the large sheet of paper. Then place the Phase of the Moon cards in the proper positions in relation to the earth and sun. The Phase of the Moon cards show the moon as it will look to an observer on earth, when the moon is in a particular position in relation to the sun and the earth. You will probably want to show the moons going around the earth.
>
> After you have the moons in the position in which you think they should be, tape them onto your large sheet of paper.

3. When students have completed this task, ask them to write a procedure that tells how to accomplish the task they have just done. They will give these instructions to a partner (from the other half of the class) who does not know what the end result is supposed to look like.
4. After students have written their procedures, have them give the instructions along with the Phase of the Moon sheet and a large piece of paper to their partner. The partner is to follow the instructions exactly as written. The partner is then to show the result to the teacher.

Throughout this lesson, emphasize to students that there are different ways to do this task. Each person's procedure will be different. The test of students' procedures will be whether their partner can follow the instructions and whether their partner produces a picture that shows the phases of the moon in their proper relation to the sun and earth.

Possible solutions

Procedure: "Phases of the Moon"

1. Draw a circle about 4 inches in diameter in the middle of the paper. Call the circle "earth."
2. Draw a half-circle coming off the bottom edge of the paper and call it "sun."
3. Find the "new-moon" picture in the Phase of the Moon cards.
4. Put the new-moon picture halfway between earth and the sun.
5. Find the "full-moon" picture in the Phase of the Moon cards.
6. Put the full-moon picture on the top part of the paper, about as far away from earth as the new-moon picture is on the other side.
7. Find the "first-quarter" moon picture.
8. Put the first-quarter moon picture on the right side of earth, about as far away from earth as the full moon is.
9. Put the last-quarter moon picture on the left side of earth, about as far away from earth as the full moon is.
10. Find the waning-crescent moon.
11. Put the waning-crescent moon halfway between the last-quarter moon and the new moon, about as far away from earth as the other moons.
12. Find the waxing-crescent moon.
13. Put the waxing-crescent moon halfway between the new moon and the first-quarter moon, about as far away from earth as the other moons.
14. Find the waxing-gibbous moon picture.
15. Put the waxing-gibbous moon picture about halfway between the first-quarter and the full moon, about as far away from earth as the other moons.
16. Put the last moon picture, the waning gibbous, about halfway between the full moon and the third-quarter moon, about as far away from earth as the other moons.
17. Tape all pictures onto the paper.
18. END.

Evaluation of solutions

Ask students:

- ☐ Can your partner understand and follow the instructions given by you?
- ☐ Does the procedure result in an accurate placement of the moons in relation to sun and earth?

Some students may wish to refer to their science book or encyclopedia to help them in this task. They should be able to do this. However, a procedure that says "copy the picture in the book" is not an acceptable solution.

Related Activities

Have students develop procedures for describing location of the sun as viewed from their home at sunrise, noon, and sunset at different times of the year.

SAMPLE ACTIVITY ☐ DEVELOPING A PROCEDURE FOR COPYING A DIAGRAM

Objectives

Students develop a procedure to show the location of blocks "over and up" on a 10 × 10 grid, and to identify the location of a given ordered pair. (Procedures 5, 6)

Prerequisites

- ☐ Students must have co.nprehension of the "Over and Up" method of locating coordinates on a grid.
- ☐ Students need to be able to copy a diagram on a grid.

Materials

- ☐ Drawing on a grid, either produced on transparency or large graph paper (see transparency master — "Copying a Diagram" at the end of this chapter). You may need to develop a simpler drawing if this kind of task is new to your students.
- ☐ Two sheets of 100-square paper (or other grid paper) and a ruler for each student. If 100-square paper is too complicated for the students, start with fewer, bigger squares and a simpler diagram. (100-square paper is available from Kurtz Bros., School Supplies & Equipment, Box L, Paoli, PA 19301.)

Time for activity

Preparation 5 to 15 minutes; teaching 15 to 20 minutes; student work 20 to 25 minutes

Classroom management

Whole-class and individual work

Teacher preparation

See the lesson plan "Coordinate Grids" on page 126 of this chapter. If that program is available, use it as an introductory activity.

Teacher

1. Have the diagram on an overhead or large sheet of paper so that all of the students can see. (If the students have been used to naming blocks as given coordinates, then the diagram on the overhead or large chart should be set up appropriately with points in the blocks. If the students have been used to locating coordinates on the intersections of a grid, then this should be the method for placing the points on the grid.)
2. Give each student a sheet of 100-square paper and review with them the procedure of "Over and Up" to locate coordinates in the following way:

   Today we are going to invent a procedure for copying this figure onto your own grid sheets. When we are finished you should be able to produce an exact copy of this figure that is on my overhead.

   I would like each of you to try copying this figure onto your grid. You may have some difficulty at first, but keep working at it and you will eventually get it. If your first copy isn't perfect, don't be concerned. We will come up with a procedure to help us do a perfect copying job every time. When you have finished, I want you to think about the steps you used to copy the picture.

Have the students begin to work on the task. At this time, put up the large blank sheet of 100-square paper next to your figure paper. Go around and observe each student. Have the students use their own methods as much as possible. Try not to give them your own idea of the proper procedure unless they get completely jammed up.

3. When the students have had sufficient time to complete the task, call them together. Ask them to describe their methods and begin recording the steps on the chalkboard.

Once the students are satisfied that they have come up with a useful procedure, ask them: "How can we make sure that we have a procedure that works here?" If the students begin to list criteria for a good procedure, record them on the blackboard. They will probably suggest having someone try out the procedure. This may be tried during this lesson.

Possible solution

Procedure name: "Copy-it"

1. Find point (0,0) on the diagram.
2. On the diagram, find the point closest to coordinate (0,0) that has not been plotted yet on your own grid.
3. Find that coordinate on your own grid and place a point there.
4. Is there a point on the diagram that is not marked on your grid?
5. If there is, go back to step 2.
6. If there is not, go on.
7. Are there any line segments that are on the diagram but not on your own grid?
8. If there are, go on to step 10.
9. If there are not, congratulations! You have a finished picture. Go to step 15.
10. Locate a line segment on the diagram that is not marked on your grid.
11. Locate the points at either end of that line segment.
12. Locate the coordinates of those points on your grid.
13. Using a ruler, draw a line segment between those two points.
14. Go back to step 7.
15. END.

Evaluation of solutions

- ☐ Is each instruction understandable?
- ☐ Can students execute the instructions?
- ☐ When the procedure is executed, is the correct drawing produced?
- ☐ Are there unnecessary steps in the procedure?
- ☐ Are there steps missing?
- ☐ Does the procedure have a name?

Related activities

"Grid Locations," from Chapter 4, might be a useful introduction for students who are not familiar with the idea of a procedure for locating points on a grid.

Demonstrate a computer program that uses simple low-resolution graphics. Talk about the fact that the person who writes this computer program has to give instructions to the computer about how to draw the diagram shown on the screen. In order to do this, the person has to write

a procedure, in the form of a computer program, that tells the computer how to draw the diagram.

SAMPLE ACTIVITY ☐ DEVELOPING PROCEDURES FOR GEOMETRIC PATTERNS

Objectives

Students develop language for describing geometric relationships; describe a construction as a procedure for building it; use subprocedures for describing repeated parts of the construction; and vary their procedures to obtain different results. (Procedures 5, 7, 8, 9)

Prerequisites

Students should have had experience playing with pattern blocks, building flat geometric constructions. They should be familiar with developing procedures. If they are not, use the activity "ZEEP007 the Robot" from Chapter 4 as an introductory activity.

Materials

Each student who is participating needs a good supply of geometric pattern blocks (use *Pattern Blocks*, from Creative Publications).

Teacher references (all from Creative Publications)

Pattern Block Activity Book

Tessalations: The Geometry of Patterns, by Stanley Bezuzska.

Designs from Mathematical Patterns, by Bezuzska, Kenney, and Silvey.

Kaleidoscope Math, by Joe Kennedy and Diane Thomas.

Time for activity

Teacher preparation — half-hour; lesson — one or two class periods

Class management

Activity is easiest to conduct in group of about ten students

Teacher

Activity A (Demonstration by teacher to whole class or small group)

1. Go through a sample activity with the students, with everyone able to see the activity.
   a. Make the geometric pattern provided as an example (see illustration).
   b. With the original pattern as a model, build the same pattern with another set of blocks. Have the students identify the parts of the pattern that are repeated and give a descriptive name for each of the repeated parts.

c. Write down the process of construction step by step.

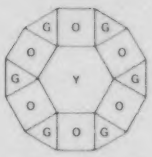
d. Verify that the instructions work.

e. Discuss bugs that could occur.

f. Ask students to follow the instructions using their own pattern blocks.

2. Observe students to see that they are actually following the instructions from the procedure, step by step, in order to build their construction. If they are not following the procedure as stated, they will miss the point of the activity.

Example For a finished pattern that looks like this:



Procedure name: "Circle Maker"

---

1. Start with a hexagon:



2. Place a square on each side of the hexagon:



3. Place a triangle in the space between every two squares:



Here is a different procedure for the same pattern:

Procedure name: "Sideways Houses"

---

1. Make six houses by putting a triangle on top of a square and making six of those



2. Place a hexagon on the table



3. Place one house along the top of the hexagon so that the point of the house is toward the right. The house is lying on its side.



4. Place the rest of the houses along the sides of the hexagon, so that the points of the houses all face in a clockwise direction.



---

3. Have the students try to build the pattern by following the procedure that has been written down, and find possible bugs in the procedure that result from ambiguities in the way the procedure is written, or that result from not following the instructions exactly as stated.

Activity B

1. Have students divide into pairs. Each student should have a generous supply of blocks.
   a. Partners sit at a desk or table wih a book or divider between them so that they cannot see each other's blocks.
   b. Student A builds a pattern.
   c. Student A rebuilds the pattern step by step, while describing it to student B.
   d. Student B constructs the pattern as described by student A (neither looks at the other's pattern).
   e. When student A says the pattern is finished, both look to see if they are the same. If not, they discuss differences and try to identify bugs.
   f. When the procedure can be followed correctly, student A writes it down.
   g. Students then reverse roles, with B inventing a pattern and developing a procedure for building the pattern.
   h. Later, the written procedures are given to a third student, C, who follows it without help from student A or B. Students A

and B watch, to detect potential bugs in their procedures or in student C's execution of the procedure.

Evaluation of solutions

Each student's procedure should have a name that describes the procedure or pattern. Did the student identify repeating patterns and describe them as such? Was the student able to find the bugs in the procedure when student B or C tried to execute it? Does the procedure tell students when they are finished?

SAMPLE ACTIVITY ☐ PATTERN BLOCKS PROCEDURES — EQUIVALENT FRACTIONS

Objectives

Students develop procedures to identify fractional names for one whole and equivalent names for fractions. (Procedures 5, 9)

Prerequisites

- ☐ Students should have beginning fractions concepts through reading and writing fractions of 1.
- ☐ Students will have applied Procedures objectives 1 through 5. If they are not experienced in developing procedures, use "ZEEP007 the Robot" from Chapter 4 as an introductory activity.

Materials

- ☐ Each student who is participating needs a good supply of geometric pattern blocks, red, blue, yellow, and green. (Use *Pattern Blocks*, from Creative Publications.)
- ☐ Worksheets for each student (see student handouts 1 and 2 in the student handout section at the end of this chapter).

Teacher Reference

Fractions with Pattern Blocks, by Matthew Zullie; Creative Publications.

Time for activity

Teacher preparation — half-hour; lesson — one to three class periods.

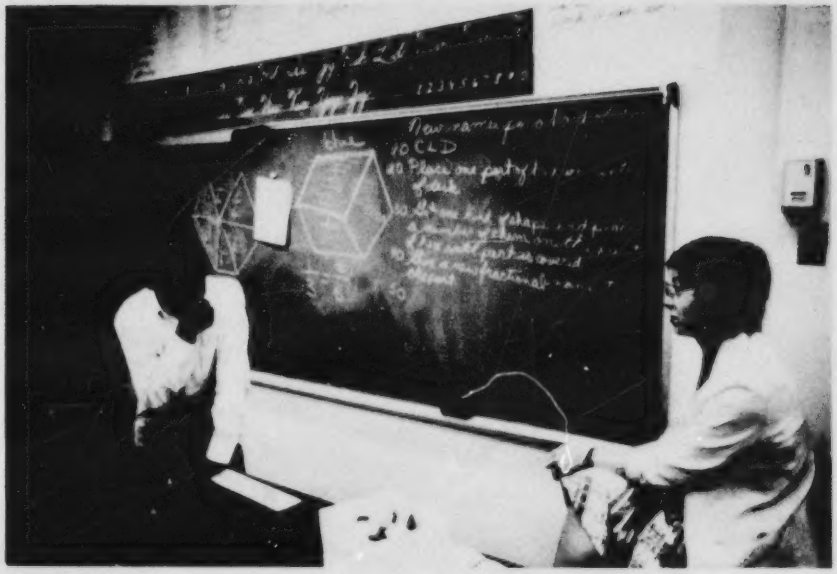
Class management

This activity is easiest to conduct in a group of about ten students. Other students, not present in the room during development of the procedure, will test the procedure.

Teacher

First-day activity

1. Give each pair of students a collection of red, blue, yellow, and green pattern blocks. Give students time to become familiar with



What's the next step? Ms. McGregor and her fourth graders are debugging their procedure for finding equivalent fractions (MacArthur Elementary School, Alexandria, VA)

the blocks if they haven't used them before. Then proceed as follows:

- Have each pair of students put a large yellow hexagon in the center of their desk. Ask them to find out how many blocks of red will fit exactly on top of the yellow hex. *(Two.)*
- Do students know a fractional name for a red block? *(One-half.)*
- Explain to the students that since two of those halves are needed to fit exactly on one whole yellow hex, another name for one whole might be "two halves."
- Write "$\frac{2}{2}$ = 1 whole" on the chalkboard.
- Similarly, work with green triangles (six) and blue diamonds (three), until several fractional names for one whole have been written on the board.

2. Introduce the idea of developing a procedure for finding out the fractional names for one whole, as follows:

> Suppose a person, say a student who is not present during this lesson, does not know the fractional names for one whole. What procedure could we develop which that person could use to figure out fractional names for one whole?

Ask students to suggest a name for the procedure, and steps in the procedure. As they suggest steps in the procedure, write the steps on the chalkboard. If their steps are "buggy," write them anyway.

Sample procedure: "Names for a Whole"

1. Start with a collection of yellow, red, blue, and green blocks all in a pile.
2. Put a yellow hexagon in the middle of the desk.
3. Call the yellow hexagon "one whole."
4. Pick another color of pattern blocks.
5. Keep putting blocks of the new color on top of the yellow hex, until they fit exactly over the yellow hex.
6. Count the number of colored blocks that are on top of the yellow hex.
7. Write that number on the top and on the bottom of a fraction.
8. Call the fraction you have written a "fractional name for one whole."
9. If there are any different colors of blocks left to try, go back to step 4.

3. After a procedure has been developed and the students agree that they think it will work, test the procedure. Erase the list of fractional names for a whole from the chalkboard, and leave only the procedure the students have developed. Ask one or more students who were not present during the first part of the lesson to follow the instructions on the board. Ask the first group of students not to make any comment, just to watch as the second group of students try out the procedure. The students who developed the procedure, however, should point out cases in which the "test" students are not following the procedure exactly as written.
4. Do the test students actually produce lists of fractional names for one whole? Why or why not? What instructions were unclear? Have the first group of students debug the procedure.
5. Hand out copies of the student worksheet for fractional names for one whole (student handout 1 — Patten Blocks Procedures — at the end of this chapter). Ask all students to complete them, using the procedure that was developed.

Related activities

Have students develop a procedure for using pattern blocks to find equivalent fractions, such as 1/2 = 3/6. Student worksheet is provided in the Handouts section at the end of this chapter.

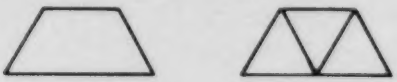
Sample procedure: "Equivalent Fractions"

1. Select a pattern block, such as a red one, and give it a fractional name.



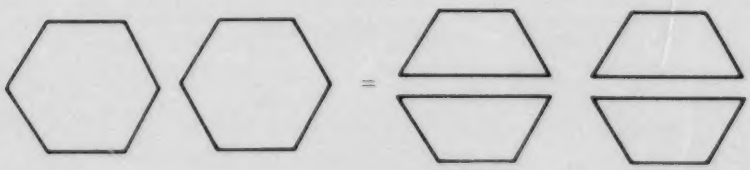
2. Pick a smaller-sized pattern block.
3. Say the fractional name of that smaller block. For example, a green block is called "one-sixth."
4. See if some number of the smaller-sized blocks will fit exactly on top of the larger block.
5. If the smaller pieces fit, count the number of smaller pieces.
6. Say the equivalent fractional name.

(1/2 = 3/6)



7. If there are any more different-colored smaller blocks to try out, go back to step 2.
8. STOP.

Have students use pattern blocks to find fractions greater than one whole.



Have students develop a procedure for using pattern blocks to find improper fractions.



Have students develop a procedure for using pattern blocks to reduce fractions.

Sample procedure: "Reducing Fractions"

1. Name the number of smaller blocks.



2. Arrange enough small blocks to make one whole and cover them with that block.



3. See if another block will evenly cover the remaining small pieces. If yes, do so and name.
4. If no, count remaining blocks and name the mixed numeral.
   Solutions: $\frac{11}{6} = 1\frac{5}{6}$

SAMPLE ACTIVITY ☐ GIVING DIRECTIONS

Objectives

Students practice giving precise instructions as they develop procedures for telling a person how get from one place to another. (Procedures 3, 4, 9)

Prerequisites

- ☐ Students will have applied Procedures objectives 1 and 2.
- ☐ Map skills: Students have knowledge of cardinal directions and knowledge of personal directions.

Materials

- ☐ Sample map on overhead transparency
- ☐ A *simple* map, well marked, of a section of your school or school neighborhood; a copy for each child
- ☐ A little cardboard mouse to move on the transparency

Time for activity

Preparation 10 to 45 minutes; teaching 15 to 20 minutes; student work 15 to 30 minutes

Classroom management

Small group and total class

Teacher

1. Put your sample map on the overhead projector, and tell the students that the class will develop a procedure that can be used to tell a friend how to get from one place to another. Invite students to suggest situations in which it is important to be able to give or receive directions to get from one place to another.

Put the mouse facing Main Street in front of the house. Invite the students to give directions for going from the house to the school. As the students call out instructions, have the little mouse do *exactly* as they say. For example, if they say, "Turn on Queen Avenue," stop because you don't know which way to turn. If they say, "Go down Queen Avenue," keep going down the avenue until the mouse runs off the end of the transparency.

Sample procedure: "House to School"

1. Come out of house and face Main Street.
2. Turn left on Main Street.
3. Walk to corner.
4. Cross Queen Avenue.
5. Continue down Main Street to King Avenue.
6. Cross King Avenue.
7. Turn right.
8. Walk down King Avenue.
9. Cross Broad Street.
10. Continue walking down King Avenue.
11. Cross Jay Street.
12. Turn left on Jay Street.
13. Stop at the school sidewalk.
14. Turn right.
15. Walk up the school sidewalk.
16. Open the door and go into the school.

2. After the first attempt, put the mouse back at the house and ask students to suggest another route and another procedure for getting from the house to the school. This time, act out the procedure

with the mouse but also have a student write down the steps in the procedure on the chalkboard. If a student suggests a procedure that has bugs in it, write down his or her suggestions without comment, and have another student find the bug.

3. Discuss the vocabulary used to give directions. Have students agree on words used to give the directions.

Ask:

- How would you give directions to a person who is blind?
- How would you give directions to a person who can't read?
- How would you give directions to a robot that understands only "turn right," "turn left," "forward so many steps," etc.?

Assignment

Provide each student with a *simple* map of the school with the surrounding neighborhood, or a diagram of *part* of the school building with classrooms named or numbered and general-purpose rooms named. Assign students the task of developing a procedure for getting from home to school, classroom to office, classroom to library, or some similar task. Students should develop their procedures in written form similar to the one the whole class developed for the sample map.

Debugging

When each child is finished, have him or her come up to show you the procedure with their map. Do not correct their solution, but instead pair up the children as they finish the task and have them trade procedure papers. Each child should attempt to follow the other's directions either physically in the school or from memory. Students should then discuss what was successful and what was unsuccessful about each others' procedures.

Common errors in this procedure might include:

- ☐ "Initial state" errors — procedure does not specify in what place or direction the person starts
- ☐ Sequence errors — putting steps in wrong order
- ☐ Omitted steps — procedure does not specify certain steps, such as "turn left" or "turn right"

Related activities

Some programs available for classroom computers provide practice with these directional and procedural skills. For example:

☐ NOMAD, from MECC

☐ *OT-2 Direction and Distance*, from Micro-Ed

☐ *Map Directions* from Robbinsdale

See also the Procedures activity, "Dragons' Den"

SAMPLE ACTIVITY ☐ DRAGONS' DEN

Objectives

Students develop procedures for telling a person how to use a map. (Procedures 9)

Prerequisites

☐ Students will have experience in using, developing and debugging procedures.

☐ Map skills: students have knowledge of cardinal directions and knowledge of personal directions.

☐ Students should have completed an activity such as "Giving Directions" in this chapter.

Materials

☐ Copy of Dragons' Den for each student (see Handout section at the end of chapter)

☐ Dragons' Den on overhead transparency

Time for activity

Preparation 10 to 15 minutes; teaching 10 to 15 minutes; student work 15 to 30 minutes

Classroom management

Whole-class discussion, then students work in pairs

Teacher preparation

Make transparency and copies of Dragons' Den for all students.

Teacher

1. Introduce the activity by discussing the importance of being able to give directions to someone so they can find a place. This becomes even more important if you are a knight who is looking for a treasure in an abandoned castle!

Pass out copies of the Dragons' Den to students as you discuss this idea:

> As if finding treasure in the castle isn't hard enough, this place is full of dragons. The dragons are not evil, but still, you wouldn't want to walk into one while it's sleeping!

As they begin the task, have students brainstorm about how to give directions when there are no names for the hallways and no specific



Third grader debugs her Dragons' Den procedure (MacArthur Elementary School, Alexandria, VA)

distances on the map. Remind students that the knight cannot see through or over the walls of the castle, and the knight does not have a map.

2. Show the dragons' den on the overhead projector; set up a treasure location and a knight's starting position. Have students suggest instructions to give to the knight, to get him to the treasure. Try to follow their instructions, drawing with marker on the transparency to show where the knight goes in response to their instructions. Interpret their instructions literally. As the students suggest instructions, get them to agree upon a vocabulary to use. As words and their specific meanings are decided upon, make a list of the words on the chalkboard. Have students specify in words which way the knight is facing at the beginning. Ask: "How will we tell distances? By number of steps?"

You might use the following example situation for this initial exercise.

Possible solution

This example starts the knight at the upper left-hand corner facing the short hallway. The treasure is in the lower right corner room next to a sleeping dragon.

Procedure: "Get the Treasure"

1. Face the short hallway that has an immediate left turn.
2. Walk down the hallway until you come to a left turn.
3. Turn left.
4. Walk one step. You see a right turn.
5. Turn right.
6. Walk down the long hallway.
7. At the end of the hallway you see an opening on your right.
8. Turn right.
9. Walk through this opening.
10. Turn left.
11. Walk down the short hall until it ends.
12. Turn right.
13. Walk quietly down the long hall.
14. Walk past the opening on the right and be careful — there are two sleeping dragons in there.
15. Walk until you come to the end of this hallway.
16. Turn right.
17. Walk down a short hallway until you come to the first opening on the left.
18. Turn into this opening and immediately turn left again.
19. Be careful. On your right as you enter this room is an opening with a sleeping dragon in it.
20. Go past the first opening and turn right into the second opening.
21. The treasure should be directly in front of you.
22. Pick up the treasure and use your magical powers to transport you out of there.

3. Give directions to the students as follows: First, each student should cut out the figure of the knight and the figure of the treasure from his or her sheet. Then each student should place the knight and the treasure wherever he or she wishes. Students then pass their Dragons' Den sheets to their partners with knight and treasure in place.

Each partner is to write a procedure for the knight to follow in getting from where he is to the treasure without bothering any dragons and without getting lost.

4. After students have completed their procedures, they should test them by giving the procedure and the Dragons' Den back to their partner. The partner should execute the procedure exactly as it is written. Does he or she get to the treasure?

As each student attempts to follow the procedure, he or she should identify errors and debug the procedure. Partners should tell each other about bugs in their procedures.

Typical kinds of errors to look for might include:

- "Initial state" errors — procedure does not specify in what place or direction the person starts
- Sequence errors — putting steps in wrong order
- Omitted steps — procedure does not specify certain steps, such as "turn left" or "turn right"
- No name for procedure
- Wrong outcome — knight steps into a dragon or can't find treasure

After procedures are tested and debugged, you may want to have students put them in final form and hand them in.

Related activities

Some computer programs provide practice with these directional and procedural skills. See descriptions in the Using Programs section for these programs:

☐ *OT-2 Direction and Distance*, from Micro-Ed

☐ NOMAD, from MECC

MORE PROCEDURES ACTIVITIES

Teachers and students have invented many useful activities involving the development of procedures and the use of the procedures for learning new skills and knowledge. They write the procedures in the form of flowcharts, line-by-line instructions, or picture sequences.

Here are some classroom-tested ideas:

1. Students develop a procedure for ZEEP007 to follow in doing a task such as the following:

   Walk to the table, pick up an empty cup, put the cup into a pan of water at an angle that will allow for picking up a cupful of water, pour the cupful of water into a second container.

This activity requires previous discussion and definition of a *limited vocabulary* for ZEEP, that will enable him to grasp a cup, place it a

specified number of centimeters into the pan of water, etc. The activity also requires that the students have access to the apparatus, to measure distances, etc.

ZEEP must be specified to be a certain height, have arms of specified length, etc.

Students test their procedure by having a classmate act it out.

2. Class works together, with teacher's help, to develop a procedure for looking up a word in the dictionary. Students test the procedure by following it exactly and seeing whether they can find a test word in the dictionary.
3. Class works together, with teacher's help, to develop a procedure for making change. Test the procedure using real coins.
4. Students devise a procedure for a repetitive task, such as a robot looking for a needle in a haystack or a student sharpening a large quantity of pencils. A good introduction for this activity is to have a demonstration on the microcomputer of a program repeating the same instructions over and over.
5. Students develop procedures for organizing a field trip. The teacher helps to break the task into subtasks. Small groups develop procedures for the subtasks.
6. Students use a procedure for classifying animals as vertebrates or invertebrates (for vertebrates, classifying as fish, amphibians, reptiles, birds, or mammals; for invertebrates, classifying as insects, arachnids, mussels/mollusks, crustaceans, annelids).
7. Students describe procedures they use to depict the food chain for a given collection of plants and animals.

SAMPLE ACTIVITY ☐ MATH STRATEGY

In this activity students are introduced to Using Programs objectives 5 and 6 in which they read and use written documentation in order to operate the program. They apply and extend their skills in Using Programs objectives 1 – 6 by learning to author their own math drills. Math objectives are to improve ability to visualize basic math equations and therefore memorize them more easily.

Objectives

Students follow written instructions for operating a program; and learn to write their own math drills to improve their ability to visualize and memorize basic math equations. (Using Programs 1, 2, 3, 4, 5, 6, 7; Impact 1)

Prerequisites

Students need to be familiar with operation of the computer and be able to use the keyboard comfortably.

Materials

- ☐ Apple II with 48K memory and disk drive
- ☐ Color TV or color monitor preferred
- ☐ *Math Strategy* program and accompanying manual by Robert Dilts, licensed by Apple Computer, Inc., 1981
- ☐ Blank disk for storing new lessons

Classroom management

Individual student work on computer drills; partners author new lessons

Time for activity

Activity may be conducted throughout the school year. Teacher preparation about half-hour to one hour for first lesson; student work on computer will vary by individual needs.

Teacher

1. Before introducing this activity to the class, spend some time using the program and reading the manual. Then use the author mode to create a lesson that includes basic math equations your students are learning. Create a new lesson disk for this purpose.
2. Introduce the program to the students by discussing with them the material in "Finding Your Mind's Eye," Chapter 1 in the *Math Strategy* manual. Have students practice visualizing a math equation, moving their eyes in the manner suggested in the manual.
3. Make sure all students get enough time on the computer to go through the math lesson you have prepared.
4. Ask for a pair of student volunteers to choose ten math equations and author a lesson on them. The students will be expected to read and follow the directions in the *Math Strategy* manual in the chapter called "Author."
5. Have the other students in the class use the new lesson. (You might decide that some students benefit more from this kind of drill than others.)
6. If the program seems to be useful to some of the students, continue to have student volunteers prepare lessons for other math equations. Students might be rewarded for perfect math tests by being selected to author the next lesson.

Related activities

Have student volunteers author math lessons for teachers and students in earlier grade levels. Have the lesson disks catalogued and filed in the library media center with the program.

Other examples of shell-type drills designed to allow the teacher or student to input their own questions, answers, data, etc. include the following:

Supplier	Name of Program	Machines
Apple	Shell Games	Apple
J. Weston Walch	PETBOWL	PET
	CONCENTRATE	PET

SAMPLE ACTIVITY ☐ COORDINATE GRID GAMES

Objectives

Students use a program to plot x, y coordinates on a grid (Using Programs 1, 2, 3, 4, 5, 6, 7; Impact 1)

Prerequisites

Students need to be familiar with operation of the computer and be able to use the keyboard comfortably. They should be familiar with locating points on an x,y grid (see sample activity "Grid Locations" in Chapter 4).

Materials

- ☐ Apple II with 48K memory and disk drive
- ☐ Color TV or color monitor preferred
- ☐ *Bumble Games* program disk by The Learning Company

Classroom management

Whole-class demonstration and lecture; pairs of students using computer program

Time for activity

Teacher preparation about 15 minutes; class demonstration 20 minutes; student work on computer varies

Teacher

1. Before introducing this activity to the class, spend some time using the program "Bumble Dots." This program has two modes: one in which the computer asks students to state the x,y locations of dots the computer has prestored for drawing a picture; the second in which students specify x,y locations of dots they wish to use to create a picture.
2. Use the "Bumble Dots" program as a demonstration aid in a lesson on giving x,y numbers to points on a grid. Arrange one or two large color monitors in such a way that all students can see the screen.

Have a student assistant work the keyboard while you show the class the "Bumble Dots" screen in "Bumble's Pictures" mode. Ask students to volunteer the x,y names of the dots shown, and have your assistant key in their answers. For correct x,y numbers, the program draws a line connecting two dots, eventually creating a picture.

3. If all or most students are able to locate the points correctly, introduce the use of "Bumble Dots" to create your own pictures on the grid. Have student assistant key in the x,y numbers that are suggested by students in the class. Start with pictures having three dots and work up to pictures having nine dots.
4. Assign students in pairs to use the program. For students who may be having difficulty with this level, ask them to work first with earlier games on the disk, such as "Visit from Space," which has smaller grids and more guidance.

Related activities

When all students can use "Bumble Dots" successfully, introduce the Sample Activity "Copying a Diagram" in this chapter.

The program disk "Bumble Plot" from the same publisher has more advanced grid games, including negative numbers on the grids and drawing fairly complex diagrams on the grids.

SAMPLE ACTIVITY ☐ SPELLING STRATEGY

Objectives

Students use a program to write their own spelling drills, improving their ability to visualize words and spell correctly. (Using Programs 1, 2, 3, 4, 5, 6, 7; Impact 1)

Prerequisites

Students need to be familiar with operation of the computer and be able to use the keyboard comfortably.

Materials

- ☐ Apple II with 48K memory and disk drive
- ☐ Color TV or color monitor preferred
- ☐ *Spelling Strategy* program and manual by Robert Dilts, licensed by Apple Computer, Inc., 1981
- ☐ Blank disk for storing new lessons

Classroom management

Individual student work on computer drills; partners author new lessons

Time for activity

Activity may be conducted throughout the school year. Teacher preparation about a half-hour to one hour for first lesson; student work on computer will vary by individual needs.

Teacher

1. Before introducing this activity to the class, spend some time using the program and reading the manual. Then use the author mode to create a spelling lesson that includes your planned spelling list for the week. Create a new lesson disk for this purpose.
2. Introduce the program to the students by discussing with them the material in "Finding Your Mind's Eye," Chapter 1 in the *Spelling Strategy* manual. Have students practice visualizing a spelling word and moving their eyes in the manner suggested in the manual.
3. Make sure all students get enough time on the computer to go through the spelling lesson you have prepared.
4. Ask for a pair of student volunteers to author the spelling lesson for next week. The students will be expected to read and follow the directions in the chapter called "Author" in the *Spelling Strategy* manual.
5. Have the other students in the class use the new lesson for the week. (You might decide that some students benefit more from this kind of drill than others.)
6. If the program seems to be useful to some of the students, continue to have student volunteers prepare lessons for the spelling lists for each week. Students might be rewarded for perfect spelling tests by being selected to author next week's lesson.

Related activities

Invite students to select words from their geography, history, or science lessons and author spelling lessons for those words.

Have student volunteers author spelling lessons for teachers and students in earlier grade levels. Have the lesson disks catalogued and filed in the library media center with the program.

Other examples of shell-type drills designed to allow the teacher or student to input their own questions, answers, data, etc. include the following:

Supplier	Name of Program	Machines
Apple	Shell Games	Apple
	Magic Spells	Apple
MicroEd	Spelling Programs	PET
National Coord.	T, S-SPELL	PET
Center for Curric.	PUNC	PET
Development	HYPHEN	PET
J. Weston Walch	PETBOWL	PET
	CONCENTRATE	PET

SAMPLE ACTIVITY ☐ LOGIC GAMES

Objectives

Students follow written instructions to operate a program which helps them to learn shape and color relationships. (Using Programs 5, 6; Impact 1)

Prerequisites

Students need to be familiar with operation of the computer and be able to use the keyboard comfortably. They need to be able to read instructions such as "Put one piece in each box to complete Gertrude's pattern."

Materials

- ☐ Apple II with 48K memory and disk drive; joystick optional
- ☐ Color TV or color monitor
- ☐ *Gertrude's Secrets* program by The Learning Company

Classroom management

Students work in pairs on computer

Time for activity

Activity may be used throughout the school year

Program description

This program series provides students with well-designed instructions, both in the manual and on the screen, for using the computer keyboard to perform a variety of functions such as moving the cursor box, picking up objects, and playing sequences of increasingly complex logic games. The program provides a good opportunity to introduce students to using computer programs without assistance, by reading and following written instructions.

Teacher

1. Introduce the activity by showing the class the program disk in its package. Show them where the program package is to be kept when not in use.
2. Remind students of rules for using equipment, and clarify schedules for use.

Classroom rules should have been established for fair use of machines and programs, schedules for use, proper care of diskettes and equipment. The manual, which is written for children, should stay with the program diskette.

3. Assign or have the students choose partners.
4. Tell students they are to use the instructions provided in *Gertrude's Secrets* program and manual, to learn how to play the games.

If some of your students have difficulty working independently with the equipment and program, appoint a pair of students to serve as consultants to the others.

Related activities

Gertrude's Puzzles, by the same company, is a series of games that uses the same format with more complex logic.

Have student volunteers demonstrate to the class their favorite logic game room in the world of *Gertrude's Secrets*.

SAMPLE ACTIVITY ☐ LITTLE PROFESSOR

Objectives

Students contrast a general-purpose classroom computer with a special-purpose computer: Little Professor for math drills. (Using Programs 1; Fundamentals 2)

Prerequisites

Students need to have used a general-purpose computer with at least two different kinds of programs. They need to have used the computer with some programs that are math drills and some that are not math drills.

Materials

Little Professor hand-held special-purpose computer for math drills. (You can adapt this activity to use hand-held calculators instead.)

Time for activity

About a week for students to have opportunity to use the Little Professor, prior to the lesson; about one class period for discussion

Classroom management

Independent work on Little Professor and on the classroom computer; whole-class discussion

Teacher

1. Make sure all students have had an opportunity to use the Little Professor, and that all students have had an opportunity to use the classroom computer with several different kinds of programs.
2. A few days before the class discussion, suggest to students that they begin to think about ways in which the Little Professor is similar to and different from the classroom computer.
3. Conduct a discussion with the class. There are many different possible answers to the following questions:

Suggested questions	Possible answers
• In what ways is Little Professor similar to the classroom computer?	• Both give math drills; both have keyboards; both have displays; both keep track of how many problems you get right; both contain electronic circuits.
• In what ways is Little Professor different from the classroom computer?	• Professor only has one kind of program but the computer has many programs; Professor can't store on disk or tape; people can't change Professor's program but people can change computer's programs if they know how; computer has bigger screen.
• Which machine would you use if you wanted to practice addition problems?	• Various answers.
• Which machine might you use if you wanted help on a difficult math problem?	• The computer, because the Professor won't solve problems for me.
• Which machine might you use while riding on a bus?	• The Professor, because it's easier to carry around.

Continue the discussion until students get the idea that each machine is useful in its own way. If someone hasn't already come up with the concept during discussion, introduce the concept of a general-purpose computer. A general-purpose computer can perform any task its program directs it to. The Little Professor is a special-purpose machine. It contains one kind of program that is intended to perform one particular kind of task.

4. Ask students to each think of one or more special-purpose machines and to write a description of what the machine is used for, what its functions are.

Possible solutions

Food blender This machine has the special purpose of chopping up food when a button is pushed on it. It can chop up food or mix liquids at several different speeds depending on which button is pushed.

Hand calculator (description may vary depending on the type of calculator) This machine has the special purpose of performing arithmetic operations — add, subtract, multiply, divide. It displays the answer to an arithmetic problem after you key in the numbers and operation desired on a keyboard.

Related activities

Have students cut out pictures of special-purpose machines and general-purpose computers from catalogs and put them on a bulletin board.

Have the class play "Twenty Questions": one student chooses a particular special-purpose machine and the other students try to guess what machine it is by asking questions about function, size, operation, etc.

SAMPLE ACTIVITY ☐ BULLETIN BOARD

Objectives

Students describe computer applications in school, local government or local business in terms of:

- — who uses the computer
- — what information (input) the person gives the computer
- — what information (output) the computer gives the person
- — how the person uses the information
- — locations of the people and machines
- — how the people and machines communicate
- — kinds of information stored in the data base

(Applications 2)

Prerequisites

Students should have had some previous discussion, field trips, or other exposure to computer applications in local government or business. They should be familiar with or be introduced to the terms "users," "information," "computer," "input," "output," and "communications."

Materials

- ☐ Large bulletin board
- ☐ Materials for drawing pictures
- ☐ Magazines, newspapers, scissors

Teacher

1. Introduce this activity by having students suggest neighborhood computer applications with which they are familiar. Write their suggestions on the board — e.g., "supermarket," "police station," "library," etc.
2. Divide the class into small groups. Have each group select a computer application to work on.
3. Explain that the bulletin board will be set up with columns like this:

Who uses?	Where?	Input	Computer — where?	Output

The student groups are to put pictures or drawings on the bulletin board for their computer application. You might give this assignment a

few days before putting the bulletin board together, so the students will have time to find actual samples of input or output, such as supermarket receipts with items listed, or a computerized library card.

Sample solution

For a computer application related to the police, students might show a picture of a policeman for the "Who uses?" category; a picture of a police car or CB radio for "Where?"; a license-plate number for "Input"; a picture or drawing of a police station for "Computer — where?"; name, address, driving violations record for "Output."

Related Activities

Have a person from the school district's computer center visit the class and describe a computer application such as payroll or student record-keeping. Have the person bring copies of input data and output documents for students to use on their bulletin board.

SAMPLE ACTIVITY ☐ "THE AWAKENING"

Objectives

Students discuss the behavior of computers in fiction and contrast fictional and real computers. (Applications 3)

Prerequisites

Students assumed to have had some experience interacting with computers

Materials

Story: "The Awakening," by Detta Ahl; in *Creative Computing*, 5, No. 11 (November 1979), 148 – 49.

Time for activity

One class period

Teacher

1. Have the students recall some of the computers they know about, by asking questions and writing their answers on the chalkboard. Examples of questions:
   - What do computers look like today?
   - Where do we find them?
   - Who uses the computers? Have you used one?
   - How can computers help us?
2. Read the story "The Awakening" to the class, mentioning that the author wrote this story when she was about their age. Then discuss the story, asking:

Possible questions	Possible answers
• Who is telling the story?	• A computer.
• How do people communicate with the computer?	• With a keyboard.
• How does the computer respond?	• Automatically. Without thinking. Doesn't study.
• How do you think the computer feels about how it works?	• O.K. It can't feel.
• What tells the computer the kind of work it should do?	• A program.
• What two pieces of equipment did the people add to the computer?	• A voice synthesizer. More memory.
• Tell what each means to the computer.	• The synthesizer lets me talk. I can remember more. I can talk more, and learn more.
• What happened after the computer got more memory and voice?	• Various answers.
• Compare how the big people and the little people treat the computer.	• The big people think something is wrong, and are always trying to fix it. The little people love it, take it for rides, play with it, etc.

3. Discuss whether the computer could really have been telling this story and thinking the way this computer was thinking.

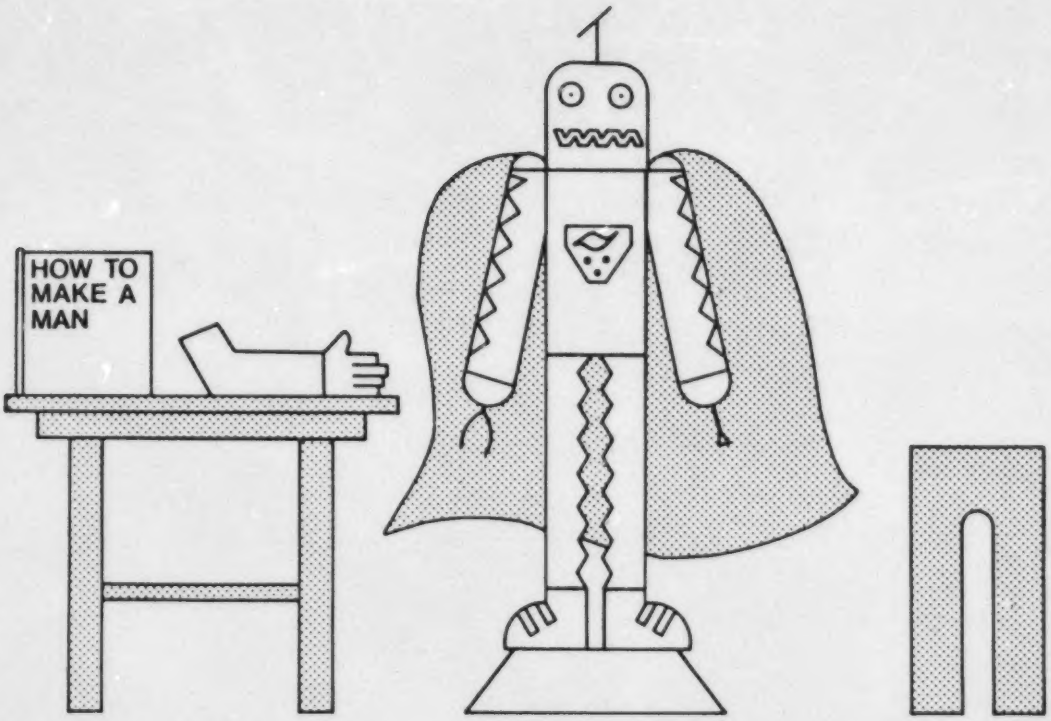
Discuss difference between fantasy and reality.

Ask students to discuss what a computer is.

Talk about other books, movies, etc. in which a machine has come to life. What do we call giving "life" to an object? *(Animation.)*

Discuss the animate vs. the inanimate.

4. Ask the students to write a story of their own in which an animate computer is a central character. Have them illustrate their story.
5. Combine the stories into a computer fiction book authored by the class.
6. Discuss the term "artificial intelligence." Why can't computers understand people when they speak? Ask the students to consider how the computer in this story could understand what the human beings said. Could this really happen?



How to make a man (Allen Lucia, Fifth Grade, Oakland Terrace)

SAMPLE ACTIVITY ☐ "THE FUN THEY HAD"

Objectives

Students discuss a story about a computerized school of the future (Applications 3)

Prerequisites

Students assumed to have had some experience interacting with computers

Materials

Story: "The Fun They Had," in *Joys and Journeys*, basal reading series, American Book Co., 1968, book 4, pp. 77 – 83. The story is also found in *Cinnamon Peaks*, Economy Co., 1975.

Teacher

1. Introduce the activity by having students discuss what school is like today. Have them compare it with what schools were like in the past. Ask, for example:

- What are our classes like?
- How do we do our work?
- What tools do we use?
- What do you think schools were like when your grandparents were children?
- What might schools be like when your grandchildren are young?

2. Tell the students they are going to read a fiction story about a school in the future. Go over the vocabulary of the story with the students, to make sure they know words such as:

diary	sector
telebook	slot
inspector	comical
regular	geography
crinkly	insert
mechanical	

3. Read the story to the class.
4. Lead a class discussion about the story, using questions such as the following:

Questions	Possible answers
• When does this story take place? • How many years is that from now? • This book was published in 1968 — how long ago is that? • Could this story really happen? • Are any parts of this story now true? • What do you think a "personal tape diary" is?	• 2155.
• What unusual object had Tommy found?	• A real book.
• Why was that unusual?	• They use telebooks.
• Compare telebooks to real books.	• The old book was crinkly and yellow. It didn't move, and was comical. It was a waste because it probably had been thrown away. The screen has many books stored; the words move on the screen, etc.
• What kind of trouble was Margie having with school?	• Trouble with the "mechanical teacher," which gave her too many geography tests.

Questions	Possible answers
• How did Margie "go to school" and do her homework?	• She worked at home with a mechanical teacher. She put homework and tests in a slot to be graded.
• How was the problem with the mechanical teacher fixed?	• The County Inspector came to her house and fixed the computer.
• What did Margie and Tommy find out about the old kind of school?	• It had a regular teacher, real books, school building; students played together, etc.
• How did they feel about a man teacher?	• Margie said a man isn't smart enough and she wouldn't want him in the house. Tommy said the man was smart enough and would not come to the house.
• How did Margie feel about school when her mother called her?	• She didn't want to work with a mechanical teacher, in the special room. She dreamed about the fun they had in the old school.
• How do you feel about this story? Which kind of school would you prefer? Explain the advantages and disadvantages of each kind.	

Related activities

1. Organize a debate on pros and cons of "old" and "new" style schools.
2. Have students make a chart comparing schools. For example:

Old	New
human teacher	mechanical teacher
real books	telebook
special building	computer in room at home
etc.	etc.

3. Have sudents draw pictures illustrating old and new schools.

Recommended reading

"The Awakening," by Detta Ahl; *Creative Computing*, 5, no. 11 (November 1979), 148 – 49.

Katie and the Computer, by Fred D'Ignazio; Creative Computing Press, 1980.

"One for the Univac," by Ethelyn M. Parkinson, in *Freedom's Ground*, level 14, pp. 240 – 50; Holt, Rinehart & Winston, 1977.

"The Computer Triumphs Again," by C. Philbrook, in *Keystone*, Book 5, pp. 414 – 25; Houghton Mifflin, 1976.

"The Fun They Had," in *Joys and Journeys*, pp. 77 – 83; American Book Co., 1968.

Tales of the Marvelous Machine, R. Taylor and Green, eds.; Creative Computing Press, 1980. (Reading level about grade 9 and above.)

"Computers — Giant Brains?", by Malcolm Weiss and Anita Soucie, in *Keystone*, Book 5; Houghton Mifflin, 1976.

STUDENT HANDOUTS AND TRANSPARENCY MASTERS FOR CHAPTER 5

The following pages are to be reproduced as overhead transparencies and/or student handouts, as suggested in the sample activities in this chapter. Table 5 – 2 lists the sample activities and corresponding masters.

Table 5 – 2 ☐ Transparency masters and student handouts, Chapter 5

Sample activity	Transparency master	Student handout
ZEEP007 and the Dishes	Optional flowchart	Story — ZEEP007 and the Dishes
Phase of the Moon		Phases of the Moon Cards
Developing a Procedure for Copying a Diagram	Copying a Diagram	
Pattern Blocks		Student Handout 1
Procedures — Equivalent Fractions		Student Handout 2
Giving Directions	Sample Map for Giving Directions	
Dragons' Den	Dragons' Den	Dragons' Den

Story ☐ ZEEP007 and the Dishes, by John Burley

ZEEP007 is a robot, a little machine who resembles R2D2 from *Star Wars*. He is my helper and friend. He goes places with me, helps me with my chores, and even helps Mom and Dad and my brother and sister. ZEEP007 is a friendly fellow and I find it easy to work with him.

ZEEP007 is very good at doing things, once he learns how to do them. He has a terrific memory. The hardest thing is to teach him new chores. He has to have very detailed instructions. Every little step must be explained very carefully. He does *exactly* what I tell him — no more, no less. If the procedure isn't right, things can go wrong.

One of my chores is washing dishes. ZEEP007 could surely help me with that! I would scrape the dishes and put them in the sink, and ZEEP could do the rest.

I gave ZEEP007 the following procedure:

Procedure: WASH-THE-DISHES

1. Put plug in sink.
2. Pour one capful of dish detergent in sink.
3. Fill sink with warm water.
4. Scrub dish with sponge.
5. If dish is clean, go to step 7.
6. If dish is not clean, go to step 4.
7. Put dish in drainer.
8. Repeat procedure for all dishes.

I gave the instructions to ZEEP, and I went to my room to do my homework. ZEEP does exactly as he is told. What do you think he did?

When I returned to the kitchen, he was still washing dishes! The bottle of detergent was empty. The dish drainer was completely filled with dishes. And ZEEP was taking more dishes from the cabinets! Was I upset?

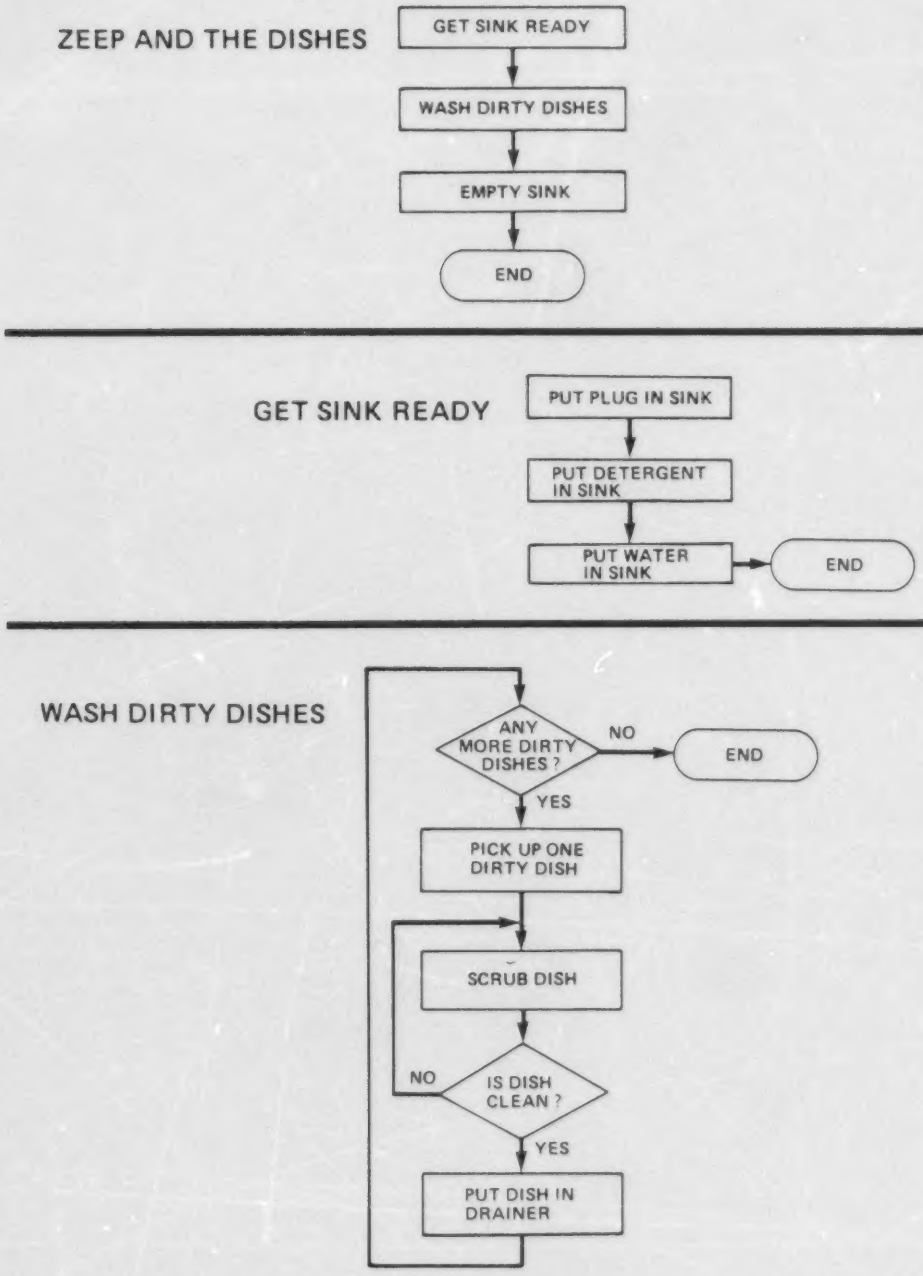
"ZEEP!", I shouted. "Why are you washing all the dishes in the house?"

"I am following the procedure you gave me," said ZEEP.

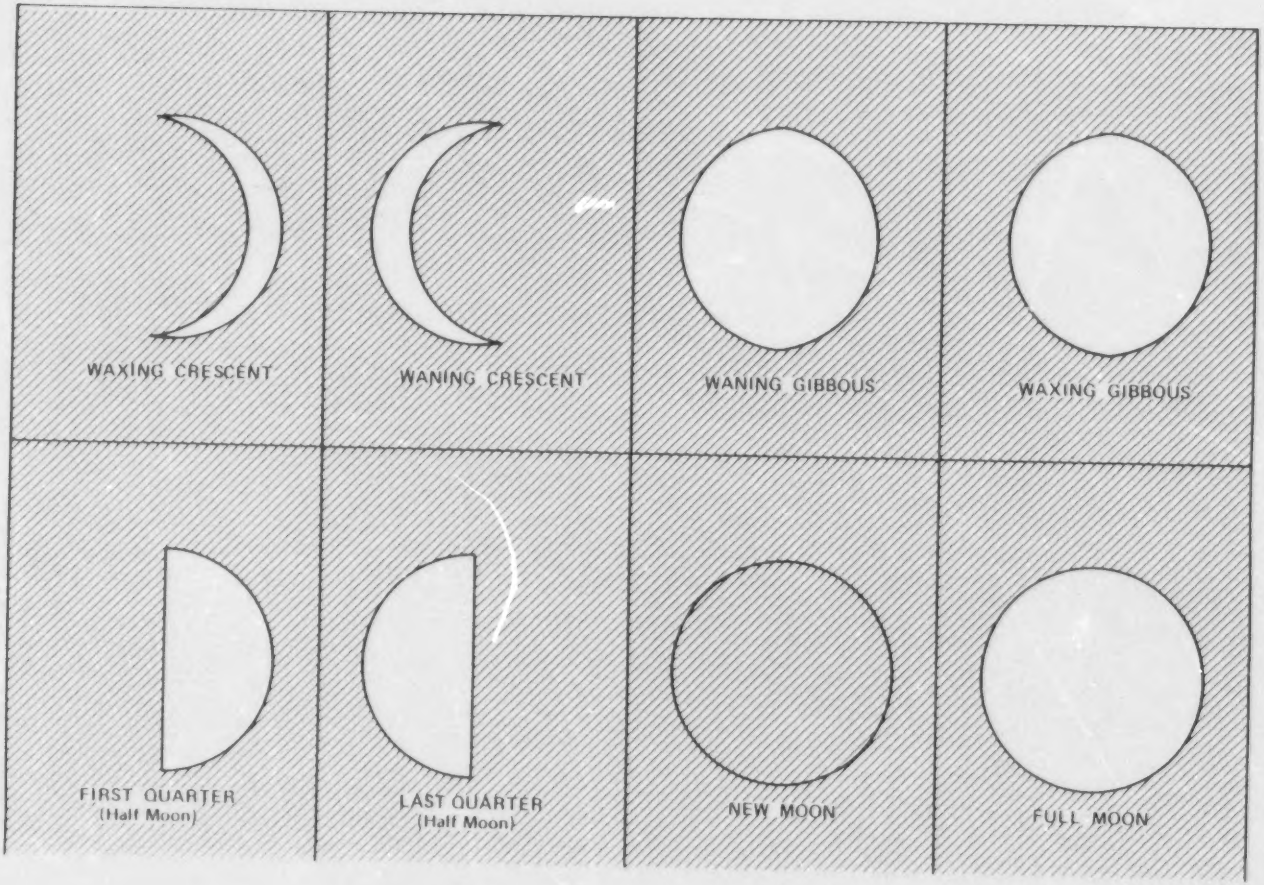
As usual, I had not been exact enough with my procedure. I had left out some important steps.

What was wrong with my procedure?

Please help me plan a better procedure to tell ZEEP how to wash the dirty dishes.

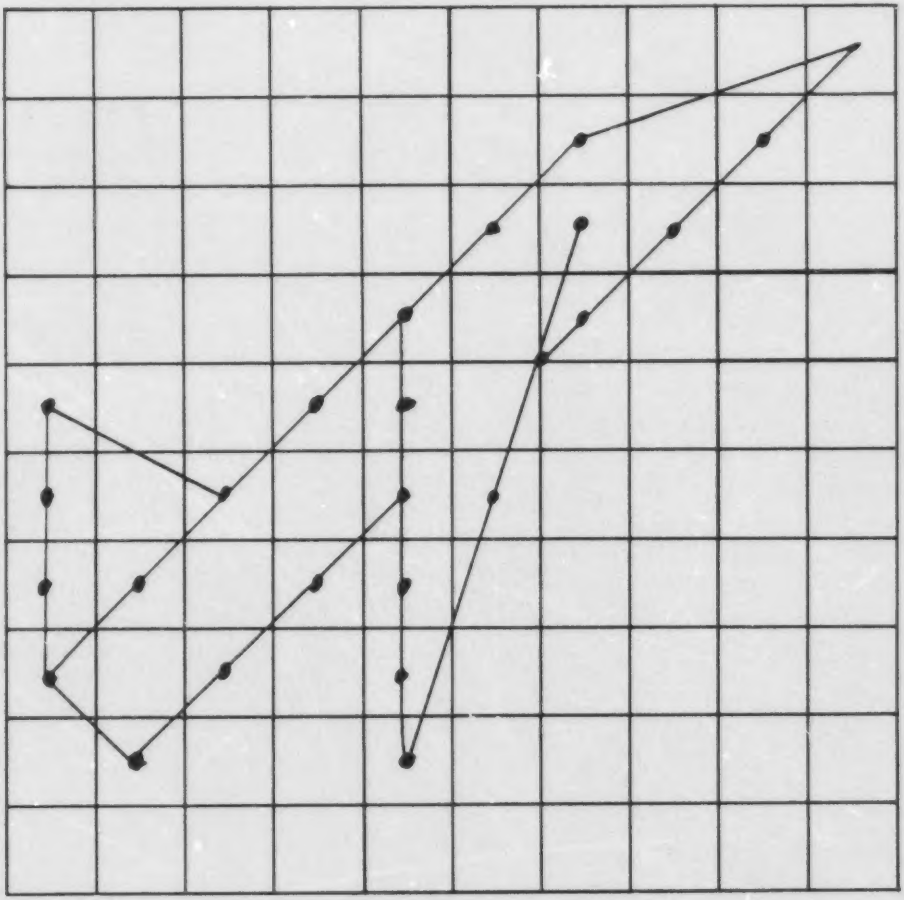


Optional flowchart for *ZEEP007 and the Dishes* (transparency master)



Phases of the Moon cards

Name _____ Grade _____

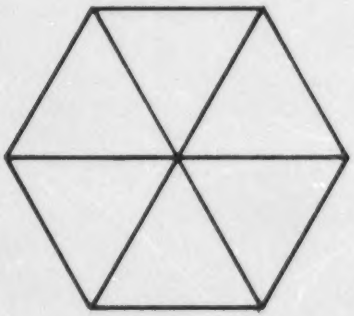


Copying a diagram (transparency master)

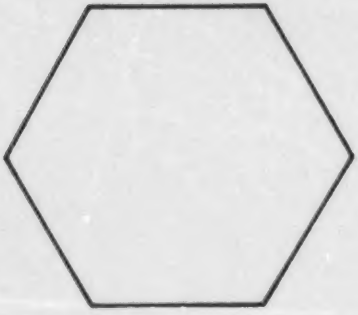
Student handout 1 ☐ **Pattern blocks procedures — equivalent fractions**

Name _____
Date _____

Sample

	You draw the parts	Write the fraction
1 WHOLE =		= 6/6

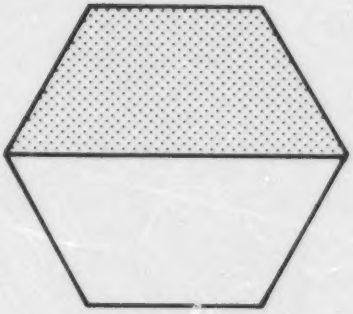
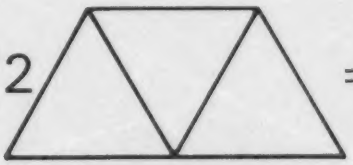
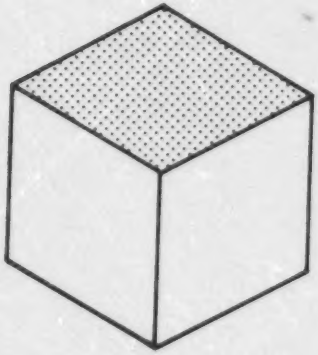
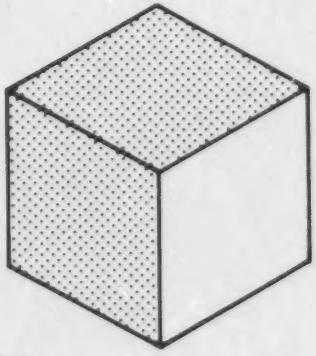
Draw the pattern blocks to help you show some *other* fractions.

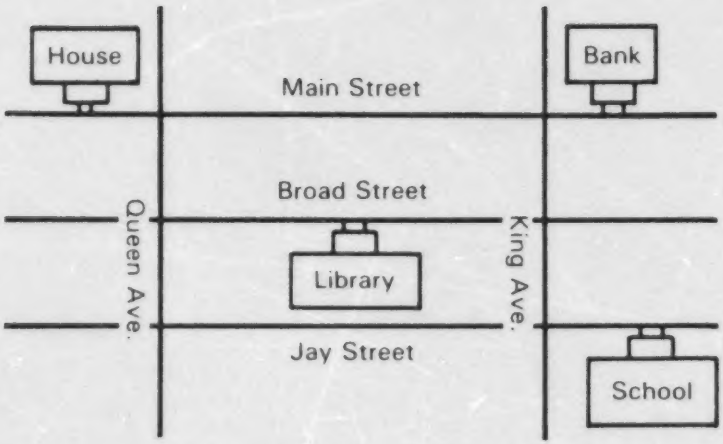
	Draw equal parts	Write the fraction
 =		=

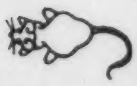
Student handout 2 ☐ Pattern blocks procedures — equivalent fractions

Name _____
Date _____

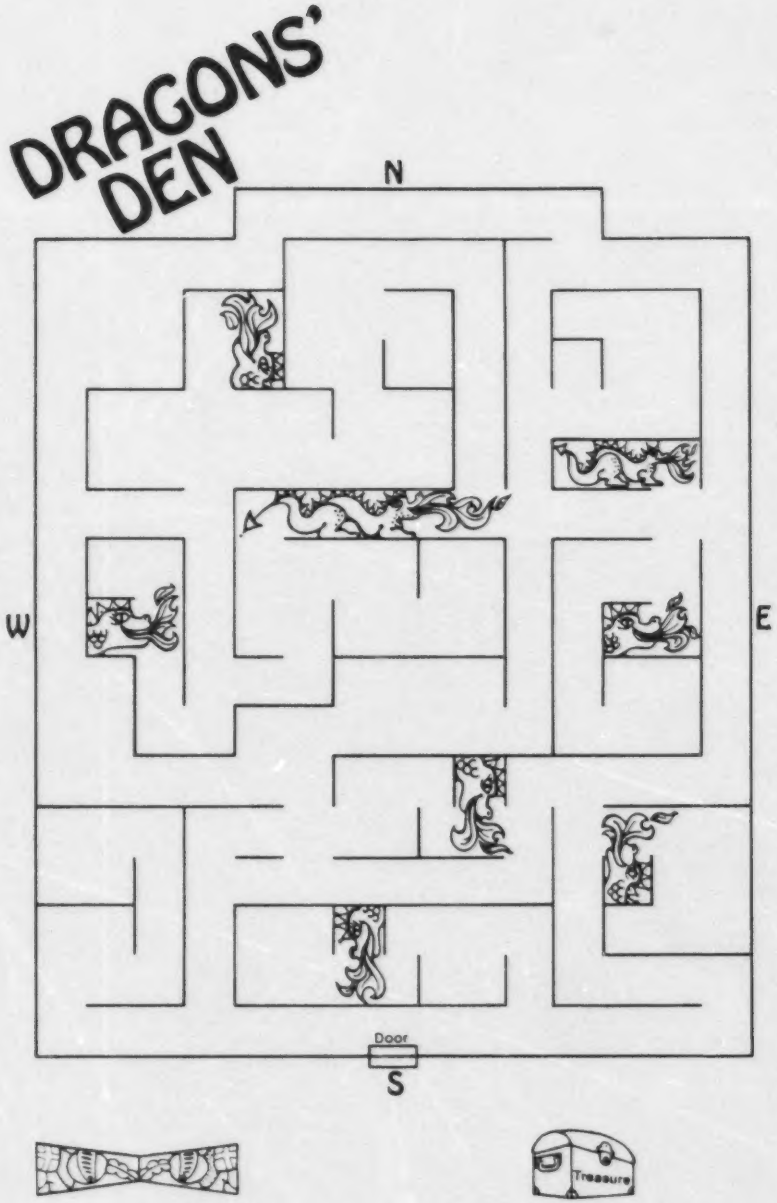
What other fractional names for these colored pieces can you find? *Draw* your solutions.

Fractions		Draw the parts		New fraction
	= 1/2		= 3/6	
	=		=	
	=		=	





Sample map for giving directions (transparency master)



Dragons' Den ☐ Student handout/transparency master

This chapter provides detailed lesson plans for sample activities. The activities provide students with opportunities to practice and apply skills and knowledge they have learned, and to learn and apply new skills and knowledge specified in the objectives for grades 5 and 6. Please read Chapter 3, "Overview of the Curriculum," for an explanation of the strands and objectives.

Figure 6 – 1 summarizes strands and objectives for grades K through 6. Table 6 – 1 provides a cross-reference between the sample activities and objectives for this chapter.

INTRODUCTION TO THE TEACHER

Fifth- and sixth-graders who have acquired basic skills in procedural thinking and using programs are now ready to apply these skills in useful ways. At this point we can begin in earnest the exciting task of applying useful computer tools to our work in math, science, social studies and language arts. At the same time, students will be gaining personal experience with computers and information that is so essential to understanding computer applications.

You will find that many of the sample activities in this chapter provide opportunities to introduce, apply, and integrate skills from several strands of the curriculum. For example, in the sample activity "Planets Data Base" students are developing procedures for organizing data; using computer programs; learning about information retrieval applications in the real world; and learning through experience why society needs rules for controlling access to computerized data bases.

Grades 5 – 6
objectives and activities



Strands	Objectives		
	Grades K – 2	Grades 3 – 4	Grades 5 – 6
Procedures	• Follow a procedure for a familiar task • Modify a procedure • Show different procedures can produce the same outcome • Find and correct errors in a procedure • Describe procedures used to perform a task	• Help to develop a procedure involving repetition, decision making, and variables • Find and correct errors in a procedure • Develop a procedure, demonstrate that it works • Use procedures to perform new tasks	• Apply procedures skills to new problems • Note differences between procedures for people and procedures for computers • Break problem into subproblems: plan procedures and subprocedures • Develop procedures for organizing data
Using Programs	• Use computer drills and games • Operate equipment; load and run programs • Recognize the computer needs instruction	• Read documentation that describes programs and tells how to use them • Select and operate programs without teacher's help • Select and use a program to solve a specific problem	• Use simulations as an aid in learning • Demonstate learning from a simulation • Retrieve information from a computer data base • Apply skills in using equipment, programs and documentation

Fundamentals	• Understand that computer instructions are contained in a program	• Understand that the computer is a general purpose machine	• Recognize tasks for which computer speed is needed • Recognize tasks requiring repetition • Recognize tasks requiring large amounts of data
Applications	• Discover computer applications in homes and neighborhoods	• Know about computer applications in school and local government • Compare fictional and real computers	• Understand 1 or more ways information retrieval is used in diverse fields • Understand how scientists might use computers
Impact	• Follow rules for using equipment and programs	• Follow rules for using equipment and programs	• Understand reasons to restrict access to data bases and programs • Understand advantages and disadvantages of particular uses of information retrieval

(Note: For grades K – 6, objectives and activities related to computer programming are reflected in the Procedures, Using Programs, and Fundamentals strands.)

Figure 6 – 1 ☐ Grades K – 6: strands and objectives

Table 6 – 1 ☐ Sample activities by strands*

Grades 5 & 6 — sample activity	1 Procedures	2 Using Programs	3 Fundamentals	4 Applications	5 Impact	6 Writing Computer Programs
ZEEP007 and the Paint	7,8,11		4			
Logo Lesson 6: Variables	7c,8c					2,4
Logo Lesson 7: Variables and Loops	7a,7b,7c 8a,8b,8c		4			2,4
Logo Lesson 8: Conditional Loops	7,8					2,4
Logo Lesson 9: Smaller than One	7,8					2,4
Procedures for Solving Math Problems	7,8,9					
Using Pattern Blocks for Adding and Subtracting Fractions	9					

SemCalc	Optional 13	7	3			
Bumble Plot	Optional 13	7				
Rocky's Boots		1,2,3,4,5				
Light Box		5,7	3,4	5		
Energy Survey	12	7		5		
Make Your Own Adventure Story		5				Optional 1
Quakes		8,9		5		
Geography Search		8,9				
Planets Data Base	12	10	5	4,5	1,3	
Data Bases and Privacy				4,5	2,3	

*Obective numbers are shown in the cells of the matrix.

About the Procedural Thinking Activities

The procedural thinking activities in this chapter enable students to apply procedures skills they have already learned to new problem areas. Use of repetition, decision making based on conditions, and variables are stressed. Students develop procedures to be used by people and by computers. They learn to break a problem into subproblems, and to plan a structured set of procedures and subprocedures for solving problems. They apply several basic procedural thinking skills to the task of organizing data in ways that are useful for analyzing and solving problems.

If your students have not previously been working on their procedural thinking skills, adapt sample activities from Chapters 4 and 5 to introduce these skills before using lesson plans in this chapter. In particular, the ZEEP007 series of activities is helpful in introducing procedural ideas.

About Using Programs

By the fifth grade, students have become fairly self-sufficient in using programs available in their computer resource center or school library. In addition to using programs available on disk or tape or time-sharing library, many students can enter a program such as those found in popular magazines or textbooks; store the program on disk or tape; and modify the program.

Sample lesson plans in this chapter provide a variety of examples of kinds of programs and software students can use: drills to help in gaining skill proficiency; a "Semantic Calculator" (SemCalc) that helps in solving math problems; a series of games to help learn and practice graphing on a coordinate grid ("Bumble Plot"); logic tools to help learn how logic gates work ("Rocky's Boots"); programs that graph the output of a laboratory instrument such as a light-measuring instrument ("Light Box"); programs to assist in analyzing and presenting data ("Energy Survey"); and programs to aid in creative writing ("Make an Adventure Story"). There are also sample lesson plans for using simulation programs and information-retrieval programs.

The kinds of computer programs that are used as examples in this chapter can be purchased or developed for any of the microcomputers commonly found in schools. If one of the sample activities here is for a machine different from yours, look for similar software for your machine.

If your students have not previously acquired the skills in Using Programs objectives 1 – 6, adapt sample activities from Chapter 5 to introduce these to your students.

Students need to become more proficient at using the keyboard. The more comfortably and easily they can use a keyboard, the more effectively they can use the computer for any application.

Try to find a good typing tutor program for the students to use. Although there are many typing tutors on the market, most are not designed specifically for children. You need to ensure that the students learn proper finger placement before they use the computer typing drills.

An example of a typing tutor that uses a game format is *MasterType*, published by Lightning Software. It requires a 48K Apple II with disk drive. *MasterType* includes an authoring option to allow the teacher or the students to create lessons using words of their own choosing.

About Using and Understanding Simulations

Computer simulations are important tools for studying complex phenomena in many fields. Any simulation represents an abstraction and simplification of the real world. In order to learn about simulations, it is most important to understand the model on which a simulation is built, and to critically evaluate that model. This can only be done if the simulation, and the assumptions upon which it is built, are well documented for the teacher and the students.

Simulations may be used in many different ways for many different purposes in the classroom. Lesson plans provided here illustrate some of these purposes. The simulations enhance, rather than substitute for, other learning activities. The sample simulations described in this chapter and in Chapter 7, and the ways in which they are used, include the following:

Use	Sample Activity	Subject
• Practice and test concepts learned in class.	Quakes	Science: Earthquakes
• Small-group decision making. Apply geography concepts to problem-solving situations.	Geography Search	Geography, Navigation
• Make scientific observations, collect data.	Scientists at Odell Lake (Chapter 7)	Science: Food chains
• Small-group decision making. Apply earth science concepts to problem solving.	Geology Search (Chapter 7)	Earth Science

About Data Bases and Information Retrieval

Every one of the strands of this curriculum has at least one objective related to data bases and information retrieval. Students develop *Procedures* for organizing data. They *Use Programs* to retrieve information from a computer data base. They recognize the *Fundamental* concept that computers are useful for tasks requiring large amounts of data. In learning about *Applications* of computers, they learn ways information retrieval is used in diverse fields. In learning about the *Impact* of computers in society, they begin to understand reasons for restricting access to data bases and to understand advantages and disadvantages of particular information retrieval systems.

The simplest and most direct way to introduce students to these interrelated skills and ideas is to have students *use* computerized data bases that are relevant to their studies. The sample activity "Planets Data Base" in this chapter, and the "States Data Base" series in Chapter 7 illustrate this approach. After students have had a chance to experience first hand the use of such data bases, they are in a better position to understand fundamental concepts, applications, and social issues.

Recommended Reading

"Computer Simulation Games, Exemplars," by Ronald Anderson, in *The Guide to Simulations/Games for Education and Training*, ed. R. E. Horn and A. Cleaves; Sage Publications 1980.

Computer Simulation and Its Instructional Uses, by Richard Dennis; College of Education, Department of Secondary Education, University of Illinois, 1979.

Stimulating Simulations, by C. W. Engle; Hayden Book Co., 1979.

Introduction to Computer Simulation: The System Dynamics Approach, by Nancy Roberts et al.; Addison-Wesley, 1982.

"Simulation: Is It Right for You?", by Charles Wilson; *Personal Computing*, 5 no. 2 (February 1981).

"Master Type: The Typing Instruction Game," review by Fred Bockman in *The Apple Journal of Courseware Review*, Issue 1, 1982.

SAMPLE ACTIVITY ☐ ZEEP007 AND THE PAINT

Objectives

Students develop procedures with subprocedures which involve repetition and decision making for the robot ZEEP. (Procedures 7, 8, 11)

Prerequisites

The students will have studied Procedures 1 through 6. Use ZEEP activities from Chapters 4 and 5 as preliminary activities if your students have not had prerequisite experience.

Materials

Copy of the story "ZEEP007 and the Paint" for each student

Time for activity

Preparation 10 minutes; teaching lesson 20 minutes; student work 20 to 30 minutes

Teacher

1. Review with students the idea of a procedure as a set of instuctions for performing a task.
2. Have the students read the story "ZEEP007 and the Paint."

Have the students try to write the answers to the questions in the story on their own before having a class discussion.

3. Have students discuss the following ideas from the story:

> ZEEP007 is a lot like a computer. It may be that you have trouble seeing how ZEEP can be so good at math and so stupid about other things.

Procedures Explain to the students that the numbered lists of instructions given to ZEEP are procedures, in the same way that a computer program is a procedure for a computer to follow. Each procedure specifies a separate and clearly defined task. Each procedure has a name, a goal, and a flow of control, just like a computer program.

Subprocedures Explain that when ZEEP doesn't understand an instruction, like "if can is empty," then we must prepare another set of instructions, more detailed than the first. "How to tell if can is empty" is a subprocedure of the procedure "to paint."

Loops Tell students that often in a procedure the same instruction needs to be performed several times. A loop is a set of instructions that is repeated a specified number of times.

Infinite loops Discuss with students that if ZEEP follows the first procedure that was given, he will keep on painting forever. When a procedure requires that an instruction be repeated over again many

times, we have to provide some other instruction that tells how to test whether the task is completed.

Error messages Tell students that when ZEEP says something like, "I don't know how to . . . ," he is giving us a message that says we have an error in our procedure. If students have seen error messages from the computer, point out the similarity between these two kinds of messages.

Possible solution

One solution is simply to reverse instructions 4 and 5. However, this does not take care of a situation in which ZEEP's paint can becomes empty before the wall is covered. A solution to handle this is the following:

Procedure: To paint

1. Get a can of paint.
2. Open paint can.
3. If wall is covered with paint, go to step 8
4. IF PAINT CAN IS EMPTY, go to step 1.
5. Dip the hairy end of the paint brush into the paint.
6. Rub the paint from the brush onto the part of the wall that has not yet been painted.
7. Go to step 3.
8. Close the lid on the paint can.
9. END

Subprocedure: If paint can is empty

1. Dip brush in can.
2. If paint gets on the brush, the answer is NO, otherwise the answer is YES.
3. END

Related activities

Let students take turns being ZEEP, while others develop procedures for classroom tasks. Have students plan and prepare a written list of instructions before giving any instruction to ZEEP.

Introduce the activity ZEEP007 Washing Dishes from Chapter 5, and use the solution showing a main procedure with subprocedures.

SAMPLE LOGO LESSONS

In Chapter 5 we introduced a series of lessons in which students apply their procedural thinking skills to writing procedures in the Logo language. Please see the introduction and sample Logo lesson plans in Chapter 5.

Story ☐ ZEEP007 and the Paint, by Dan Watt and John Burley

ZEEP007 is a robot, a little fellow who looks something like R2D2 from the movie *Star Wars*. ZEEP007 is my helper and friend. He goes places with me, helps me with my chores, and even helps my friends in school. ZEEP is a friendly machine, so I usually find it pretty easy to work with him.

ZEEP007 is pretty good at doing some things, once he learns how to do them. He is very good at math and has an excellent memory. The hardest thing is to get him to learn to do new tasks. He has to have very specific directions. Every little step has to be explained carefully, and I don't dare leave out any steps in the procedure I give him.

For example, my parents told me I could paint my room any color I wanted. I really was excited about decorating my room just the way I wanted it. But I was not interested in spending time painting. I decided to have ZEEP007 do the painting. Then I would hang posters and some finishing touches later.

I gave my helper a can of paint, a brush, and some instructions. The procedure I developed for ZEEP looked like this:

Procedure: Paint the room

1. Open the paint can.
2. Dip the hairy end of the brush into the paint.
3. Rub the paint from the brush onto the wall.
4. Go to step 2.
5. If the wall is covered with paint, go to step 6.
6. Close the paint can.
7. Clean the brush.
8. END.

"Now do it," I said to ZEEP.

ZEEP started as instructed. His paint strokes were not the most beautiful, but he seemed to be doing O.K. He followed steps 1, 2, and 3, and when he got to step 4 he read it, and went back to step 2.

"Looks good," I said as I watched him repeat the instructions over and over. "I have to go to school now, but I will see you when I get home."

I couldn't wait to get home and see my newly painted room. I ran home and went upstairs as fast as I could. There was ZEEP007, rubbing a dry brush on the wall, dipping it into an empty can, and then rubbing the brush on the wall again. The paint was ruined by the dry-brushing. *"Stop!"* I shouted. "Why didn't you stop when the wall was covered?"

ZEEP looked at me and replied, "I followed your directions. I did steps 1, 2, 3, and 4 in sequence, then returned to step 2 as directed."

Then it dawned on me. ZEEP never got to steps 5, 6, 7, and 8 because he was stuck in the loop set up in step 4. I would have to change my procedure. I decided to let this mess dry overnight and start all over again tomorrow.

Can you improve my procedure for me?

I also decided to give ZEEP some instructions to use in case the paint can got empty before the wall was finished. I inserted the following steps into the procedure:

If paint can is empty, get another can.
Go to step 1.

Where should these steps be inserted into the procedure? Why?

Then I realized that ZEEP might not know how to determine whether the can of paint is empty. I needed a subprocedure he could use. What steps might be included in the subprocedure called "Is the Can Empty?"

SAMPLE ACTIVITY ☐ LOGO LESSON 6 — VARIABLES

Objectives

Students develop and debug Logo procedures that include variables. (Procedures 7c, 8c; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 to 5, from Chapter 5

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Giving assignment to partners 10 minutes; partners on the computer 20 minues

Classroom management

Whole class and partners



Students debug their Logo procedure and admire their results (Travilah Elementary School, Montgomery County, MD)

Teacher

1. Write the following procedure on the chalkboard:

```
TO MYBOX :SIZE
FD :SIZE
RT 90
FD :SIZE
RT 90
FD :SIZE
RT 90
FD :SIZE
END
```

(*Note:* Space before colon is important.)
Ask students what they think the turtle will do if they tell it to:

```
MYBOX 20
```

What will turtle do if students tell it to:

```
MYBOX 50
```

The word SIZE in this procedure is used as a variable. SIZE will vary from time to time, depending on what number is specified when the turtle is told to execute the procedure. Demonstrate the use of MYBOX :SIZE on your computer.

2. Discuss the rules for using variables on the Logo system. Note that the variable name must be shown in both the procedure name and the command that uses the variable.
3. Work with the class to develop a procedure to draw a line of variable length. For example:

```
TO LINE :LENGTH
FD :LENGTH
END
```

4. Assign partners to develop and demonstrate a procedure that will draw a rectangle that is always 25 turtle steps wide but will have variable length. For example:

```
TO RECT :LENGTH
FD 25
RT 90
```

```
FD :LENGTH
RT 90
FD 25
RT 90
FD :LENGTH
END
```

SAMPLE ACTIVITY ☐ LOGO LESSON 7 — VARIABLES AND LOOPS

Objectives

Students work with Logo procedures involving repetition, variables, and loops. (Procedures 7a, 7b, 7c, 8a, 8b 8c; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 through 6

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Class discussion 30 minutes; partners on the computer 20 minutes

Classroom management

Whole class and partners

Teacher

1. Write the following procedure on the chalkboard:

```
TO BIGBOX :SIZE
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
FD :SIZE
RT 90
END
```

Ask students what they think the turtle will do if they tell it to:

```
BIGBOX 20
```

What will turtle do if I tell it to:

```
BIGBOX 50
```

The word SIZE in this procedure is used as a variable. When we say:

```
MAKE "SIZE :SIZE + 5
```

Logo adds 5 to whatever number is in SIZE. So SIZE gets bigger. Then when the turtle goes FD :SIZE, the turtle goes 5 further than it did the last time. (Demonstrate use of BIGBOX :SIZE on your computer.)

2. Discuss the rules for using variables on the Logo system. Note that the variable name must be shown in both the procedure name and the command that uses the variable.
3. Point out that if we wanted a large design we would like to tell turtle to just go on and on, adding 5 more to SIZE each time around the box. We can do this with a LABEL and a LOOP:

```
TO BIGGER :SIZE
LABEL "LOOP
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
GO "LOOP
END
```

Demonstrate BIGGER :SIZE to the class on your computer.

Show the class how to interrupt execution of this endless loop (CTRL G in Apple LOGO).

4. Have the students copy the BIGGER procedure onto a piece of paper.

Assign partners to experiment with BIGGER by trying things such as the following:

- Substitute RT 45 for the RT 90.
- Change the arithmetic in MAKE "SIZE :SIZE + 5. Try subtracting 1 instead of adding 5.

Related activities

If students seem to have difficulty following the logic of the procedure, have them "play turtle" and physically walk through the steps in the procedure.

Show students another way to repeat a procedure:

```
TO BIGGER :SIZE
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
BIGGER :SIZE
END
```

SAMPLE ACTIVITY ☐ LOGO LESSON 8 — CONDITIONAL LOOPS

Objectives

Students learn about conditional loops. (Procedures 7, 8; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 through 7

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Class discussion 30 minutes; partners on the computer 20 minutes

Classroom management

Whole class and partners

Teacher

1. Write the following procedure on the chalkboard:

```
TO BIGGER :SIZE
LABEL "LOOP
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
GO "LOOP
END
```

Invite students to demonstrate or describe results they got when they varied this procedure.

Point out the problem with this procedure; that is, that it loops endlessly and you have to interrupt it when you execute it.

Explain that there is a way in Logo to specify a condition under which the procedure will STOP:

```
TO BIGGER :SIZE
LABEL "LOOP
IF :SIZE > 90 [STOP]
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
GO "LOOP
END
```

Invite students to describe what will happen when they execute this new BIGGER procedure.

Demonstrate the procedure on your computer.

Change the IF command to read:

```
IF :SIZE > 200 [STOP]
```

Demonstrate the procedure on your computer.

2. Have the students copy the BIGGER procedure onto a piece of paper.

Assign partners to experiment with BIGGER by trying things such as the following:

- Substitute RT 45 for the RT 90.
- Change the arithmetic in MAKE "SIZE :SIZE + 5. Try subtracting 1 instead of adding 5. Make the procedure STOP when :SIZE equals 0.

Related activities

Have students use the following method for making the conditional loops:

```
TO BIGGER :SIZE
IF :SIZE > 90 [STOP]
FD :SIZE
RT 90
MAKE "SIZE :SIZE + 5
BIGGER :SIZE
END
```

SAMPLE ACTIVITY ☐ LOGO LESSON 9 — SMALLER THAN ONE

Objectives

Students develop and debug Logo procedures which involve decimal numbers smaller than one. (Procedures 7, 8; Writing Computer Programs 2, 4)

Prerequisites

Logo lessons 1 through 8

Materials

- ☐ Logo on the classroom computer(s)
- ☐ Logo manuals
- ☐ Chalkboard

Time for activity

Class discussion 30 minutes; partners on the computer 20 minutes

Classroom management

Whole class and partners

Teacher

1. Write the following procedure on the chalkboard:

```
TO BIG :SIZE
LABEL "LOOP
IF :SIZE > 90 [STOP]
FD :SIZE
RT 20
MAKE "SIZE :SIZE + 1
GO "LOOP
END
```

Demonstrate the procedure on your computer. Point out that the circle becomes very large very fast. A nicer spiral could be made if SIZE didn't become so large so fast.

Explain that a nicer spiral can be made if something less than one is added to SIZE each time the loop is executed. We can, for example, add point 5 to SIZE instead of 1.

Change the :SIZE + 1 to :SIZE + .5

Demonstrate the program.

Talk about the relationship between .5 and 1.

2. Have the students copy the BIG procedure onto a piece of paper.

Assign partners to experiment with BIG by

- changing RT 20 to other values
- using other numbers, less than 1, in the command MAKE "SIZE :SIZE + 1

Related activities

Write a procedure to print out all the one-digit numbers smaller than 1.

Have students use this method for their procedure:

```
TO BIG :SIZE
IF :SIZE > 90 [STOP]
FD :SIZE
RT 20
MAKE "SIZE :SIZE + 1
BIG :SIZE
END
```

SAMPLE ACTIVITY ☐ PROCEDURES FOR SOLVING MATH PROBLEMS

Objectives

Students write procedures to help them solve a challenging math problem. (Procedures 7, 8, 9; Writing Computer Programs 2, 4)

Prerequisites

- ☐ Students will have used Procedures 1 through 6
- ☐ Familiarity with metric measurements
- ☐ Ability to multiply and divide whole numbers, fractions, and decimals

Materials

No materials required

Time for activity

Two class periods of about 45 minutes each

Classroom management

Work with one group of up to ten students

Teacher

1. Review the process of writing procedures with students. Introduce the following problem during the review:

   If it takes 14 cm of steel wire to make a widget and the ABC Company needs 1384 widgets, how many meters of steel wire will the company need? (Steel wire is sold only in whole numbers of meters.)

2. Work with students until the group develops a general procedure for this type of problem.

Sample procedure: "Make Widgets"

1. Multiply the number of centimeters of wire needed to make one widget times the number of widgets needed.
2. Divide the total number of centimeters of wire needed from step 1 by the number of centimeters in one meter.
3. If the answer in step 2 is a whole number, stop.
4. If answer in step 2 is not a whole number, use the next larger whole number.

Students may need help understanding that the number must be rounded up.

3. Now introduce the problem that will be assigned. Stress that you do not want an answer but rather a procedure for solving this problem — a procedure that could be used by anyone to solve the problem.

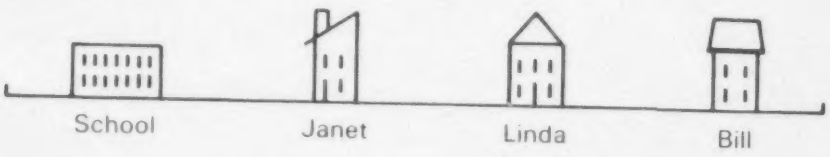
Problem

Janet, Bill, and Linda live on the same street as the school. Janet lives two-fifths as far from the school as Bill does. Bill lives four-fifths of a mile from the school. If Linda lives halfway between Janet and Bill, how far is Linda's house from school?

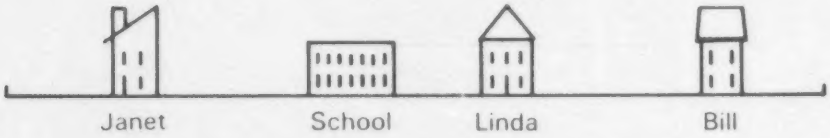
Explain to the students that this problem has two answers, each of which can be expressed in several ways — fractional or decimal miles and fractional or decimal feet.

Have the students discuss the meaning of the problem. The first step in understanding this problem should be to draw a diagram representing the problem. The most obvious picture will be where the students all live on the same side of the school.

Situation 1



Encourage the students to think of a different set of assumptions about the locations of the houses. If they do not come up with situation 2, suggest that Janet and Bill might live on opposite sides of the school.



Situation 2

When all your students appear to understand the problem and the two situations, assign the task of developing a procedure to solve the problem. Students should make their choice of which situation to assume. Remind them to name their procedures and to provide clear instructions in their procedures. Tell them that their procedures will be tested by having another person attempt to use their procedure to get a correct answer to the problem.

Give students a week to prepare their procedures, and ask them not to involve friends or families in the development of the procedures.

Collect students' procedures before the next class period to be spent on this activity. Black out their names from the papers and substitute coded numbers.

4. In the next class period pass out the procedures papers randomly and have each student follow the procedure he or she has been given. Ask the students to find errors in the procedures they have been given. Errors might include instructions that are not understandable, wrong sequence of instructions, steps omitted, unnecessary steps. Have the students describe to the class the procedure they tested, the types of errors found, and suggestions for improving the procedure.

Possible solutions

Situation 1

Procedure: "How Far from School?"

1. Draw a diagram of the problem.
2. Find the number of miles from school to Janet's house by multiplying 2/5 by 4/5 mile.

3. Find the distance between Janet's house and Bill's house by subtracting the answer in step 2 from 4/5 mile.
4. Divide the answer in step 3 by 2.
5. Add the answer from step 4 to the answer from step 2.
6. Label the answer in miles.

This solution can be varied in many ways. For example, step 5 might be, "Subtract the number in step 4 from the number of miles Bill lives from school." Also, students might work in decimals instead of fractions, or feet instead of miles.

Situation 2

Procedure: (give procedure a name)

---

1. Draw a diagram of the problem.
2. Find the number of miles Janet's house is from school by multiplying 2/5 by 4/5 mile.
3. Add the answer from step 2 to 4/5 mile.
4. Divide the answer in step 3 by 2.
5. Label the answer in miles.

Answers to the problem

Situation 2	*Situation 1*
6/15 mile	14/25 mile
.24 mile	.56 mile
1267.2 feet	2956.8 feet
1267 1/5 feet	2956 4/5 feet

This problem should raise lots of discussion. Ask students what would happen if the first sentence were omitted from the problem.

Can the students develop a procedure that would take care of both situations, by using conditional statements (if – then)?

Related activities

See activity "SemCalc" in this chapter (page 176). Students might try using SemCalc to help with this problem.

Use problem-solving activities from *Heath Mathematics Teachers Guide, 1981 Edition*, such as "Hearty Handshakes." This activity is useful for demonstrating a variety of different methods for solving the same problem, and the need for a systematic approach to solution.

See the book *Solving Problems Kids Care About*, by Randall J. Souviney. Have students develop step-by-step instructions for solving the problems.

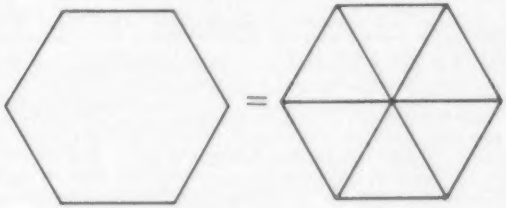
SAMPLE ACTIVITY ☐ USING PATTERN BLOCKS FOR ADDING AND SUBTRACTING FRACTIONS

Objectives

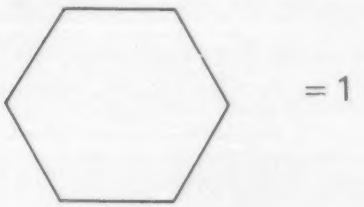
Students use procedures to manipulate pattern blocks as an aid to adding and subtracting fractions. (Procedures 9)

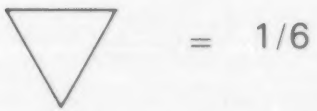
Prerequisites

Students should have had experience playing with pattern blocks. They need the idea of "equivalence" — i.e., two sets of blocks are equivalent when they cover each other exactly, as in the illustration below:



Students need to know how to name the fractional parts of one whole — i.e.:







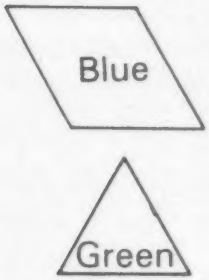


Materials

For each student, set of pattern blocks that includes only red, blue, yellow, and green blocks







Time for activity

One or more class periods

Classroom management

Whole class discussion and demonstrations; pairs of students practice using procedures to solve problems

Teacher

In this series of lessons, alternate between providing the procedures to the student to use and having the class invent the procedures.

Procedure 1

Count the number of blocks of each color it takes to cover one whole unit (yellow). For example:

Six green blocks make one whole (six-"sixths").

Procedure 2

Identify and name groups of blocks of one color. For example:

One green block makes one-sixth. Three green blocks makes three-sixths.

Procedure 3

Add two groups of blocks all of the same color, e.g.,

Two-sixths plus three-sixths equals five-sixths.



Procedure 4: Adding unlike fractions (sums less than 1)

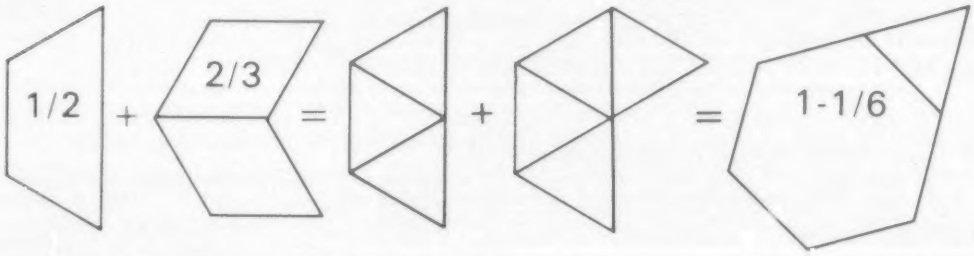
To find the sum of two unlike fractions (e.g., 1/2 plus 1/3). Then

☐ Begin with two unlike blocks (e.g., 1 red and 1 blue) that represent those fractions.

- ☐ Cover the combined blocks with blocks all of one color that will completely cover the first blocks (e.g., five green blocks).
- ☐ Is this the largest-size block, all of one color, that will completely cover the original blocks? If so, then this is the answer (e.g., five-sixths).
- ☐ If there is a larger-size block, all of one color, that will completely cover the original blocks, use the larger size (e.g., one red half-block could replace three green sixths-blocks).

Procedure 5: Adding unlike fractions (sums greater than 1)

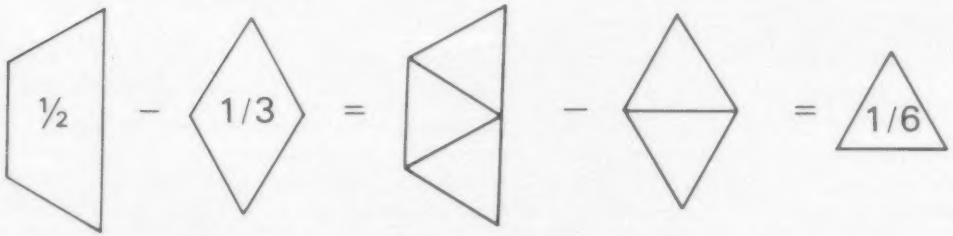
This is the same as Procedure 4, except full hexagons must be replaced with yellow:



Procedure 6: Subtracting unlike fractions

To find the result of subtracting two unlike fractions, begin with two unlike blocks that represent those fractions. Then

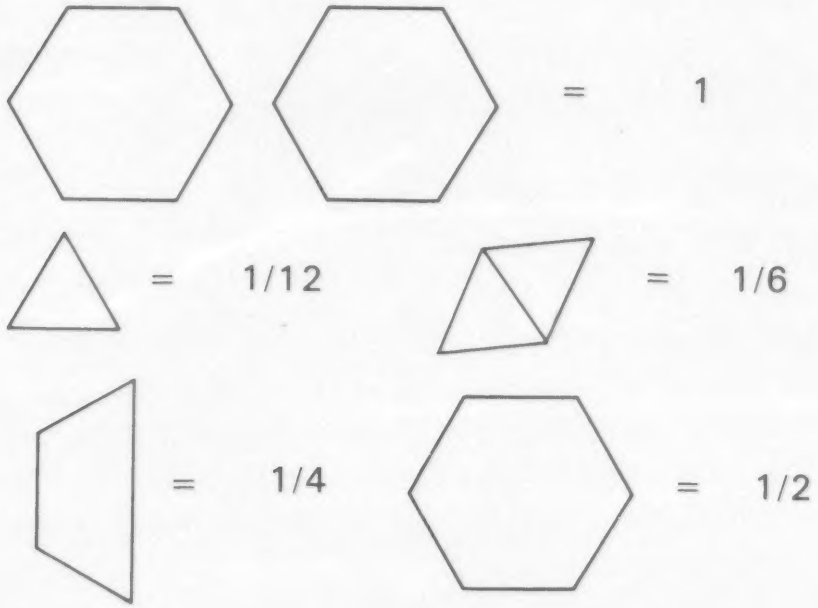
- ☐ Find a color of blocks that can replace the original blocks (e.g., replace with green triangles).
- ☐ Subtract from the first group of blocks the number of blocks in the second group.



- ☐ Can the remaining blocks be replaced by equivalent larger blocks? If yes, replace them.
- ☐ Name the remaining blocks as the fraction answer.

Related activities

After the students have thoroughly mastered the above activities, let something else equal one whole — e.g., two hexagons = one whole.



LANGUAGE ARTS PROCEDURES

Developing procedures for outlining a composition or doing library research is a very useful activity, both for language arts and for learning procedural thinking. The sample activity "Make Your Own Adventure Story" (p. 184) in the Using Programs section of this chapter provides a good opportunity to sharpen up procedures for outlining and organizing a composition.

The use of procedures to generate sentences and poetry has been suggested by some researchers. Children are encouraged to widen the scope of their English composition and expression activities by exploring and playing with language. One such activity involves making lists or cards with words of different parts of speech, and having a procedure for combining words in such a way as to produce poetry or sentences. Such activities may be carried out with or without a computer.

See the article "A Computer-Based Language Workshop," by Mike Sharples, in the *SigCue Bulletin*, 14, no. 3 (July 1980) for more details.

SAMPLE ACTIVITY ☐ SemCalc

Objectives

Students use a program to perform computations needed to solve math problems. (Procedures 13—optional; Using Programs 7)

Prerequisites

The students will have applied Using Programs objectives 1 through 4

Materials

- ☐ "SemCalc" (Semantic Calculator) program and associated documentation, by Education Development Center Cognitive Research Group
- ☐ Classroom computer (SemCalc runs on several different machines)
- ☐ Large monitors placed so that all students can read screen

Time for activity

Teacher preparation about 1 hour first time; class sessions 30 minutes first day, 15 minutes second day; individual student work on computer varies (this program may be used by students throughout school year)

Classroom management

Whole-class demonstration; individual or partners work on computer

Teacher

SemCalc is a tool that students can use to help them in solving math problems involving addition, subtraction, multiplication, and division. The problems can range in complexity from "How many eggs are there in five dozen?" to "What is the acceleration of a tropical storm that is observed at noon to be moving northward at 30 miles per hour and at 3 PM northward at 360 miles per hour?"

1. Before introducing the program to the class, read the documentation and try out a few sample problems yourself using SemCalc. Identify a collection of math problems from your textbook or from the SemCalc documentation.
2. Demonstrate the program to the class, using a few sample problems. Choose sample problems that help to illustrate the following points about using SemCalc:
   - Entering HOW MANY and WHAT
   - Deciding what units the answer should be in
   - Deciding what operations to perform
   - Deciding on the appropriate level of precision
   - Restarting the calculation when the operations or units are inappropriate

3. Assign a list of problems for students to work using SemCalc. Schedule students to work individually or in pairs on the computer.
4. After all students have had a chance to use the program, invite volunteers to demonstrate to the class how they used SemCalc to do their problems.
5. Invite students to comment on the usefulness and limitations of SemCalc as a tool for doing math problems. Can they do the problems more accurately using SemCalc than they can by using pencil and paper? By using a hand calculator? Can they do the problems more quickly? Which problems?
6. You might make three lists on the chalkboard, for paper and pencil, calculator, and SemCalc. Have students pick certain problems and tell which method is advantageous for that problem and why. They should take into account such considerations as the time it takes to do that problem using each tool; what kind of help they need (figuring out what method, or just doing the computations); how difficult or complex the problem is for them; how portable or accessible the tool is (we can find a pencil and piece of paper just about anywhere); what they learn about problem solving by using the method.

Related activities

See sample activity "Procedures for Solving Math Problems," on p. 169. Try using SemCalc to help solve that sample problem.

SAMPLE ACTIVITY ☐ BUMBLE PLOT

Objectives

Students use a program to plot points on an x,y coordinate grid from minus 10 to plus 10. (Procedures 13—optional; Using Programs 7)

Prerequisites

Students will have applied Using Programs objectives 1 through 4.

Materials

- ☐ "Bumble Art" program on the program disk *Bumble Plot* from The Learning Company
- ☐ Apple II plus computer with disk
- ☐ Large monitors placed so that all students can read screen.

Program description

The "Bumble Art" program allows students to create their own pictures or graphs by specifying x,y coordinates on a grid −10 to +10. The student names the picture, and then the program makes a game in which another student tries to re-create that named picture or graph.

Time for activity

Teacher preparation about 15 minutes first time; class sessions 15 minutes; individual student work on computer varies (this program may be used by students throughout the school year)

Classroom management

Whole-class demonstration; partners work on computer

Teacher

1. Use "Bumble Art" as an electronic chalkboard for a lecture/demonstration of plotting on a -10 to $+10$ coordinate grid. Have a student assistant work the keyboard for you as you pose problems for the class and invite them to plot points.
2. Pair up the students. Each student will design a graph or picture using up to 20 points on a graph. One student in a pair will first go to the computer and input his or her graph and name it. The partner will then come to the computer and try to re-create that picture with the help of the program. Then partners should swap places.
3. Give the students a collection of problems in which they are to graph data points on a grid. Have them work half the problems on graph paper and the other half on Bumble Art.

When all students have completed the problems, invite discussion on the usefulness of this program for working this kind of problem. Can they do the problems more quickly using paper and pencil or the program? Can they learn more by doing it either way? Under what conditions would they prefer to use paper and pencil (e.g., on the school bus)? What are the limitations of the program (e.g., with the program you can't change the size of the grid; you can't store your graph for later reference)?

Related activities

See sample activity "Copying a Diagram," p. 107 in Chapter 5.
See sample activity "Graphing," on p. 234 in Chapter 7.

SAMPLE ACTIVITY ☐ ROCKY'S BOOTS

Objectives

Students learn to use logic gates, sensors, oscillators, flipflops, clocks and delays, and build logic machines to perform specified functions. (Using Programs 1, 2, 3, 4, 5)

Prerequisites

Students need to be able to follow directions.

Materials

- ☐ "Rocky's Boots" program disk from The Learning Company
- ☐ Apple II plus computer with disk
- ☐ Large monitors placed so that all students can read screen

Program description

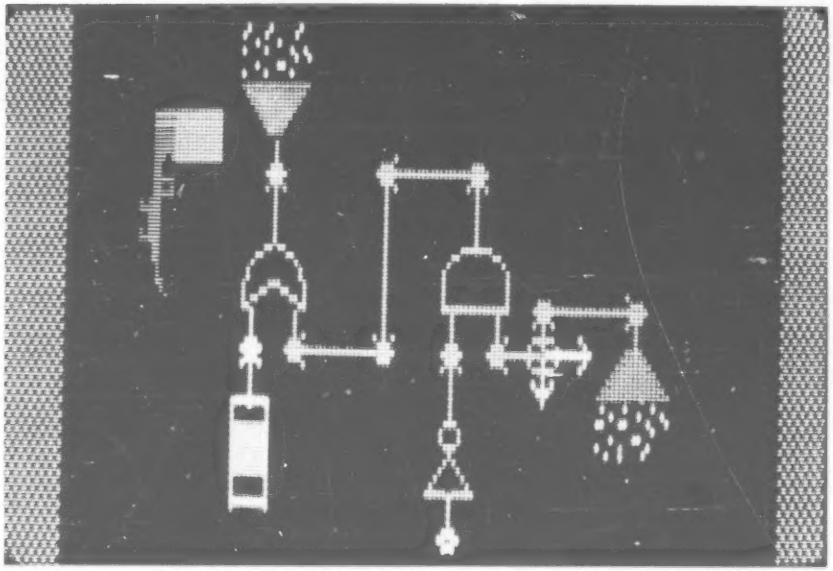
"Rocky's Boots" teaches students how logic gates work, by graphically showing the flow of orange electricity through the circuits. Students connect sensors, gates, wires, etc. into machines that will function in specified ways.

Time for activity

Teacher preparation about 2 hours first time; several class demonstrations about 15 minutes each; individual student work on computer varies (this program may be used by students throughout the school year)

Classroom management

Whole-class demonstration; partners work on computer



Rocky's Boots

Teacher

Spend some time working with the program yourself, and get a student assistant to learn to operate the various keyboard functions for moving the cursor, picking up objects, connecting wires, etc.

1. Use the program as an electronic chalkboard for a lecture/demonstration of gates and circuits. Have a student assistant operate the keyboard while you go over the material from the first three lessons with the class. Then have the class play "Rocky's Boots" as a group effort, with your assistant keying in the class suggestions on how to play.

Assign students to work as partners on the computer until they can successfully play "Rocky's Boots."

2. To play the more advanced games in "Rocky's Challenge," the students will need to learn about flipflops, clocks, and delays. Go over this material in demonstration mode in class. Help students who may have difficulties by discussing each point and experimenting with each device.

Assign partners to work on the flipflops section of the program. Then invite volunteers to demonstrate to the class the machines they built in the "practice rooms" of the flipflop program.

3. To test students on what they have learned, have them give you individual demonstrations of the most difficult games they are able to play in "Rocky's Challenge."
4. Invite volunteers to demonstrate and explain to the class their solutions to challenging problems in "Rocky's Challenge."

SAMPLE ACTIVITY ☐ LIGHT BOX

Objectives

Students use a program to measure the amount of light reflected by different objects and surfaces. (Using Programs 5, 7; Applications 5)

Prerequisites

Students should have been introduced to the following concepts: Light is a form of energy; light travels in a straight line; light can be reflected.

Materials

- ☐ *Light Box Lab*, published by McDonald & Entwhistle. Lab includes program on diskette, documentation, light box, and computer interface.
- ☐ Apple II with disk drive
- ☐ Shade cards (black, gray, white)
- ☐ Small mirror
- ☐ Color cards of any kind

Time for activity

Teacher preparation about 30 minutes first time; 10 minutes thereafter. Two 30-minute class sessions; 20 minutes per student on the computer.

Classroom management

Whole-class instruction; individual work on computer

Teacher

This program and equipment enables the computer to measure the amount of light being reflected by an object, and to graph the amount on the computer's screen. The program is a tool that will help students explore the concept of reflected light and make observations of measured amounts of reflected light from different objects.

1. Read the documentation, connect the equipment to your computer, and try out the program.
2. Review the prerequisite ideas with the students. Introduce the use of the equipment and demonstrate the lesson. Give the assignment (from the documentation) and schedule individual student work on the computer.
3. After all students have used the lab equipment and gathered data on their own experiments, review the results of the prepared experiment. Process on the computer the data that students gathered in their own experiments.
4. Discuss with students the idea that the kind of equipment they are using is an example of the kind of equipment scientists use in the laboratory. Ask:
   - What is the role of the computer in the work we have been doing? *(It takes as input the light reflected from an object.)*
   - What does the computer program do with that input? *(It converts it to a graph that we can read on the screen.)*
   - What does the scientist (you) do with that information? *(Study the differences in amount of light reflected from different objects.)*

Explain that this kind of a computer application is sometimes called "laboratory automation" because we are using the computer to "automate" the process of measuring the light reflected and putting the data into a readable form.

5. Demonstrate or discuss the procedure that the students would (or do) follow if they are studying the light reflected from objects without a computer. What are the advantages of using a computer for this purpose? What are the disadvantages?

Related activities

This activity supplements *Concepts in Science Level 4 (Orange)*, "The Bounce of Light," and the ESS unit on light.

"Temperature Grapher" is a program put out by the National Science Teachers Ass'n. (NSTA) that uses a thermistor probe plugged into the game-paddle input on an Apple computer. Students can use one or more thermistors to graphically record the temperature in a variety of laboratory experiments. Temperature changes of different materials can be recorded simultaneously by using two thermistors.

"Light Energy Probe" is another NSTA program similar to "Light Box"; it reads input through the game paddle interface from light probes. Power output or energy output can be graphically displayed.

Recommended reading

For more information on the electronics of using game-paddle ports for making laboratory measurements, see articles by Robert Tinker in *Hands On!*, the newsletter published by Technical Education Research Centers, TERC, Winter 1981 – 82.

SAMPLE ACTIVITY ☐ ENERGY SURVEY

Objectives

Students use a program to display and analyze the results of an energy conservation survey. (Procedures 12; Using Programs 7; Applications 5)

Prerequisites

Students should have been introduced to energy and energy-conservation issues.

Materials

- ☐ *Energy Survey*, National Science Teachers Association; teacher manual and program on diskette
- ☐ Apple II computer
- ☐ Large monitors placed so all students can read screen

Program description

This NSTA program aids students in graphing the data they collect in a survey on energy conservation.

Time for activity

Teacher preparation about 1 hour first time; 15 minutes thereafter. Class sessions 30 minutes first day, 15 minutes second day. Ten minutes per student on the computer. Follow-up 20 minutes class discussion.

Classroom management

Whole-class instruction; individual work on computer



Sixth grade science student learns to interpret a bar graph of her energy survey data (Redland Middle School, Montgomery County, MD)

Teacher

1. Read the documentation, and try out the program.
2. Introduce the activity by asking students to make up a question they might ask people about energy conservation. Ask each student to read his or her question aloud. Ask students to write a five-question survey. For homework, have the students survey ten persons (friends, neighbors, relatives) by phone. Help the students formulate a readable response data sheet.
3. After the students have collected their survey data, demonstrate on the computer how to build a graph and then read the graph of their data. Go over the computer explanation (on the screen) of how to figure percentages.

Ask the students to figure the percentages for each of their responses and place the percentages for each response on a separate sheet of paper (for example: Question 1: yes 60%, no 40%).

Tell students the procedure they will follow in using the computer program individually:

- Build the graph, using survey response sheet
- Place the response sheet face-down
- When computer asks students to read the graph, they will input answer on keyboard on the basis of reading the graph
- If answer is incorrect, computer will give the correct procedure for figuring the percentage; students compare their answer to the correct answer

4. After all the students have worked on the computer, discuss this use of the computer as an aid in displaying data and as an aid in teaching us how to do something (i.e., figure percentages). Discuss the use by scientists of computer as an aid in analyzing data and displaying results in readable form (e.g., the bar charts the students have been building).

Related activities

Several other programs in the NSTA series include "Cost of Electricity" and "Where Has All the Coal Gone?" In "Cost of Electricity," students read electric meters, calculate use of electricity, electric bills, and cost of operating household appliances, with the aid of computer programs.

In the coal series, students enter and run five programs in which they examine the depletion of the U.S. coal reserves at various use rates. Student learn basic programming skills, including arithmetic operations, if – then statements, chart display, and other programming.

SAMPLE ACTIVITY ☐ MAKE YOUR OWN ADVENTURE STORY

Objectives

Students write story episodes and enter stories on the computer. (Using Programs 5; Writing Computer Programs 1 — optional)

Prerequisites

Students will have applied Using Programs objectives 1, 2, and 4. If they are to enter their stories into the shell program themselves, they need to be able to use the cursor controls and the BASIC editor, and be able to save their program on tape or disk.

Materials

- ☐ An adventure story from the *Choose Your Own Adventure* series by Bantam Books
- ☐ A shell program for writing an adventure story (figure 6 – 2)
- ☐ Copies for each student of the shell program listing (see figure 6 – 2)
- ☐ Chart for Tracking Episodes (see figure 6 – 3)

- ☐ Microcomputer with tape or disk (the example shell program is for a 16K PET)
- ☐ One or more backup copies of the shell program on tape or disk

Time for activity

Teacher preparation about 2 to 3 hours first time; 15 minutes thereafter. This activity will take place over a period of one or two weeks.

Preparation

- ☐ Enter the shell program on your computer. If there is a programming class in your school you might have the students in that class prepare the program for you.
- ☐ Become familiar with the program and test it by entering a story setting and a few selections and episodes into your shell.
- ☐ Make backup copies of your shell and your sample story.

Classroom management

Whole class, small group, and individual work

Teacher

1. Read a *Choose Your Own Adventure* story aloud to the students. Discuss the choices given at the end of each episode and have students decide which path to follow. Continue reading, through a concluding episode.

Discuss how these stories differ from most stories with which the students are familiar.

Demonstrate your sample adventure story on the computer. Have students in small groups try out the sample story you have prepared.

Tell students they will be writing a *Choose Your Own Adventure* together as a class, and that they can put their story on the computer.

2. Discuss possible situations that might lead to a good adventure story. Have the class decide on an opening situation for a story. Have students work in pairs or in small groups, writing an opening situation to the point where the character has to make an important decision.

Have students read their opening situations aloud to the class. The class will choose one of these to enter into the computer.

3. Hand out to the students copies of the first page of the shell program listing. Have the students identify on the listing where they think the text for the opening situation will be entered into the

```
READY.

 10 REM CHOOSE YOUR OWN ADVENTURE, A SHELL PROGRAM
 20 REM FOR 16K PET. 15 EPISODES.
 30 PRINT" "
 40 :
 50 REM INSERT TITLE OF YOUR ADVENTURE
 60 :
 70 PRINT"THE GRAPEFRUIT DIAMOND
 80 FOR J=1 TO 2000:NEXT J
 90 :
100 PRINT" "
110 :
120 REM INSERT NAME OF AUTHOR OR CLASS
130 :
140 PRINT"GRADE 6 PINEY BRANCH MIDDLE SCHOOL
145 REM TIME DELAY
150 FOR J=1 TO 2000:NEXT J
160 :
170 PRINT" "
180 :
190 REM INSERT TEXT #1--SETTING
200 :
250 PRINT"YOU ARE ONE OF THE MOST CLEVER THIEVES"
260 PRINT"IN THE WORLD.YOU WILL ATTEMPT TO STEAL"
270 PRINT"THE MARQUIS CUT GRAPEFRUIT DIAMOND
280 PRINT"LOCATED IN THE NATIONAL GALLERY OF GEMS.
290 PRINT"YOU ARE READY TO ATTEMPT THIS THEFT BY
300 PRINT"YOURSELF BUT YOU MIGHT HAVE A BETTER
310 PRINT"CHANCE IF YOU GOT A FEW HELPERS TO COME
320 PRINT"ALONG.  BY THE WAY,THE DIAMOND WAS
330 PRINT"NAMED THE WAY IT WAS BECAUSE THE MAN
340 PRINT"WHO  FOUND IT  WAS EATING A GRAPEFRUIT
350 PRINT"WHEN HE DISCOVERED THE DIAMOND HIDDEN
360 PRINT"INSIDE OF IT.
370 :
380 REM INSERT TEXT FOR CHOICE #1
390 :
400 PRINT"IF YOU GO FOR HELPERS, PRESS 1"
410 PRINT"
420 :
430 REM INSERT TEXT FOR CHOICE #2
440 :
450 PRINT"IF YOU ATTEMPT THE HEIST YOURSELF
460 PRINT"PRESS 2
470 :
550 INPUT A
560 IF A=1 GOTO 600
570 IF A=2 GOTO 900
580 GO TO 400
600 PRINT "3"
610 :
620 REM INSERT TEXT #2--SELECTION #1;   CHOICE1
630 :
640 PRINT"YOU PROWL THROUGH ALLEYS LOOKING FOR"
650 PRINT"SOMEONE TO HELP WITH THE HEIST. AND
```

Figure 6 –2 ☐ Shell program for "Write Your Own Adventure Story"*

*Shaded lines show sample student text.

```
660 PRINT"SUDDENLY YOU FEEL SOMETHING POKE YOUR
670 PRINT"BACK. A VOICE SAYS 'HANDS UP AND FACE"
680 PRINT"THE WALL.' YOU MIGHT TURN AND TACKLE"
690 PRINT"THE MUGGER. BUT WHY RISK YOUR LIFE?"
700 :
710 REM INSERT TEXT FOR CHOICE #1
720 :
730 PRINT"IF YOU FOLLOW THE INSTRUCTIONS PRESS 1
740 PRINT"                                      "
750 :
760 REM INSERT TEXT FOR CHOICE #2
770 :
780 PRINT"IF YOU TURN AROUND AND YOU DIVE AT THE "
790 PRINT"MUGGER, PRESS 2
800 :
850 INPUT A
860 IF A=1 GOTO 1200
870 IF A=2 GOTO 1500
875 PRINT "PLEASE PRESS 1 OR 2 AND THEN RETURN
880 GOTO 850
890 :
900 PRINT" "
910 :
920 REM INSERT TEXT #3--SELECTION #1;    CHOICE 2
930 :
940 PRINT"YOU GO BEHIND THE MUSEUM AND FIND A"
950 PRINT"SMALL LOCKED DOOR. HOWEVER YOU HAVE"
960 PRINT"BROUGHT A LONG LADDER WHICH MIGHT REACH"
970 PRINT"AN OPEN WINDOW. BUT YOU ALSO HAVE SOME"
980 PRINT"SKILL IN PICKING LOCKS. IT IS UP TO YOU."
990 PRINT"                                      "
1000 :
1010 REM INSERT TEXT FOR CHOICE #1
1020 :
1030 PRINT"IF YOU PUT THE LADDER UP TO THE"
1040 PRINT"WINDOW AND CLIMB IT PRESS 1"
1050 :
1060 REM INSERT TEXT FOR CHOICE #2
1070 :
1080 PRINT"IF YOU TRY TO PICK THE LOCK ON"
1090 PRINT"THE SMALL DOOR PRESS 2"
1100 :
1150 INPUT A
1160 IF A=1 GOTO 1800
1170 IF A=2 GOTO 2100
1180 GOTO 1150
1190 :
1200 PRINT" "
1210 PRINT"
1220 REM INSERT TEXT #4--SELECTION #2;     CHOICE 1:1
1230 :
1240 PRINT"
1250 PRINT"
1260 PRINT"
1270 PRINT"
1280 PRINT"
1290 PRINT"
1300 :
```

200

```
1310 REM INSERT TEXT FOR CHOICE #1
1320 :
1330 PRINT"
1340 PRINT"
1350 :
1360 REM INSERT TEXT FOR CHOICE #2
1370 :
1380 PRINT"
1390 PRINT"
1400 :
1450 INPUT A
1460 IF A=1 GOTO 2400
1470 IF A=2 GOTO 2700
1480 GOTO 1450
1490 :
1500 PRINT" "
1510 :
1520 REM INSERT TEXT #5--SELECTION #2;  CHOICE 1:2
1530 :
1540 PRINT"
1550 PRINT"
1560 PRINT"
1570 PRINT"
1580 PRINT"
1590 PRINT"
1600 :
1610 REM INSERT TEXT FOR CHOICE #1
1620 :
1630 PRINT"
1640 PRINT"
1650 :
1660 REM INSERT TEXT FOR CHOICE #2
1670 :
1680 PRINT"
1690 PRINT"
1700 :
1750 INPUT A
1760 IF A=1 GOTO 3000
1770 IF A=2 GOTO 3300
1780 GOTO 1750
1790 :
1800 PRINT" "
1810 :
1820 REM INSERT TEXT #6--SELECTION #2;  CHOICE 2:1
1830 :
1840 PRINT"
1850 PRINT"
1860 PRINT"
1870 PRINT"
1880 PRINT"
1890 PRINT"
1900 :
1910 REM INSERT TEXT FOR CHOICE #1
1920 :
1930 PRINT"
1940 PRINT"
1950 :
1960 REM INSERT TEXT FOR CHOICE #2
```

```
1970 :
1980 PRINT"
1990 PRINT"
2000 :
2050 INPUT A
2060 IF A=1 GOTO 3600
2070 IF A=2 GOTO 3900
2080 GOTO 2060
2090 :
2100 PRINT" "
2110 :
2120 REM INSERT TEXT #7--SECTION #2;    CHOICE2:2
2130 :
2140 PRINT"
2160 PRINT"
2170 PRINT"
2180 PRINT"
2190 PRINT"
2200 :
2210 REM INSERT TEXT FOR CHOICE #1
2220 :
2230 PRINT"
2240 PRINT"
2250 :
2260 REM INSERT TEXT FOR CHOICE #2
2270 :
2280 PRINT"
2290 PRINT"
2300 :
2350 INPUT A
2360 IF A=1 GOTO 4200
2370 IF A=2 GOTO 4500
2380 GOTO 2350
2390 :
2400 PRINT" "
2410 :
2420 REM INSERT TEXT #8--SELECTION #3;  CHOICE 1:1:1
2430 :
2440 PRINT"
2450 PRINT"
2460 PRINT"
2470 PRINT"
2480 PRINT"
2490 PRINT"
2500 :
2510 REM INSERT TEXT FOR CHOICE #1
2520 :
2530 PRINT"
2540 PRINT"
2550 :
2560 REM INSERT TEXT FOR CHOICE #2
2570 :
2580 PRINT"
2590 PRINT"
2600 :
2650 INPUTA
2660 IF A=1 GOTO 4800
2670 IF A=2 GOTO 5100
```

202

```
2680 GOTO2650
2690 :
2700 PRINT" "
2710 :
2720 REM INSERT TEXT #9--SELECTION #3;  CHOICE 1:1:2
2730 :
2740 PRINT"
2750 PRINT"
2760 PRINT"
2770 PRINT"
2790 PRINT"
2800 PRINT"
2810 PRINT"
2820 PRINT"
2830 PRINT"
2840 PRINT"
2850 PRINT"
2860 :
2940 :
2950 GOSUB 9800
2960 :
3000 PRINT"3"
3010 :
3020 REM INSERT TEXT #10--SELECTION #3;   CHOICE 1:2:1--ENDING #3
3030 :
3040 PRINT"
3050 PRINT"
3060 PRINT"
3070 PRINT"
3080 PRINT"
3090 PRINT"
3100 PRINT"
3110 PRINT"
3120 PRINT"
3130 PRINT"
3140 PRINT"
3150 PRINT"
3160 :
3300 PRINT"3"
3310 :
3320 REM INSERT TEXT #11--SELECTION #3;  CHOICE 1:2:2--ENDING #4
3330 :
3340 PRINT"
3350 PRINT"
3360 PRINT"
3370 PRINT"
3380 PRINT"
3390 PRINT"
3400 PRINT"
3410 PRINT"
3420 PRINT"
3430 PRINT"
3440 PRINT:PRINT
3450 PRINT"
3460 :
3540 :
3550 GOSUB 9800
3560 :
```

```
3600 PRINT"3"
3610 :
3620 REM INSERT TEXT #12--SELECTION #3;  CHOICE 2:1:1--ENDING #5
3630 :
3640 PRINT"
3650 PRINT"
3660 PRINT"
3670 PRINT"
3680 PRINT"
3690 PRINT"
3700 PRINT"
3720 PRINT"
3730 PRINT"
3740 PRINT"
3750 PRINT"
3760 :
3840 :
3850 GOSUB 9800
3860 :
3900 PRINT"3"
3910 :
3920 REM INSERT TEXT #13--SELECTION #3;  CHOICE 2:1:2--ENDING #6
3930 :
3940 PRINT"
3950 PRINT"
3960 PRINT"
3970 PRINT"
3980 PRINT"
3990 PRINT"
4000 PRINT"
4010 PRINT"
4020 PRINT"
4030 PRINT"
4040 PRINT"
4050 PRINT"
4060 :
4070 :
4080 GOSUB 9800
4200 PRINT"3"
4210 :
4220 REM INSERT TEXT #14--SELECTION #3;  CHOICE 2:2:1--ENDING #7
4230 :
4240 PRINT"
4250 PRINT"
4260 PRINT"
4270 PRINT"
4280 PRINT"
4290 PRINT"
4300 PRINT"
4310 PRINT"
4320 PRINT"
4330 PRINT"
4340 PRINT"
4350 PRINT"
4360 :
4440 :
4450 GOSUB 9800
```

```
 4500 PRINT"3"
 4510 :
 4520 REM INSERT TEXT #15--SELECTION #3;  CHOICE 2:2:2--ENDING #
 4530 :
 4540 PRINT"
 4550 PRINT"
 4560 PRINT"
 4570 PRINT"
 4590 PRINT"
 4600 PRINT"
 4610 PRINT"
 4620 PRINT"
 4630 PRINT"
 4640 PRINT"
 4650 PRINT"
 4660 :
 4740 :
 4750 GOSUB 9800
 4760 :
 4800 PRINT"3"
 9800 :
 9810 FOR J=1 TO 2000:NEXT J
 9820 :
 9830 PRINT:PRINT
 9840 :
 9850 PRINT"TYPE 1 TO CONTINUE
 9860 :
 9870 INPUT A
 9880 IF A=1 GOTO 10000
 9890 GOTO 9870
 9900 :
 10000 PRINT"3"
 10010 :
 10020 PRINT"DO YOU WISH TO PLAY AGAIN?
 10030 PRINT:PRINT
 10040 PRINT"IF YES,TYPE 1
 10050 PRINT:PRINT
 10060 PRINT"IF NO,TYPE 2
 10070 :
 10080 INPUT A
 10090 IF A=1 GOTO 10
 10100 IF A=2 GOTO 10150
 10110 :
 10150 PRINT"3"
 10160 PRINT"GOODBYE.SEE YOU SOON!
 10170 :
 10180 END
READY.
```

program. Point out that it says "TEXT #1" in the REM statement. Have them correctly identify the line number in the program where the PRINT statements begin for TEXT #1.

Have students count the number of lines and spaces per line available for entering their text into the program. Discuss whether or not the situation text they have just written will need to be revised to fit into the available space in the PRINT statements. If so, revise the writing with the students.

Enter, or have a student enter, the revised text into the program shell. Show students how it looks on the screen. Do they want to revise it?

Discuss with students how extra PRINT statements could be added to TEXT #1 if they wanted to make the opening-situation text to be longer.

4. Have the students identify where the character's choices of actions will be entered into the shell (the REMark statements INSERT TEXT FOR CHOICE #1 and INSERT TEXT FOR CHOICE #2).

Ask the students to write character choices, read them to the class, and have class select two choices to enter into the shell program.

Enter these choices or have a student enter them.

Run the program again, showing the new text that has been entered.

Have the students identify where the title of their story and name of authors will be placed in the program. Have them decide on a title and author name and enter it into the program.

Run the program as developed so far. Make sure all students know how to load and run the program.

5. Start a Chart for Tracking Episodes. This should be a large chart on the wall where all students can easily refer to it.

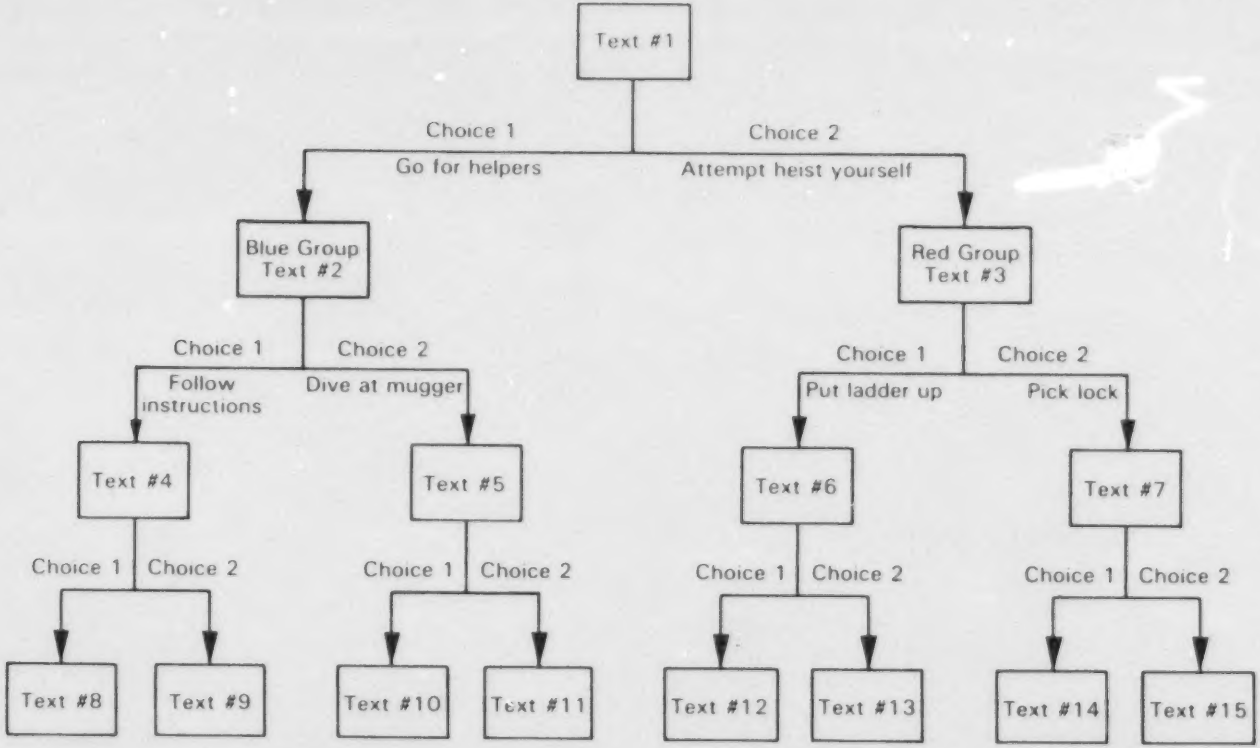
Show on the chart the choices provided so far.

Tell students they can now choose one of the two character choices they have put in the story. Split the class into two groups: one for students who choose choice 1 and the other for choice 2. Choice 1 students will write the next story episode for TEXT #2. Choice 2 students will write the next story episode for TEXT #3.

Have students find where their next episode will be entered into the shell program, and count the lines available for their text.

Have the students write their own versions of TEXT #2 or TEXT #3, share their versions with the others in their group, and choose a version to enter into the shell.

Enter TEXT #2 and TEXT #3 into the shell program, and have the students proofread and make corrections.



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Figure 6 – 3 □ Chart for Tracking Episodes



Student keys in the next episode for his group's adventure story (Redland Middle School, Montgomery County, MD)

Ask the students to write character choices for the episode they have worked on, again having each group choose from among all students' writing the version the group wishes to use. As before, enter the choices into the shell, proofread, and run the whole program.

Update the Chart for Tracking Episodes, by writing in the character choices from TEXT #2 and TEXT #3.

6. Repeat the process. This time, the two groups will each split up into another two groups, so that there will be four different

groups, each working on a different episode (TEXT #4, TEXT #5, TEXT #6, and TEXT #7). Have students write their names on the Chart for Tracking Episodes, beside the text box they are working on.

Encourage the students to go back to the computer from time to time and reread the story so far, with the choice path they are following.

Have the students continue to update the Chart for Tracking Episodes by writing in the choices they are creating.

7. Continue to repeat the process until the shell program is completed. Be sure the program gets updated on tape or disk each day, and that a backup is made.
8. When the story is complete, have students decide whether to make improvements, change the title, etc., and make these changes.

When the story is completed to the students' satisfaction, they might invite another class or group to try out their adventure story. They can have the tape put in the library media center's program collection and card file.

If you have access to a printer, have the story printed out in its various versions and post it on the bulletin board.

Ask the students to identify the ending they like best.

Have the students discuss what they learned about writing a story.

Related activities

A more sophisticated version of a story-writing program is "StoryMaker," by Bolt, Beranek & Newman, Inc., 10 Moulton St., Cambridge, MA 02238.

Recommended reading

"The Adventures and Exploits of the Dynamic Story Maker and Textman," by David Zacchei; *Classroom Computer News*, 2, no. 5 (May/June 1982), 28 – 31.

SAMPLE ACTIVITY ☐ QUAKES

Objectives

Students use a computer simulation to practice locating the epicenter of an earthquake. (Using Programs 8, 9)

Prerequisites

☐ Students need to have studied earthquakes and methods used to locate the epicenter of an earthquake.

- ☐ Vocabulary: seismographs, epicenter, shock waves, primary and secondary waves, lag-time

Materials

- ☐ "Quakes" simulation program and Teacher Manual, from *Science Volume 3* (Minnesota Educational Computing Consortium)
- ☐ Apple II computer
- ☐ Large monitors of TVs arranged so all students can see a screen
- ☐ Copies of "Quakes" Worksheets 1 and 2 for each student (it is helpful to write the names of the cities on Worksheet 2); these worksheets are in the MECC Teacher's Manual
- ☐ Transparency of illustrations from the MECC Teacher's Manual

Time for activity

Teacher preparation about 1 hour the first time, 15 minutes thereafter; activity, about two class periods.

Classroom management

Whole class and individuals or partners on the computer

Teacher

1. Read the background information in the manual, prepare handouts and transparencies, and try out the program a few times yourself.
2. Introduce the activity by reviewing with the students what they have already learned about earthquakes and locating the epicenter of an earthquake. Introduce the method for calculating the distance from a seismographic station to the epicenter of an earthquake, as shown in the Teacher's Manual.

Have students practice making the calculations with the aid of Worksheet 2.

3. Have a student assistant operate the computer program option 3 as you describe it to the students. Have monitors or TVs arranged so all students can see the screen. Explain that "Quakes" gives the students a chance to play seismologist and find the epicenter of an earthquake. Point out the various features of the displays, such as the distance gauge and the city markings.

Go through each step in locating a simulated earthquake. Have students work out each step in the computations. Spend plenty of time on the demonstration, to ensure that the students all understand how to apply concepts and computations to the solution to the problem.

Do not depend on the explanation given at the beginning of the *Quakes* program to help the students, as this explanation is confusing to many people.

4. After a demonstration, hand out both worksheets. While partners are taking their turns using option 3 of the "Quakes" program, the rest of the class can be filling in Worksheet 1. Have students run the program about three times.

By observing the students working on the program, the teacher can get a good assessment of whether they learned and can apply the concepts about locating the epicenter of an earthquake. Ask students to use the simulation in this way, as a test of what they have learned.

5. After all the students have had an opportunity to use the program, discuss with them whether they were able to locate the simulated earthquakes. You may have observed specific aspects with which they had difficulty — for example, identifying the cities; doing the computations; estimating distances.

Have the students reflect on the usefulness of this program for testing how much they have learned about this topic. Ask the students to describe the limitations or weaknesses of this simulation.

SAMPLE ACTIVITY ☐ GEOGRAPHY SEARCH

Objectives

Students use a computer simulation to aid in studying geography and navigation; they discover parameters of the simulation and discuss the realism of the program. (Using Programs 8, 9).

Prerequisites

Students should be familiar with terms and concepts used in the simulation, such as "degrees," "latitude," "minutes," "longitude," "constellations."

Materials

- ☐ *Geography Search*, by Thomas F. F. Snyder and Computer Learning Connection, Inc., published by Webster Division McGraw-Hill Book Co., 1982
- ☐ Teacher's Manual, program diskette, and student Searchbooks
- ☐ Apple II plus computer with disk drive

Program description

In this activity, the students are crew members of an ancient sailing ship looking for the New World. The computer helps them navigate, using the sun, stars, ocean depth, climate, and trade winds. Their goal is to locate the New World and return safely home with the promised riches. To reach their goal, the student groups must make decisions based both on content information in their Searchbook and on changing data from the computer simulation.

Time for activity

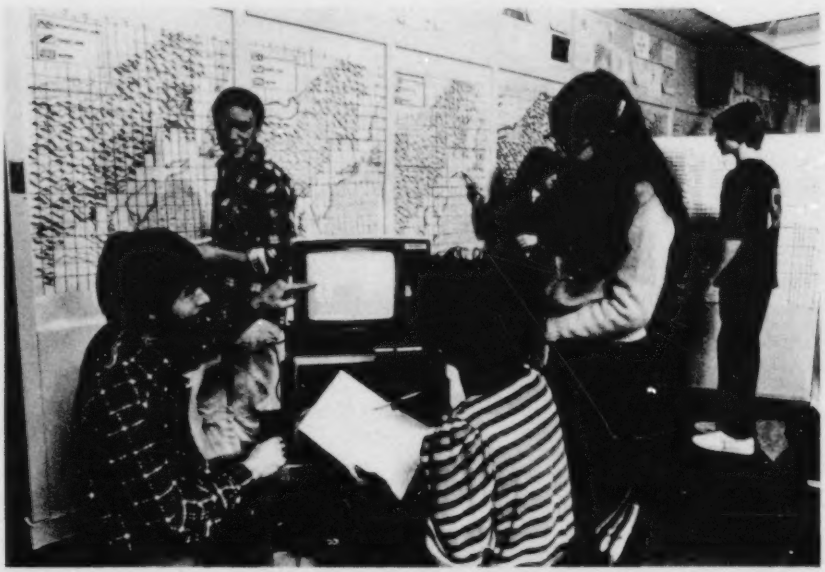
Teacher preparation about 2 hours; student work from two to ten class periods

Classroom management

Small groups of five to six students per group (Teacher's Manual includes detailed guidance for the teacher on how to manage the activity)

Teacher preparation

Before introducing the activity to the class, read the Teacher's Manual and try out the program.



Mr. Ridge works with a student team in a geography simulation called "Discovery," as team members chart their progress. Social studies teachers wrote the computer program to keep records and do computations for the teams (Redland Middle School, Montgomery County, MD).

Teacher

1. Introduce and manage the activity as described in the Teacher's Manual.
2. From a computer literacy standpoint, it is important for the students to reflect upon and discuss the role of the computer program in this learning activity. Several questions to raise in class discussions include the following:
   - In what ways does the computer show what it was really like on an ancient sailing ship?

- What aspects of sailing on a ship are not reflected in this simulation?
- Does the program allow enough choices for action in order for you to make intelligent choices about the control of your ship?

3. After the students have completed the number of rounds you have planned for this activity, discuss with them the assumptions built into the computer model. These are described in a section of the Teacher's Manual called "Between You and the Computer." Did the students discover some of the parameters of the model, such as the fact that a ship can sail from Vesuvia to the New World in as few as four days with strong winds? Did they discover the fact that the trade winds blow predictably (within certain boundaries)?

Related activities

A much simpler simulation might be introduced first, to acquaint students with small-group decision-making processes. An example is "Sell Lemonade," in *Elementary Vol. 3*, by the Minnesota Educational Computing Consortium.

Recommended reading

"Search Series: Geography Search," review by W. Hartley Clark in *The Apple Journal of Courseware Review*, Issue 1, 1982.

SAMPLE ACTIVITY ☐ PLANETS DATA BASE

Objectives

Students retrieve information from a computer data base as an aid to learning about planets. (Using Programs 10; Impact 3)

Prerequisites

Students will have applied Using Programs objectives 1 through 5. They also need to be able to use the computer, disks, and keyboard comfortably.

Materials

- ☐ PFS Personal Filing System software, published by Software Publishing Corporation (or a similar program)
- ☐ PFS User's Manual at the computer
- ☐ Apple II computer with dual disk and printer
- ☐ Monitors or TVs arranged so that students can all see class demonstrations
- ☐ PFS Planets Data Base prepared by the teacher (and/or capable students) (sample format and contents are shown on Figures 6 – 4 through 6 – 13).
- ☐ Overhead transparency summarizing PFS keystrokes for moving cursor, using menu, etc.

Reference

The sample planets data shown is extracted from *The Solar System* by Scientific American, Inc.; W. H. Freeman & Co., 1975.

Time for activity

Teacher preparation first time 2 to 3 hours; teaching about two class periods; student work about 30 minutes

Classroom management

Whole-class demonstrations and discussion; partners work on computer

Teacher preparation

1. Obtain the program and create the data base. You may prefer to modify the example format shown on Figure 6 – 4. Notice that a specific format is shown for numeric fields; for example (NNN.NNN). Data must be entered in this exact format, including leading zeroes, if you are using PFS software. If you do not use the leading zeroes, PFS will not sort the fields properly.

   Your more capable students may be able to enter the data for you, after you have created the format.

2. Make a backup copy of your data base.
3. Show one or two students how to use PFS to retrieve planets information. These students can serve as your assistants during class demonstrations, and as consultants to other students if they require assistance in using the program.
4. Make an overhead transparency summarizing PFS keystrokes.

Teacher

1. First day: Demonstrate to the class how to retrieve information from the data base, using the SEARCH function. Ask, for example: "What planets are smaller in diameter than Earth is?" Have your student assistant operate the keyboard while you explain the procedure for making the inquiry. The procedure for this inquiry is:
   a. SEARCH for Earth. Find Earth's diameter.
   b. Ask for another SEARCH. This time on the RETRIEVE SPEC item for DIAMETER, enter the symbol for "less than" and then Earth's diameter.
   c. PFS will bring to the screen each of the planets having a diameter less than Earth.
2. As you go through the demonstration, point out on the overhead the keystrokes the assistant is using to move the cursor, get to the main menu, etc. Explain that the instructions for operating PFS SEARCH are in Chapter 4 of the manual, and that students are expected to use the manual to help them learn to operate the program.

```
                PLANETS DATA BASE

PLANET NAME: SAMPLE FORMAT

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  :

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:           CLOUDS:

DIAMETER(KILOMETERS)(NNN,NNN):

MASS (EARTH=1)        (NNN.NNN):

DENSITY (WATER=1)         (N.N):

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET:
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      :       :        :
       PERIOD OF REVOLUTION
YEARS(NNN.N):        DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN):

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N):
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N):
  NITROGEN       (Y/N):
  OXYGEN         (Y/N):
  HYDROGEN       (Y/N):
  HELIUM         (Y/N):
  METHANE        (Y/N):
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 4 □ Format for planets data base

```
                PLANETS DATA BASE

PLANET NAME: MERCURY

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 00.387

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS: +350      CLOUDS:

DIAMETER(KILOMETERS)(NNN,NNN): 004,880

MASS (EARTH=1)        (NNN.NNN): 000.055

DENSITY (WATER=1)         (N.N): 5.4

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: MERCURY
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
: 59   :       :        : N
       PERIOD OF REVOLUTION
YEARS(NNN.N):        DAYS(NNN.N): 088.0

NUMBER OF KNOWN SATELLITES(NN): 0

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 47.9
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): N
  HELIUM         (Y/N): N
  METHANE        (Y/N): N
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 5 □ Planets data for Mercury

```
                PLANETS DATA BASE

PLANET NAME: VENUS

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 00.723

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS: +480      CLOUDS: -033

DIAMETER(KILOMETERS)(NNN,NNN): 012,104

MASS (EARTH=1)        (NNN.NNN): 000.815

DENSITY (WATER=1)         (N.N): 5.2

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: VENUS
       ROTATION PERIOD
DAYS   HOURS    MINUTES   RETROGRADE(Y/N)
: 243  :        :         : Y
       PERIOD OF REVOLUTION
YEARS(NNN.N):          DAYS(NNN.N): 224.7

NUMBER OF KNOWN SATELLITES(NN): 0

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 35.0
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): Y
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): N
  HELIUM         (Y/N): N
  METHANE        (Y/N): N
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 6 ☐ Planets data for Venus

```
                PLANETS DATA BASE

PLANET NAME: EARTH

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 01.000

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS: +022      CLOUDS:

DIAMETER(KILOMETERS)(NNN,NNN): 012,756

MASS (EARTH=1)        (NNN.NNN): 001.000

DENSITY (WATER=1)         (N.N): 5.5

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: EARTH
       ROTATION PERIOD
DAYS   HOURS    MINUTES   RETROGRADE(Y/N)
:      : 23     : 56      : N
       PERIOD OF REVOLUTION
YEARS(NNN.N):          DAYS(NNN.N): 365.3

NUMBER OF KNOWN SATELLITES(NN): 01

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 29.8
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): Y
  OXYGEN         (Y/N): Y
  HYDROGEN       (Y/N): N
  HELIUM         (Y/N): N
  METHANE        (Y/N): N
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 7 ☐ Planets data for Earth

```
        PLANETS DATA BASE

PLANET NAME: MARS

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 01.524

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS: -023      CLOUDS:

DIAMETER(KILOMETERS)(NNN,NNN): 006,787

MASS (EARTH=1)        (NNN.NNN): 000.108

DENSITY (WATER=1)        (N.N): 3.9

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: MARS
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      : 24    : 37     : N
       PERIOD OF REVOLUTION
YEARS(NNN.N):        DAYS(NNN.N): 687.0

NUMBER OF KNOWN SATELLITES(NN): 02

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 24.1
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): Y
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): N
  HELIUM         (Y/N): N
  METHANE        (Y/N): N
  OTHER: ARGON?
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 8 ☐ Planets data for Mars

```
        PLANETS DATA BASE

PLANET NAME: JUPITER

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 05.203

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:          CLOUDS: -150

DIAMETER(KILOMETERS)(NNN,NNN): 142,800

MASS (EARTH=1)        (NNN.NNN): 317.900

DENSITY (WATER=1)        (N.N): 1.3

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: JUPITER
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      : 09    : 50     : N
       PERIOD OF REVOLUTION
YEARS(NNN.N): 11.9  DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN): 13

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 13.1
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): Y
  HELIUM         (Y/N): Y
  METHANE        (Y/N): N
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 9 ☐ Planets data for Jupiter

```
          PLANETS DATA BASE

PLANET NAME: SATURN

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 09.539

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:          CLOUDS: -180

DIAMETER(KILOMETERS)(NNN,NNN): 120,000

MASS (EARTH=1)       (NNN.NNN): 095.200

DENSITY (WATER=1)       (N.N): 0.7

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: SATURN
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      : 10    : 14     : N
       PERIOD OF REVOLUTION
YEARS(NNN.N): 029.5 DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN): 10

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 09.6
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): Y
  HELIUM         (Y/N): Y
  METHANE        (Y/N): N
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 10 ☐ Planets data for Saturn

```
          PLANETS DATA BASE

PLANET NAME: URANUS

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 19.180

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:          CLOUDS: -210

DIAMETER(KILOMETERS)(NNN,NNN): 051,800

MASS (EARTH=1)       (NNN.NNN): 014.600

DENSITY (WATER=1)       (N.N): 1.2

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: URANUS
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      : 11    :        : Y
       PERIOD OF REVOLUTION
YEARS(NNN.N): 084.0 DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN): 05

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 06.8
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): Y
  HELIUM         (Y/N): Y
  METHANE        (Y/N): Y
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 11 ☐ Planets data for Uranus

```
        PLANETS DATA BASE

PLANET NAME: NEPTUNE

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 30.060

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:          CLOUDS: -220

DIAMETER(KILOMETERS)(NNN,NNN): 049,500

MASS (EARTH=1)       (NNN.NNN): 017.200

DENSITY (WATER=1)       (N.N): 1.7

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: NEPTUNE
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
:      : 16    :       : N
       PERIOD OF REVOLUTION
YEARS(NNN.N): 164.8 DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN): 02

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 05.4
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): N
  NITROGEN       (Y/N): N
  OXYGEN         (Y/N): N
  HYDROGEN       (Y/N): Y
  HELIUM         (Y/N): Y
  METHANE        (Y/N): Y
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 12 ☐ Planets data for Neptune

```
        PLANETS DATA BASE

PLANET NAME: PLUTO

MEAN DISTANCE FROM SUN IN ASTRONOMICAL
  UNITS (NN.NNN)  : 39.440

MEAN TEMPERATURE AT VISIBLE SURFACE IN
  DEGREES CELSIUS (+OR-NNN) (DAYTIME)
  SOLIDS:          CLOUDS: -230

DIAMETER(KILOMETERS)(NNN,NNN): 006,000

MASS (EARTH=1)       (NNN.NNN): 000.100

DENSITY (WATER=1)       (N.N): ?

TO SEE PAGE 2, PRESS CTRL AND N.
TO RETURN TO MENU, PRESS CTRL AND C.
```

```
PAGE 2 DATA FOR PLANET: PLUTO
       ROTATION PERIOD
DAYS   HOURS   MINUTES  RETROGRADE(Y/N)
: 006  : 09    :       : N
       PERIOD OF REVOLUTION
YEARS(NNN.N): 247.7 DAYS(NNN.N):

NUMBER OF KNOWN SATELLITES(NN): 0

ORBITAL VELOCITY (KM PER SECOND)
                              (NN.N): 04.7
ATMOSPHERE, MAIN COMPONENTS
  CARBON DIOXIDE (Y/N): ?
  NITROGEN       (Y/N): ?
  OXYGEN         (Y/N): ?
  HYDROGEN       (Y/N): ?
  HELIUM         (Y/N): ?
  METHANE        (Y/N): ?
  OTHER:
PRESS CTRL AND P TO SEE PAGE 1.
PRESS CTRL AND C FOR MAIN MENU.
```

Figure 6 – 13 ☐ Planets data for Pluto

3. Give the class the assignment to work as partners, learning to SEARCH for information from the Planets data base. Retrievals should be fairly simple, such as:
   - Which planets have more satellites than Earth does?
   - What is the temperature of Mercury? Clouds or solids?
   - Does any planet have an orbital velocity greater than 40.0 kilometers per second?
   - How many planets have oxygen as a main component of their atmosphere?
4. Second day: Invite students to volunteer to demonstrate to the class a retrieval they have made.
5. Introduce the idea of posing some interesting questions about planets. For example, do the students think that the farther a planet is from the sun, the colder it will be? What about the speed (orbital velocity) at which a planet travels? Will it be slower or faster, the farther the planet is from the sun?
6. Demonstrate to the class how the data base can be used to help answer such questions. For example, to find out about the relationship between distance from the sun and temperature of the planet, we can do the following:
   a. Select function 5 PRINT from the main menu.
   b. Select PRINT FORMS from the PRINT MENU.
   c. Leave the RETRIEVE SPEC blank. We want to retrieve all planets.
   d. On the PRINT OPTIONS menu, leave the PREDEFINED PRINT SPEC blank.

   Change LINES PER PAGE to 7. Change NUMBER OF COPIES to 6.

   e. On the PRINT SPEC form, enter X+ for PLANET NAME.

   Enter XS for MEAN DISTANCE FROM SUN. This tells PFS to sort the planet records in order of distance from the sun (S stands for sort), and print that data item.

   Enter X+ for SOLIDS and X for CLOUDS, to ask PFS to print the MEAN TEMPERATURE AT VISIBLE SURFACE IN DEGREES CELSIUS.

   f. Make sure the printer is turned on and paper is properly aligned in the printer.
   g. Press CTRL C. PFS will begin printing a report like that shown in Figure 6 – 14.
7. Pass the copies of the report around the class. Ask the students what the report tells us about the statement, "The farther a

```
PLANETS DATA BASE

PLANET NAME: MERCURY  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 00.387
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS: +350  CLOUDS:
PLANETS DATA BASE

PLANET NAME: VENUS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 00.723
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS: +480  CLOUDS: -033
PLANETS DATA BASE

PLANET NAME: EARTH  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 01.000
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS: +022  CLOUDS:
PLANETS DATA BASE

PLANET NAME: MARS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 01.524
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS: -023  CLOUDS:
PLANETS DATA BASE

PLANET NAME: JUPITER  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 05.203
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS:   CLOUDS: -150
PLANETS DATA BASE

PLANET NAME: SATURN  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 09.539
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS:   CLOUDS: -180
PLANETS DATA BASE

PLANET NAME: URANUS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 19.180
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS:   CLOUDS: -210
PLANETS DATA BASE

PLANET NAME: NEPTUNE  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 30.060
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS:   CLOUDS: -220
PLANETS DATA BASE

PLANET NAME: PLUTO  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 39.440
MEAN TEMPERATURE AT VISIBLE SURFACE IN
DEGREES CELSIUS (+OR-NNN) (DAYTIME)
SOLIDS:   CLOUDS: -230
```

Figure 6 – 14 □ Planets sorted by distance from sun, showing temperature

planet is from the sun, the colder it is." *(Since we have sorted the planets by distance from the sun, the temperatures should get increasingly colder as we go down the list of planets.)* Do they? *(Yes, except for Venus.)*

8. Assign partners to work on projects together. Partners should formulate and print out a PFS report that will help them to answer one of the questions below, in the "Assignment" section or some other question of interest to them (Figures 6 – 15 through 6 – 17 provide examples of PFS printouts for these projects).

Students should refer to the manual for assistance in making their inquiries and requesting their reports.

Assignment

Ask PFS to print out a report that will help you to answer one of the following questions. What conclusions do you draw from the information? Does our Planet data base have enough information in it to allow us to know the answer for sure?

1. "The farther a planet is from the sun, the slower its orbital velocity." Tell whether this statement is true or false. How do you know?
2. "The farther a planet is from the sun, the longer it takes to revolve around the sun." Tell whether this is true or false. How do you know?
3. "The larger the diameter of the planet, the more satellites it has." Is this true or false? How do you know?
4. "The greater the mass of the planet, the more satellites it has." Is this true? Are there exceptions?

Related activities

After students have completed this activity, the teams can each report to the class on the problem they were addressing, what information request they made of the computer, and what information they got out.

Invite students to think about the advantages and disadvantages of using this information-retrieval method as opposed to looking up the information in an encyclopedia or science book. Have a class discussion about this.

Have students plan another data base they would like to have available to them to use in their studies.

See "Sample Activities—States Data Base" p. 245 of Chapter 7, for other information-retrieval activities.

```
PLANETS DATA BASE

PLANET NAME: MERCURY  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 00.387
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 47.9
PLANETS DATA BASE

PLANET NAME: VENUS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 00.723
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 35.0
PLANETS DATA BASE

PLANET NAME: EARTH  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 01.000
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 29.8
PLANETS DATA BASE

PLANET NAME: MARS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 01.524
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 24.1
PLANETS DATA BASE

PLANET NAME: JUPITER  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 05.203
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 13.1
PLANETS DATA BASE

PLANET NAME: SATURN  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 09.539
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 09.6
PLANETS DATA BASE

PLANET NAME: URANUS  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 19.180
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 06.8
PLANETS DATA BASE

PLANET NAME: NEPTUNE  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 30.060
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 05.4
PLANETS DATA BASE

PLANET NAME: PLUTO  MEAN DISTANCE FROM SUN IN ASTRONOMICAL
UNITS (NN.NNN)  : 39.440
ORBITAL VELOCITY (KM PER SECOND)
(NN.N): 04.7
```

Figure 6 – 15 □ Planets sorted by distance from sun, showing orbital velocity

```
PLANETS DATA BASE

PLANET NAME: PLUTO  DIAMETER(KILOMETERS)(NNN,NNN): 006,000
NUMBER OF KNOWN SATELLITES(NN): 0


PLANETS DATA BASE

PLANET NAME: VENUS  DIAMETER(KILOMETERS)(NNN,NNN): 012,104
NUMBER OF KNOWN SATELLITES(NN): 0


PLANETS DATA BASE

PLANET NAME: MERCURY  DIAMETER(KILOMETERS)(NNN,NNN): 004,880
NUMBER OF KNOWN SATELLITES(NN): 0


PLANETS DATA BASE

PLANET NAME: EARTH  DIAMETER(KILOMETERS)(NNN,NNN): 012,756
NUMBER OF KNOWN SATELLITES(NN): 01


PLANETS DATA BASE

PLANET NAME: NEPTUNE  DIAMETER(KILOMETERS)(NNN,NNN): 049,500
NUMBER OF KNOWN SATELLITES(NN): 02


PLANETS DATA BASE

PLANET NAME: MARS  DIAMETER(KILOMETERS)(NNN,NNN): 006,787
NUMBER OF KNOWN SATELLITES(NN): 02


PLANETS DATA BASE

PLANET NAME: URANUS  DIAMETER(KILOMETERS)(NNN,NNN): 051,800
NUMBER OF KNOWN SATELLITES(NN): 05


PLANETS DATA BASE

PLANET NAME: SATURN  DIAMETER(KILOMETERS)(NNN,NNN): 1 0,000
NUMBER OF KNOWN SATELLITES(NN): 10


PLANETS DATA BASE

PLANET NAME: JUPITER  DIAMETER(KILOMETERS)(NNN,NNN): 142,800
NUMBER OF KNOWN SATELLITES(NN): 13
```

Figure 6 – 16 □ Planets sorted by number of satellites, showing diameter

```
PLANETS DATA BASE

PLANET NAME: MERCURY
MASS (EARTH=1)      (NNN.NNN): 000.055
NUMBER OF KNOWN SATELLITES(NN): 0
PLANETS DATA BASE

PLANET NAME: PLUTO
MASS (EARTH=1)      (NNN.NNN): 000.100
NUMBER OF KNOWN SATELLITES(NN): 0
PLANETS DATA BASE

PLANET NAME: MARS
MASS (EARTH=1)      (NNN.NNN): 000.108
NUMBER OF KNOWN SATELLITES(NN): 02
PLANETS DATA BASE

PLANET NAME: VENUS
MASS (EARTH=1)      (NNN.NNN): 000.815
NUMBER OF KNOWN SATELLITES(NN): 0
PLANETS DATA BASE

PLANET NAME: EARTH
MASS (EARTH=1)      (NNN.NNN): 001.000
NUMBER OF KNOWN SATELLITES(NN): 01
PLANETS DATA BASE

PLANET NAME: URANUS
MASS (EARTH=1)      (NNN.NNN): 014.600
NUMBER OF KNOWN SATELLITES(NN): 05
PLANETS DATA BASE

PLANET NAME: NEPTUNE
MASS (EARTH=1)      (NNN.NNN): 017.200
NUMBER OF KNOWN SATELLITES(NN): 02
PLANETS DATA BASE

PLANET NAME: SATURN
MASS (EARTH=1)      (NNN.NNN): 095.200
NUMBER OF KNOWN SATELLITES(NN): 10
PLANETS DATA BASE

PLANET NAME: JUPITER
MASS (EARTH=1)      (NNN.NNN): 317.900
NUMBER OF KNOWN SATELLITES(NN): 13
```

Figure 8 – 17 ☐ Planets sorted by mass, showing number of known satellites

SAMPLE ACTIVITY ☐ DATA BASES AND PRIVACY

Objectives

Students examine information retrieval in diverse fields, identify advantages and disadvantages of particular information retrieval systems and consider issues relating to privacy. (Applications 4, 5; Impact 2, 3)

Prerequisites

This activity is more understandable to the students if they have used a computer data base themselves.

Teacher preparation

Obtain and read the following materials:

Computers and Privacy, Biological Sciences Curriculum Study, 1980. See especially the activity on Education Records, which includes the Family Educational Rights and Privacy Act of 1974 (Public Law 93-380).

"Electronic Privacy Intrusion," in *Computers and Social Controversy*, by Tom Logsdon; Computer Science Press, 1980.

Time for activity

For preparation — 1 hour; teaching lesson —one – two class periods; student work — 1 to 2 hours

Classroom management

Small-group work, whole-class discussion, and individual student assignments

Teacher

1. Ask students to keep track of everything they buy for a week. Have them each write down on a 3 × 5 card everything they have bought. Collect the cards. Suggest that they could build a computer data base using this information, and in a class discussion, find out if it would bother them if their classmates and teachers were able to call up such information on the computer. Is there any personal information they would not like to have on the computer data base, open to anyone to see?
2. Discuss with students the idea of building a computer data base containing records on each person in the class. What might be put into such records and how would it be used? For example, we might want to know each student's phone number and address. Information on hobbies would be useful so that students with similar interests could find each other easily. What about information on each student's grades? What about how much allowance each person gets?

Have students create a list of possible items of information they might put into the class data base, and then vote on each item, as to whether they would want that information to be openly available to all classmates, teachers, principal, etc.

If students have been working with a filing-system program, they might want to try building such a data base.

3. Have all the students make a list of all the places that keep records about individuals — e.g., schools, medical facilities, the Census Bureau. Ask if students know what is in these records. Who can see or use them?
4. Lead a class discussion on how your students would feel if their records could be seen by all of their classmates and teachers.
5. Divide the class into groups. Give each group one of the following projects, or a similar one to research and report on to the class:
   a. Find out the status of your private medical records by answering the following questions:
      - Who can see them (e.g., insurance investigators, government agents, welfare officials)?
      - Could the police see them if they wished?
      - Could your parents?
      - Can you see them?
      - If not, can you see them when you are an adult?
      - Are the records computerized?
      - How long are they kept?
      - How are they protected?
      - Who decides who can see what records?
      - Are there any laws protecting your records?
   b. Find out the status of the records your school keeps about you by answering the same questions.
   c. Find out what information about you is kept by the local, state, and federal government. Answer the same questions about these records.
   d. Find out what information is stored on an individual at the Department of Motor Vehicles. What about a credit bureau? the police department? the IRS? Answer the same questions.

This chapter provides detailed lesson plans for sample classroom activities. Please read Chapter 3, "Overview of the Curriculum," for an explanation of the scope and sequence of objectives. Figure 7 – 1 summarizes the strands and objectives for grades K through 8. Table 7 – 1 provides a cross-reference between the sample activities in this chapter and the strands and objectives.

INTRODUCTION TO THE TEACHER

Your students have reached an exciting stage in using computers. They have reached a stage of development at which they can use the power of computers in realistic ways to help manage information and solve complex problems. At this stage, the capabilities of computers begin to have real meaning in applied situations.

To get the greatest benefit from the sample activities in this chapter, your students need to have already developed skills in procedural thinking and in using computer programs. Most of the activities require that the students be able not only to follow fairly complex sets of written instructions for performing tasks, but also to develop their own problem-solving procedures. If your students have not had the benefit of the kinds of activities suggested in earlier chapters, help them now to acquire the prerequisite skills and knowledge. For introducing procedural thinking, the entire "ZEEP007 the Robot" series (beginning in Chapter 4) is useful and efficient.

Grades 7 – 8
objectives and activities



Objectives

Strands	Grades K – 2	Grades 3 – 4	Grades 5 – 6	Grades 7 – 8
	TEACH STUDENTS TO:			
Procedures	• Follow a procedure for a familiar task • Modify a procedure • Show different procedures can produce the same outcome • Find and correct errors in a procedure • Describe procedures used to perform a task	• Help to develop a procedure involving repetition, decision making, and variables • Find and correct errors in a procedure • Develop a procedure, demonstrate that it works • Use procedures to perform new tasks	• Apply procedures skills to new problems • Note differences between procedures for people and procedures for computers • Break problem into subproblems: plan procedures and subprocedures • Develop procedures for organizing data	• Apply procedures skills to new problems • Choose the best aid for solving a problem: calculator, computer, pencil?
Using Programs	• Use computer drills and games • Operate equipment; load and run programs • Recognize the computer needs instruction	• Read documentation that describes programs and tells how to use them • Select and operate programs without teacher's help • Select and use a program to solve a specific problem	• Use simulations as an aid in learning • Demonstrate learning from a simulation • Retrieve information from a computer data base • Apply skills in using equipment, programs and documentation	• Use word processor to improve writing • Use more complex simulations • Use new methods to retrieve information

Fundamentals	• Understand that computer instructions are contained in a program	• Understand that the computer is a general purpose machine	• Recognize tasks for which computer speed is needed • Recognize tasks requiring repetition • Recognize tasks requiring large amounts of data	• Apply knowledge of fundamentals to new situations
Applications	• Discover computer applications in homes and neighborhoods	• Know about computer applications in school and local government • Compare fictional and real computers	• Understand 1 or more ways information retrieval is used in diverse fields • Understand how scientists might use computers	• Recognize uses of word processor • Recognize uses of computer in business and manufacturing • Recognize use of computer systems in large organizations • Recognize main components of computer systems
	• Follow rules for using equipment and programs	• Follow rules for using equipment and programs	• Understand reasons to restrict access to data base and programs • Understand advantages and disadvantages of	• Become aware of new social issues created by computers • Appreciate social dependence on computers

Figure 7 – 1 □ Overview of objectives

Impact			particular uses of information retrieval	• Understand effects of computer failures • Understand the kinds of computer skills needed in diverse careers • Become aware of computer professions
Writing Computer Programs	(Note: For grades K – 6, objectives and activities related to computer programming are reflected in the Procedures, Using Programs, and Fundamentals strands).			• Modify programs • Code programs • Write documentation • Test and debug programs • Plan and develop programs

Figure 7–1 □ Cont'd

Table 7 – 1 ☐ Sample activities by strands*

Grades 7 & 8	1 Procedures	2 Using Programs	3 Fundamentals	4 Applications	5 Impact
ZEEP007 Mowing Lawns	7a,7b,8a,8b,12				
Line Up	3,6,9,12				
Comparing African Countries	all				
Scientists at Odell Lake		8,9		5	
Geology Search		8,9			
Graphing Data	12	7	3,5	5	
Personal Energy Audit		7,10	3,5	3	3
Using TellStar		6,7,10	3,5		
Experiments with the Sky	12	6,7,10		5	
Sky Projects	12	10		5	
States Data Base	12	10			
Search and Update		10			
Update: Land Area and Altitude		10			

*Objective numbers are shown in the cells of the matrix.

Table 7–1 ☐ Cont'd

Retrieval: Selecting, Sorting, and Reporting	12	10			
Update: States Populations		10			
Exploring the Data Base	12	10			
Using Apple Writer		6,11			
Apple Writer Experiments		6,11			
Apple Writer Editing		6,11			
Apple Writer Projects		6,11			
Junk Mail				6	
Time Line					5
Computers and Ethics					1,4
Computers and Crime					1,4
School Case Study				8	
The Computer Did It					4
Opinion Survey					4
Electronic Money		233		7	2,5,6
The Feeling of Power					4

About Using Computer Programs

Lesson plans in this chapter provide a variety of examples of different kinds of computer programs that are useful in math, science, language arts, and social studies. These tools include simulations, plotters, information-retrieval programs, and word processors. Many of the lesson plans are interdisciplinary and can be used to focus on different content areas.

Many activities from Chapter 6 are also suitable for your students. They also use simulations, plotters, and information-retrieval programs. In addition, the activity for "Rocky's Boots" in that chapter is appropriate for grades 7 and 8 because the problems ("challenges") have a wide range of complexity.

Activities in this chapter assume that your students are comfortable in using programs and are "keyboard-literate." If they have not had experience in using computers previously, they need to acquire the skills and knowledge indicated in Using Programs objectives 1 through 5. A good way to introduce these skills to your students is to provide them with a few well-documented and easy-to-use programs in order to familiarize them with keyboard operations and documentation techniques. Most of the programs described in Chapters 5 and 6 can be used for such purposes by your students. See especially "Spelling Strategy," "Math Strategy," "SemCalc," and "Rocky's Boots."

About Applications Strand Objectives

Many of the sample activities in this chapter provide opportunities for students to learn about computer applications that are important in the "real world." More important than reading about such applications in a book, are the experiences students get in *using* computer applications. For example, an Applications strand objective is for students to describe ways in which word processing is used in fields such as business, government, and journalism. It is a simple matter for students to investigate this question if they have used a word processing program. Similar considerations apply to applications of data bases and information retrieval, simulations, and the like. Therefore, the skills and knowledge from the Using Programs strand and the Applications strand are closely intertwined. This is reflected in the sample activities in this chapter.

About Social Issues and the Impact of Computers on Society

Several of the sample activities focus directly on social issues, such as "Computers and Ethics." However, many other activities also provide

excellent opportunities to explore social issues. For example, suppose a student accidentally or mischievously enters erroneous data into a computerized data base the whole class is using. This is a good opportunity to have students think about the possible impact of data base errors in, say, law enforcement or medical fields.

Try to capitalize on classroom events as well as current events in the news, by focusing students' attention on socially relevant issues as they arise.

About Computers and Careers

Most members of the workforce in the U.S. now use computers directly or indirectly. Students and teachers should have some awareness of the kinds of computer-related skills required in many careers. This would help students make informed elective choices in junior high and high school.



Time Magazine's "Man of the Year" is the theme of this computer literacy bulletin board created by eighth graders (Redland Middle School, Montgomery County, MD)

Through experiences such as those suggested in the sample activities in this chapter, students are acquiring computer-related skills needed by people in many career fields. Students might further their understanding of computer-related skills needed by people in various careers, by doing some of the following:

- ☐ Interviewing adults in their neighborhood or family to find out how these people use computers in their work
- ☐ Inviting parents or a local business person to come to class and describe computer experiences at work

Recommended Reading

Bits 'n Bytes About Computing: A Computer Literacy Primer, by R. Heller and C. D. Martin; Computer Science Press, 1982. Includes suggested classroom activities related to the history of computers, how computers work, applications, careers, and social issues.

Exploring the World of Computers, by D. Spencer; Camelot Publishing Co., 1982. Written for students, this book provides introductory material on computer applications, history, careers, and the future.

"A Future Career With Computers? It's Possible!" in *Computeronics*, Leon County Public Schools, 1978.

What Can She Be? A Computer Scientist (Career Unit), by Gloria and Esther Goldreich; Lothrop, Lee & Shepard, 1979.

Computers and Privacy, a set of learning activities and readings developed by Biological Sciences Curriculum Study, 1980; includes Teacher's Guide and book of readings.

The Compleat Computer, by Dennie L. Van Tassel; SRA, 1976. Contains many sections on social issues. See, for example, "Controls or Maybe Lack of Controls," pp. 179 – 201; "Waiting for the Great Computer Rip-off," pp. 146 – 51; "Help Wanted: 50,000 Programmers," pp. 89 – 92; "On the Impact of the Computer on Society," by Weizenbaum, p. 168; "Variation on an Old Theme: Man Replaces Computer," p. 76.

Computers and Social Controversy, by Tom Logsdon; Computer Science Press, 1980.

"Pulling the Plug," by Charles Mossman, in *Tales of the Marvelous Machine*, R. Taylor and B. Green, eds.; Creative Computing Press, 1980.

Computers in Society, by Donald Sanders; McGraw-Hill, 1981.

SAMPLE ACTIVITY ☐ ZEEP007 MOWING LAWNS

Objectives

Students locate and correct errors in procedure. They take a problem related to the robot ZEEP and plan a set of procedures and subprocedures for solving the problem. (Procedures 7a, 7b, 8a, 8b, 12)

Prerequisites

Students have applied Procedures objectives 1 through 10. They should do ZEEP problems from earlier chapters if they have not previously learned how to develop procedures.

Materials

Copy of the story "ZEEP007 Mowing Lawns" for each student*

Time for activity

Preparation 15 minutes; teaching 20 minutes; student work 30 minutes

Classroom management

Total class presentation; small group; individual student follow-up

Teacher

1. Hand out copies of the story to the students. As you do, tell the students they will be working on developing procedures for the robot ZEEP007.

Review the idea of procedures and subprocedures with the students. Review the idea that robots such as ZEEP007 or R2D2 from *Star Wars*, have computers inside them. Like all computers, they have to be given instructions in order to operate.

2. Ask the students to first read the story. After they have had time to read it, you might conduct a class discussion about the problem. The amount of discussion needed will depend on how much experience your students have had in developing, revising, and debugging procedures. You might have students suggest ideas as to what was wrong with the procedure given in the story.
3. After the discussion, have students work independently on developing their own procedures as stated in the assignment at the end of the story. Then have each student trade his or her procedures with a partner. Have partners work together to debug each other's procedures.
4. After partners have worked together, have some students describe their solutions to the rest of the class. There may be some disagreements among partners as to what is a workable procedure. Invite the students to discuss these issues with the rest of the class.

*Student handouts are at end of this chapter.

Possible solution

Procedure: MOW-THIS-LAWN

1. If entire lawn is mowed, do FINISHED; go to end.
2. If mower engine is not running, do CHECK-GAS.
3. Do START-MOWER.
4. If first strip is not mowed, do MOW-FIRST-STRIP.
5. If entire lawn is not mowed, do REST-OF-LAWN.
6. END.

Subprocedure: FINISHED

1. Push control lever to "Stop."
2. Push mower into storage shed.
3. Task is complete.

Subprocedure: MOW-FIRST-STRIP

1. Push mower to corner of driveway and front walk, facing the street.
2. Align left side of mower with driveway edge.
3. Mow strip along driveway to sidewalk. Stop.
4. At sidewalk, turn right 90 degrees.
5. Align left side of mower with sidewalk edge.
6. Mow strip along sidewalk to light post. Stop.
7. At light post, turn right 90 degrees.
8. Align left side of mower with an imaginary line running to the corner of the house.
9. Mow strip along line to corner of house. Stop.
10. At corner of house, turn right 90 degrees.
11. Align left side of mower with edge of house.
12. Mow strip along house to the mowed strip that is beside the driveway. Stop.
13. END.

Subprocedure: REST-OF-LAWN

1. If engine is not running, return to procedure MOW-THIS-LAWN, step 1.
2. If lawn is all mowed, return to procedure MOW-THIS-LAWN, step 1.
3. Align left side of engine with right line of the last strip you mowed.
4. Mow a strip alongside the last strip, until you come to another mowed strip.
5. Turn right 90 degrees.
6. Go to step 1.

Note: Subprocedures CHECK-GAS and START-MOWER are listed in the story.

SAMPLE ACTIVITY ☐ LINE UP

Objectives

Students develop a procedure for analyzing and solving the problem: How many ways can 5 people be arranged in a line? (Procedures 3, 6, 9, 12)

Prerequisites

Students should have been introduced to using procedures to solve problems, and should have had group problem-solving experience.

Materials

- ☐ Statement of the problem on flipchart
- ☐ Picture of people on overhead (transparency master is at end of chapter)

Approximate time

One class period

Classroom management

Small groups of five students each

Teacher

1. Introduce the problem: How many ways can five people be posed in a line for a picture?

Have the picture of people on the overhead and the statement of the problem on a flipchart. Have a student read the problem aloud.

Emphasize the following ideas:

- There may be many different ways of solving the problem.
- We are more interested in *methods* for solving the problem, than in the answer.
- Each student's ideas are valuable. There are no "dumb" ideas. Encourage risk taking.
- It is important to understand the problem before trying to select a method for solving it.
- All five people have to be in the picture.

2. Have students work in their small groups to develop and test a method for solving this problem.
3. Have groups take turns reporting to the class on their methods.

One important fact that students should discover is that each problem can be solved in several ways. They should also learn to use several of the different ways. Five methods are described below for solving Problem 1. You or your students may discover other methods or combinations of methods.

Experiment Someone may suggest getting five people and actually forming the various arrangements.

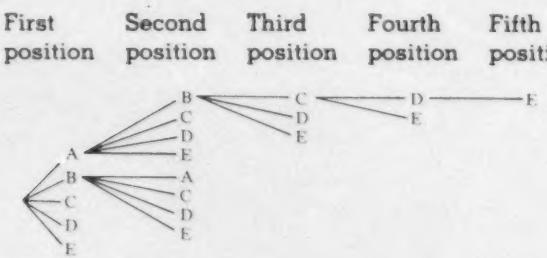
Look at simpler but similar problems to find a pattern Other students may suggest counting the arrangements for smaller groups in the hope that the counting will be easier and that a pattern will emerge. From the pattern they can get a rule to apply to the problem itself. They can make a table of the data so that a pattern will be easier to find.

Number of people	1	2	3	4
Number of arrangements	1	2	6	24

Make a list Students can choose names of five people and make a list of all possible arrangements:

1. Alan, Betty, Carl, Dan, Ellen
2. Alan, Betty, Carl, Ellen, Dan
3. Alan, Betty, Dan, Carl, Ellen

Make a diagram Students may suggest making a diagram of the arrangements. In this case a "tree diagram" is suitable.



Use logical reasoning Finally, some students may try to solve the problem by reasoning without resorting to any of the above "data gathering." They might reason as follows: There are 5 choices for the person who is to be first in line. Then there are 4 choices for the next person, 3 choices for the next, 2 choices for the next, and only 1 choice for the last. Now we can just multiply 5, 4, 3, 2, and 1.

Other methods such as systematic trial and error and manual labor will be suggested for some problems. Some of these methods can be tedious with pencil and paper, but sometimes are quite easy with a calculator.*

*Reproduced with permission of the D.C. Heath Company from 1981 Heath Mathematics Program, Grade 6, Teachers Edition.

4. Have the class vote on their preferred method. Then challenge them to develop a step-by-step sequence of instructions for solving the problem by the method they have selected. The instructions should enable a person who does not know the answer to the problem to solve it step by step.

Students using one of the methods suggested above may have trouble finding a systematic way of organizing and counting. Unless they are systematic, they may count some arrangements twice and others not at all.

Students using the logical reasoning method may incorrectly decide to add the numers of choices instead of deciding to multiply them.

Students might work in small groups or contribute to a teacher-led effort to develop a procedure.

5. Have students test their procedure by giving it to a student who has not participated in this activity (perhaps a classmate who was absent). The test of the procedure is:
   - Whether the classmate can read and follow the instructions
   - Whether the classmate produces a correct solution by following the instructions

Related activities

See other "Creative Problem Solving Activities" in the Heath 1981 Mathematics series for grades 6 and 7, teacher editions.

Students might develop a computer program to solve this problem.

See sample activity, "Procedures for Solving Math Problems," in Chapter 6. This activity introduces students to developing procedures to solve math problems.

SAMPLE ACTIVITY ☐ COMPARING AFRICAN COUNTRIES

Objectives

Students apply all procedures skills to help them compare African countries by per capita income levels. (Procedures — all)

Prerequisites

Students have had experience in developing procedures. They are assumed to have been studying Africa prior to performing this activity.

Materials

Students need access to data on per capita income and other data for all African countries.

Time for activity

Two or more class periods

Classroom management

Students work on this assignment in small groups of two or three. Within groups, the problem is broken into subproblems, with each student writing a subprocedure to address a particular subproblem.

Teacher

1. Have a class discussion on some of the factors that might be considered as having some effect on the wealth and income of people in a country. Students should consider, perhaps, factors such as political and governmental structure, educational levels of the population, natural resources, industries, etc. Invite students to suggest possible reasons for the difference in per capita income between countries.
2. Introduce the problem to the students. Tell them the idea is to identify the African country having the lowest per capita income and the African country having the highest per capita income, and try to get some insights and understanding about the differences between these two countries.
3. Since this is a pretty complex problem, the problem will have to be broken into subproblems, and with well-thought-out procedures developed for getting the information that is needed, organizing it, presenting it to one another, and drawing inferences from it.
4. Have the class discuss the end product of the work to be done. Ask the students what form the information will need to be in, so they can make some inferences about the factors involved.
5. Have the class discuss the materials and sources of information available. Geography books? Almanacs? Encyclopedias? What specific items of information are available in each of the available sources?
6. Ask the class to consider how they will get from their sources of information to the end product they want. Can they break the problem down into smaller problems?

Guide the class to think through some ways of breaking up this problem and planning an approach. Here is one possible way of thinking about it:

Subproblem Decide on a product of the work

- Make a form for recording data about each country

Subproblem Identify countries

- Look up per capita income for each country
- Write per capita income on the data form
- Find the lowest per capita income; select that country for study
- Find the highest per capita income; select that for study

Subproblem Collect information about countries

Look up the following facts for each country under study:

- Average education level for population
- Year present government was established
- Have they been in any wars in the past ten years?
- What is most valuable natural resource?
- What is monetary value of exports?

Write the facts on the data form.

Subproblem Analyze the information

- Compare the two countries for each fact listed in the form
- Identify factors that are most different for the two countries

Subproblem Present and discuss results

- Prepare a chart or graph that shows the difference between the two countries
- Discuss whether these factors might explain the difference in per capita income; why or why not?

7. After the class has agreed on an approach and a set of procedures, have small groups take on responsibility for subproblems. This will require that the groups collaborate with each other. For example, the group designing the form will distribute it to the other groups that need it in their work.
8. Have the groups work on their assignments, reporting to you on interim progress as appropriate.

Related activities

The teacher might prepare in advance a list of all countries and their per capita incomes, and a form for recording the other data. This will make the assignment simpler and less time-consuming for the students.

SAMPLE ACTIVITY ☐ SCIENTISTS AT ODELL LAKE

Objectives

Students use a computer simulation as an aid in making scientific observations and identifying food chains. They discuss use of simulations by scientists and limitations of this program. (Using Programs 8, 9; Applications 5)

Prerequisites

Students should have some knowledge of food chains and food webs, and experience in making observations and collecting data.

Materials

- ☐ "Odell Lake" simulation program and Teacher Manual, from *Science Volume 3,* Minnesota Educational Computing Consortium
- ☐ Apple II computer
- ☐ Large monitors or TVs arranged so all students can see a screen
- ☐ Copies of Odell Lake worksheet for each student (from MECC Teacher Manual)
- ☐ Transparency of "Odell Lake Answer Key"
- ☐ Blank transparency for developing a data-collection worksheet

Time for activity

Teacher preparation about 1 hour the first time, 15 minutes thereafter; activity about 1 hour

Classroom management

Whole class or individualized for faster students

Teacher

1. Read the background information in the manual, particularly "The Program," "The Model," "Assumptions," and "Follow-up." Run through the entire program yourself.
2. Introduce the activity by telling the students they are going to be scientists studying the food webs in Odell Lake. They will need to arrange for food, clothing, transportation, and shelter so that they can live several weeks by the lake as they observe the organisms in the lake. Then explain that since it is so expensive to actually go to the lake and they would miss too much school, they will use a computer simulation of the lake for making their observations.
3. Run one sequence of the Odell Lake simulation, inviting students to suggest ideas about what data they will need to be recording on paper as they observe the behavior of one fish in relation to the other fish in the lake. Through class discussion, develop a data-collection worksheet and draw it on the overhead transparency.

4. Run through several sequences of the simulation, having students choose which fish to observe (when the program asks "Which fish do you wish to be?"). Have students choose which actions to take as the fish encounters other fish. From time to time, interrupt the simulation with class discussions about what data each student is collecting. You can have students working in small groups, and give some students extra help in collecting their data.

5. Ask the students to prepare a food chain using the Odell Lake worksheet and the data they have collected. Some students may find that they have not recorded enough observations to be able to construct the food chain. If time permits, have them go back to the lake and make more observations.

6. From a computer-literacy standpoint, it is important for the students to reflect upon and discuss the role of the computer simulation in this learning activity. Questions to raise in class discussions include the following:

   - In what ways does the computer show what it is really like in Odell Lake? What aspects of the real lake are not reflected in this simulation? (e.g., *weather, seasons, encounters between fish of the same species, effects of disease or old age on behavior of the fish.)*
   - Can we compare Odell Lake to a lake in our area? How would we do this? *(Discuss dominant species, food chains, effects of fishing and pollutants, etc.)*
   - In what ways does this simulation help us as we learn to make scientific observations, collect data, and learn about food chains? (e.g., *we can make a larger number of observations in an hour with the simulation than we could out at a real lake; it's not as expensive to study the simulation as it is to go to a real lake; we can easily go back and make more observations if we made a mistake in our data-collection procedure.)*

Related activities

Twelve related activities are suggested in the "Follow-Up" section of the Teacher's Manual for Odell Lake.

SAMPLE ACTIVITY ☐ GEOLOGY SEARCH

Objectives

Students use a computer simulation to aid in studying geology; they discover parameters of the simulation and discuss the realism of the program. (Using Programs 8, 9)

Prerequisites

Students need to have been studying the geological concepts and vocabulary used in the simulation.

Materials

- ☐ *Geology Search*, by Thomas F. F. Snyder and Computer Learning Connection, Inc., published by Webster Division, McGraw-Hill Book Co., 1982
- ☐ Teacher's Manual, program diskette, and student Searchbooks
- ☐ Apple II plus computer with disk drive

Program description

Students are natural-resource explorers engaged in the search for oil. On their instructions, the computer performs various geological tests at different sites on a fictitious continent. Students assimilate the resulting data concerning rocks, fossils, and underground structures and then make decisions regarding drilling. The process involves reading, interpreting and recording data, decision making, and teamwork.

Time for activity

Teacher preparation about 2 hours; student work from two to ten class periods

Classroom management

Three small groups of three to five students per group (Teacher's Manual includes detailed guidance to the teacher on how to manage the activity)

Teacher

1. Before introducing the activity to the class, read the Teacher's Manual and try out the program.
2. Introduce and manage the activity as described in the Teacher's Manual.
3. From a computer-literacy standpoint, it is important for the students to reflect upon and discuss the role of the computer program in this learning activity. Several questions to raise in class discussions include the following:
   - In what ways does the computer show what geological formations are really like?
   - What aspects of searching for oil are not reflected in this simulation?

- Does the program allow enough choices for action in order for you to make intelligent choices about where to drill for oil?

4. After the students have completed the number of rounds you have planned for this activity, discuss with them the assumptions built into the computer model. These are described in a section of the teacher's manual called "Between You and the Computer." Did the students discover some of the parameters of the model, such as the fact that the area near the two large river deltas contains a lot of sedimentary rock with the correct history for oil and with several large oil traps? Are students aware that the probability of finding oil in this simulation is many times greater than the probability in real life?

Related activities

Several supplementary activities are suggested in the Teacher's Manual, such as having students collect sample rocks and find the density of them.

See Sample Activity "Geography Search" in Chapter 6, which is a similar activity focused on geography topics.

SAMPLE ACTIVITY ☐ GRAPHING DATA

Objectives

Students use a computer program to plot graphs of their laboratory data; they discuss tasks performed by scientists which require computer assistance in processing and graphing large amounts of data. (Procedures 12; Using Programs 7; Fundamentals 3, 5; Applications 5)

Prerequisites

Students should be familar with operation of the classroom computer. They should also have done some science laboratory work in which data have been gathered.

Materials

- ☐ Students' laboratory data
- ☐ Dataplot program, from Muse-Software, Inc., or Appleplot program, Apple Computer, Inc., or similar plotting program for your computer
- ☐ Apple II computer with disk and monitor, arranged so all students can see the screen

Classroom management

Whole-class demonstration; individual student work on computer; whole-class discussion of lesson

Time for activity

Teacher preparation 30 minutes first time, 10 minutes thereafter; class demonstration about 15 minutes; individual work time is time it would take to type data on a sheet of paper



Science teacher Mr. Snyder uses DataPlot to graph students' laboratory data. He adds a bar graph to the display to help students visualize the relationship between the length of an inclined plane ramp and force required to move an object (Redland Middle School, Montgomery County, MD).

Teacher

1. Read the documentation that comes with the software you are using, and try out the program with a sample of your students' data.
2. Demonstrate to the class the process of inputting a set of their data. Demonstrate the process of choosing various kinds of graphs for the same data and comparing the usefulness of each graph for the purpose of the lab activity you are doing.
3. Allow individual students to input data while the class works on making a traditional graph on paper. Students need to know how to plot data by hand as well as how to use the computer to help.
4. Working with the class as a group, call up various sets of student data and interpret the graphs with the class. Use several kinds of graphs for the same set of data to teach the appropriateness of

certain graphs to certain situations. Compare graphs from several days' data or from several different students' data.

5. Have the students discuss the advantages and disadvantages of using the computer in this way. Relate these ideas to fundamentals about computers: speed, repetition, handling large amounts of data.

Have students identify the fact that a laboratory scientist might often use such computer tool to help analyze data.

SAMPLE ACTIVITY ☐ PERSONAL ENERGY AUDIT

Objectives

Students use a program to examine their personal energy use. They cite advantages and disadvantages of this information-retrieval application. (Using Programs 7, 10; Fundamentals 3, 5; Applications 3)

Prerequisites

Students should be familiar with operation of the classroom computer. They should also have had some instruction in energy conservation.

Materials

- ☐ *Personal Energy Audit,* National Science Teachers Association (includes Teacher's Manual, Energy Audit program and data base, and student handout materials)
- ☐ 48K Apple II with disk
- ☐ One or more large monitors, arranged so that all students can see demonstrations
- ☐ Copies of student survey sheet for each student (from Teacher's Manual)

Program description

This program allows students to look at their personal energy use, compare it to local and national averages, use the computer to analyze their findings, graph their data, and use a data base to determine their own energy usage.

Classroom management

Whole-class demonstration; individual student work on the computer; whole-class discussion of lesson

Time for activity

Teacher preparation 2 hours first time, 30 minutes thereafter; class demonstration about one class period; individual students on computer about 10 minutes per student; follow-up class discussion about one class period

Teacher

1. Acquire the package, read the supporting material, and fill out a student survey sheet yourself. Go through the program, using your own data to become familiar with the program. Then collect your own data for a second day.
2. Hand out the student survey sheets and ask the students to fill them in for their own energy use for a day, and bring the filled in sheets to class.
3. Demonstrate to the class the procedure for entering your data on the computer. Have a student assistant enter the data while you explain the procedure to the class. Have monitors arranged so all students can see the screen. Compare your day-one and day-two data and show the students the graph and discuss how to interpret all the information.
4. Send one or two students at a time to the computer to input their day-one data while the rest of the class continues to work on other assignments.
5. After step 4 has been completed for all students, process the information on the computer with the class. Compare different days' data; compare student data to group data and group data to national data.
6. Ask the students to collect another day of data, this time conserving as much energy as possible. After they input that data, make comparisons and interpret the results.
7. You can differentiate for faster students in many ways. For example, ask students to input data for a day, using only a shower and a bath. Have them review data for that day and determine the amount of energy used for each. The data base assumes that it uses twice as much energy to take a shower as to take a bath. Ask the students to design an experiment to test that assumption. Students can go on to modify the program's data base to reflect new findings. (See supporting material in the Teachers Manual for instructions.)
8. Ask the students to reflect on their experience with this energy audit program, in terms of computer capabilities to process large amounts of data at high speeds. How long would it have taken them to retrieve all the information on the energy use for each appliance, and compute total energy expenditures, if they had had to get the information from a book and do the computations by hand?

Ask students to contribute to two lists on the chalkboard. One is a list of the advantages of computerized information retrieval for this energy audit activity. The other list is a list of disadvantages.

Advantages	Disadvantages
• Information is found quickly and processed automatically. • We can change the data base with new information. • We can do experiments with different data items.	• There may be errors we don't know about. • It takes time to learn how to use. • We don't always have a computer available.

Related activities

The National Science Teacher's Association has several other programs in this series of energy-related microcomputer applications.

SAMPLE ACTIVITIES — TELLSTAR

Introduction

Tellstar is a program used to retrieve information about celestial objects including moon, sun, planets, stars, constellations, and Messier objects. You tell Tellstar the longitude, latitude, day, time, and year from which you want to observe the sky; and Tellstar generates for you an accurate picture of the sky for that location, time, and date.

Tellstar can be used in a wide variety of ways to help students learn science as well as learn how to use computer programs and data bases for experimentation and problem solving.

Objectives

In the activities in this section, students extend and apply skills and knowledge from several strands, as follows:

Using Programs objectives 6, 7 and 10:

6. Use documentation to select and operate program without teacher assistance
7. Select and use a program that helps to solve an assigned program
10. Retrieve selected information from a computer data base as an aid in an activity such as writing a term paper or preparing a science project

Procedures objective 12:

12. Develop a procedure for organizing data in a way that is needed to analyze or solve a problem and present the solution

Applications objective 5:

5. Describe one or more computer applications used by scientists, including:
   - What the scientist is studying
   - What kind of information the computer provides to the scientist
   - How the scientist uses the information
   - What kinds of data are input to the computer

Fundamentals objectives 3 and 5:

3. Give examples of tasks for which the computer's speed is necessary or advantageous; compare speed of humans to speed of computers in performing such tasks
5. Give examples of tasks that require processing of large amounts of data and explain why a computer is useful for carrying out such tasks

Science objectives, to be determined by the teacher, may involve applications and reinforcement of specific facts and concepts learned in class, formulating hypotheses, making observations, gathering and organizing data, drawing conclusions, and writing reports. Topic areas may include:

- ☐ Latitude and longitude
- ☐ Right ascension and declination
- ☐ Earth rotation
- ☐ Moon — positions, path, relation to earth
- ☐ Planets — appearance, locations, movement
- ☐ Stars — magnitudes, locations
- ☐ Constellations
- ☐ Messier objects

Materials

- ☐ *Tellstar* program published by Information Unlimited Software, Inc.
- ☐ Tellstar User Manual
- ☐ 48K Apple II with disk; paddles or joystick

☐ One or more large monitors, arranged so that all students can see demonstrations

Teacher preparation

Before using Tellstar with the class, spend about two hours or more becoming familiar with the operation of the program. Have one or two students also become familiar with operating the program, so they may serve as your assistants for demonstrations and to help other students.

SAMPLE TELLSTAR LESSON 1 ☐ USING TELLSTAR

Objectives

Students learn to operate the Tellstar program to retrieve information about celestial objects. They apply concepts of latitude, longitude, right ascension, declination, star magnitude, and phases of the moon. (Using Programs 6, 7, 10; Fundamentals 3, 5)

Prerequisites

Students should be familiar with operation of the classroom computer and be able to use program documentation to help in operating a program. They should also have been introduced to the concepts of latitude, longitude, right ascension, declination, star magnitude, and phases of the moon.

Materials

- ☐ *Tellstar* program published by Information Unlimited Software, Inc.
- ☐ Tellstar User Manual
- ☐ 48K Apple II with disk; paddles or joystick
- ☐ One or more large monitors, arranged so that all students can see demonstrations
- ☐ Copy of Tellstar Lesson 1 assignment for each student

Classroom management

Whole-class demonstration; student partners work on the computer

Time for activity

Teacher preparation 2 hours; class demonstration about one class period; partners on computer about 20 minutes

Teacher

1. Ask students if they know the latitude and longitude in your location. If they don't know, have someone look it up. Review with students the concept that the sky looks different to people at different locations on the earth and why.
2. Start up Tellstar, and have a student assistant input the latitude, longitude, viewing time, and date for about 9 P.M. tonight.

Enter the DISPLAY command to load the Display section of Tellstar.

3. Discuss with the students what Tellstar is doing as it calculates the sky picture for you. Have students discuss the fact that the program is doing a large number of computations in order to prepare the correct picture of the sky for your time and location. Discuss the fact that Tellstar has stored a set of data describing each of the celestial objects. Use the "Display" section of the manual as a guide for discussion as each of the series of calculations is performed and the status messages appear on the screen.
4. When the display appears, have your student assistant use the DIRECTION command to select a North compass heading. Point out the cross symbols that represent stars. Invite the class to try to identify a star they can see. Many should recognize Polaris, the North Star. Have your assistant go into IDENTIFY mode and use the joystick or paddles to move the cross-hairs to the object pointed out.

Have your assistant press Switch 0, which tells Tellstar to display information about the selected object.

Was the student correct in identifying the star? If not, use the LOCATE mode command to ask Tellstar to locate Polaris. Tellstar will respond with a display of data about Polaris.

5. Go over the data display for Polaris. Ask students: "What does magnitude mean? Is Polaris one of the brightest stars?"

Relate the terms "right ascension," "heading," "declination," and "elevation" to previous study of these concepts.

Return to display, and note that Polaris is shown blinking.

6. Ask the students to suggest a planet that might be visible from your location tonight. Have your assistant use the LOCATE mode to ask Tellstar to locate that planet.

Have students look at the data display for the planet. Is the planet visible at the time and location specified? When does it rise? Set?

7. Demonstrate CONSTELLATION mode. Can students identify the constellations drawn?
8. Ask Tellstar to locate the moon. Talk about the data displayed. If the moon is visible on the display, point out the symbol used to display it.
9. Review any operations the students wish to see.

10. Assign partners to work on Tellstar to learn to operate it in display mode. Point out the manual, which will be kept beside the computer. Ask students to leave the program running when they are finished, so that the next students won't have to reload the program.

Related activities

See sample Tellstar Lesson 2.

SAMPLE TELLSTAR LESSON 2 ☐ EXPERIMENTS WITH THE SKY

Objectives

Students learn to use Tellstar to perform experiments that involve sky observations from different latitudes and longitudes. They apply the concepts of latitude and longitude, and their relationship to celestial objects. (Using Programs 6, 7, 10; Procedures 12; Applications 5)

Prerequisites

Students will have done sample Tellstar Lesson 1. They should also have been introduced to the concepts of latitude, longitude, right ascension, declination, and Earth's position in relationship to the sun.

Materials

- ☐ *Tellstar* program published by Information Unlimited Software, Inc.
- ☐ Tellstar User Manual
- ☐ 48K Apple II with disk; paddles or joystick
- ☐ One or more large monitors, arranged so that all students can see demonstrations
- ☐ Copy of Tellstar Lesson 2 Assignment for each student

Classroom management

Whole-class demonstration; student partners work on the computer

Time for activity

Teacher preparation one-half hour; class demonstration about one class period; time partners spend on computer varies

Teacher

1. Review with students the concept that the sky looks different to people at different locations on the earth and why.

   A program like Tellstar is useful to us in learning about the relationship of Earth to the sun, moon, planets, and stars. We can't travel all around the world, making observations of the sky. But we can use Tellstar to simulate the experience of traveling around the world, making observations. Also, some-

times it is cloudy or rainy outside at night, so we can't make observations of the real sky.

Based on what we have learned in class, we can formulate some hypotheses about the way the sky would look from different latitudes. We can test our hypotheses by observing the skies that Tellstar shows us for those latitudes.

From what we have learned in class, what do we know about the rising and setting of the sun in northern latitudes in the winter? About when do you think the sun rises and sets in December at a place like Fairbanks, Alaska?

2. Start up Tellstar, and have a student assistant input the latitude and longitude for Fairbanks, Alaska (from the Appendix in the Tellstar manual). Enter a viewing time of 9 at night and a December date. Enter the DISPLAY command to load the Display section of Tellstar.
3. Review with the students what Tellstar is doing as it calculates the sky picture for you. Invite students to suggest differences they might expect between the Fairbanks sky and the sky at your location. Where would the North Star be expected to appear, for example?
4. When the display appears, have your student assistant use the LOCATE mode to retrieve data on the sun. Have students record on paper the data for time rising, time setting, and the headings for rising and setting. Were their initial guesses close?
5. Locate Polaris. Have students record the data for Polaris. Discuss the differences between Polaris at this latitude and Polaris at your latitude.
6. Have students suggest a city near the equator, such as Bogota, Colombia, where they might go to observe the sky for this same date and time. What are their predictions about the rising and setting of the sun there? For the location of Polaris?
7. Have the assistant set up Tellstar for the chosen city's latitude and longitude, for the same date and time as the Alaska trip. Locate, record, and discuss the differences in data for the sun and for Polaris, between Fairbanks, the equatorial city, and your location.
8. Invite students to suggest other sky experiments involving longitude and latitude that could be performed using Tellstar. Ask: "How will the sky appear, for example, in Moscow tonight as compared with our sky?"

9. Hand out copies of the assignment for Tellstar Lesson 2. Assign partners time to design an experiment and carry it out on the computer using Tellstar.

SAMPLE TELLSTAR LESSON 3 ☐ SKY PROJECTS

Objectives

Students use Tellstar to collect data on the orbits of planets in relation to the earth. (Procedures 12, Using Programs 10, Applications 5)

Prerequisites

Students will have done sample Tellstar Lessons 1 and 2. They should also have studied the orbits of the planets in our solar system.

Materials

- ☐ *Tellstar* program published by Information Unlimited Software, Inc.
- ☐ Tellstar User Manual
- ☐ 48K Apple II with disk; paddles or joystick
- ☐ One or more large monitors, arranged so that all students can see demonstrations

Classroom management

Whole-class demonstration; student partners work on the computer

Time for activity

Teacher preparation one-half hour; class demonstration about one class period; time for partners on computer will vary according to complexity of project

Teacher

1. Review with students the studies they have made of the orbits of the planets in the solar system, and the changes over time in the visibility of planets from Earth, as follows:

   A program like Tellstar is useful in our studies of the relationship of Earth to the sun, moon, planets, and stars. We can't travel in time, making observations of the sky. Also, sometimes the planets can't be seen because they are visible in the daytime when the sun is up. But we can use Tellstar to simulate the experience of observing the sky at different times and dates from 1975 to 1999.

   Based on what we have learned about the orbits of the planets, we can plan a class project to study the planets over time.

2. Have the class plan a project in which partners collect data from Tellstar on the positions of selected planets in relation to earth at specified dates between 1975 and 1999. Each partner team will

present its data in visual form on a chart to be placed on the wall in the classroom. The charts will be posted in sequence by dates. All the observations, when summarized, should enable us to visualize the paths of the selected planets in relation to Earth over a period of time.

Some of the decisions to be made in planning the project will include:

- What planets will we observe?
- Should the observations all be made for the same time of day?
- How far apart in time should observations be made in order to get an accurate picture of the motion of the planets in relation to Earth — daily, weekly, monthly, every six months?
- Should all our observations be made from the same latitude and longitude?
- How will we represent visually (on paper) the data we collect on the right ascension, heading, declination, elevation, rising time and heading, and setting time and heading?
- How many observations, in total, should we make — 10, 50, 100, 200?

3. After a sufficient number of observations have been made and posted, and discussions have been held regarding the interpretation of the data, have students assess the usefulness of Tellstar in comparison with other sources of information such as charts in textbooks and encyclopedias, planet and star "wheels," actual observation of the sky, visits to a planetarium. Ask: "Does the program help us to better understand the material we have been studying from the textbook or other sources? What are some of the limitations of this program?"

SAMPLE ACTIVITIES — STATES DATA BASE

Introduction

The sample lessons on the following pages show how students can build and use computerized data bases* to help them manage information on the subject of the fifty states of the United States. You can adapt these ideas to suit nearly any subject matter in your curriculum.

*We are using the phrase "data base" in a general way, to mean any organized collection of data stored in computer-readable form.



Student checks accuracy in information a classmate has just entered into the computer. This data base is being created by a sixth grade class in Black History (Redland Middle School, Montgomery County, MD).

In these lessons, students use PFS, a program for storing and retrieving data. It is published by Software Publishing Corporation for the Apple II. We chose this program because it is easy to learn and use, and is well documented. PFS has certain limitations and peculiarities, which are noted in the lesson plans where appropriate. There are many similar programs available for your computer.

Objectives

Students build and use a data base of states to explore interesting questions. (Procedures 12; Using Programs 10)

Materials

- ☐ PFS program published by Software Publishing Corporation (or similar program for your computer)
- ☐ PFS User Manual
- ☐ Two diskettes for storing your data base
- ☐ 48K Apple II with disk
- ☐ One or more large monitors, arranged so all students can see demonstrations
- ☐ Printer for printing reports from the data base

Teacher preparation

Before using these lessons, the teacher should do the following:

- ☐ Acquire PFS or other computer program that can be used to store and retrieve information.
- ☐ Spend a weekend experimenting with the program, to become familiar with its operation and documentation.
- ☐ DESIGN a file for the states data, according to the format shown in Figure 7 – 2 (DESIGN is a PFS function).
- ☐ ADD a form to the file for each state, filling in the state name and two-character abbreviation on each form, as shown in Figure 7 – 3 (ADD is a PFS function).
- ☐ Get enough copies of the *Information Please Almanac* so that each pair of students has one copy (Simon & Schuster, New York, 1982).

Students need to be able to use the computer keybourd comfortably and easily. If they are not proficient "keyboarders," they should use a typing tutor drill program before starting the data base lessons (see Chapter 5).

```
        POPULATION DATA
STATE ABBREV:

1980 STATE POPULATION
          (NN,NNN,NNN):
1980 POPULATION PER SQUARE MILE
                (NNN):
PERCENT CHANGE 1970 TO 1980
          (+ OR -NN.N):

LARGEST CITY          POPULATION
  NAME               (NN,NNN,NNN)
:                  .:
.
1980 PER CAPITA INCOME
            (NN,NNN) :

TO GET PAGE 1 FOR THIS STATE, PRESS
CTRL AND P.
TO RETURN TO MAIN MENU PRESS CTRL AND C.
```

```
        STATES DATA BASE
STATE: SAMPLE FORMAT   ABBREV:
CAPITAL:
FLOWER:
YEAR ENTERED UNION (NNNN):

1980 LAND AREA IN SQUARE MILES
            (NNN,NNN) :
STATE FORESTS, PARKS IN ACRES
          (N,NNN,NNN) :
MEAN ALTITUDE IN FEET
              (N,NNN) :
HIGHEST POINT        ALTITUDE
  NAME               (NN,NNN)
:                  .:
LOWEST POINT         ALTITUDE
  NAME               (N,NNN)
:                  .:

PRESS CTRL AND N FOR PAGE 2 POPULATIONS
PRESS CTRL AND C FOR MENU.
```

Figure 7 – 2 □ States data base format

```
        STATES DATA BASE
STATE: VIRGINIA        ABBREV: VA
CAPITAL:
FLOWER:
YEAR ENTERED UNION (NNNN):

1980 LAND AREA IN SQUARE MILES
            (NNN,NNN) :
STATE FORESTS, PARKS IN ACRES
          (N,NNN,NNN) :
MEAN ALTITUDE IN FEET
              (N,NNN) :
HIGHEST POINT        ALTITUDE
  NAME               (NN,NNN)
:                  .:
LOWEST POINT         ALTITUDE
  NAME               (N,NNN)
:                  .:

PRESS CTRL AND N FOR PAGE 2 POPULATIONS
PRESS CTRL AND C FOR MENU.
```

```
        POPULATION DATA
STATE ABBREV: VA

1980 STATE POPULATION
          (NN,NNN,NNN):
1980 POPULATION PER SQUARE MILE
                (NNN):
PERCENT CHANGE 1970 TO 1980
          (+ OR -NN.N):

LARGEST CITY          POPULATION
  NAME               (NN,NNN,NNN)
:                  .:
.
1980 PER CAPITA INCOME
            (NN,NNN) :

TO GET PAGE 1 FOR THIS STATE, PRESS
CTRL AND P.
TO RETURN TO MAIN MENU PRESS CTRL AND C.
```

Figure 7 – 3 □ Sample state form with name of state and state abbreviation on each page

SAMPLE DATA-BASE LESSON 1 ☐ SEARCH AND UPDATE

Objectives

Students use the PFS SEARCH/UPDATE function to retrieve STATES forms to enter data on state flowers, capital cities, and entrance dates to the union. (Using Programs 10)

Prerequisites

Students are able to operate the computer keyboard easily and comfortably.

Materials

- ☐ PFS Computer Program, published by Software Publishing Corporation
- ☐ STATES data base, containing a form for each state which includes the state name and abbreviation (see introduction, on page 245)
- ☐ Apple II computer with dual disk drive
- ☐ If possible, two large TV/monitors connected to the computer for the class demonstration, so all students can see information on a screen during demonstration
- ☐ Copy of *Information Please Almanac* (Simon & Schuster, New York, 1982) or equivalent information source for each pair of students
- ☐ Copy of Data-Base Lesson 1 assignment sheet for each partner team

Time for activity

Teacher preparation of STATES data base and addition of a form for each state — about 2 hours; class demonstration and assignment — about 20 minutes; student work at computer — 10 to 15 minutes for each pair of students

Classroom management

Whole-class demonstration and partners on computer

Teacher

1. Review with the class the terms "data base" and "information retrieval." Introduce the STATES data-base concept, and the fact that students will be building and using a computerized data base.
2. Assign partners to work together. Divide the fifty states fairly equally among the partner teams, and assign each team responsibility for particular states (e.g., with ten teams, each team gets five states).
3. Hand out assignment sheets to all students; have them fill in the names of partners and states for which they are responsible.
4. Demonstrate on the computer the PFS program and the procedure the students will follow when they do their assignment for this

lesson. As you perform each step, explain to the students what you are doing:

a. Load PFS on the computer, according to instructions in Chapter I of the PFS manual.

b. When the PFS menu appears on the screen, remove the PFS program disk and insert your STATES data-base disk in drive 1.

c. The STATES disk contains a form for each state in the U.S. Each pair of students is going to SEARCH/UPDATE the forms for the states assigned to them.

SEARCH/UPDATE is function 4 on the menu, so type "4" to the right of SELECTION NUMBER. Press the right arrow key to move the cursor down to the FILE NAME position.

The name of the file we are using is STATES, so type STATES to the right of FILE NAME:.

Press CTRL and C to tell PFS to continue.

d. PFS puts page 1 of the STATES form on the screen, with the phrase "RETRIEVE SPEC" on the bottom. PFS is waiting for us to tell it what form to retrieve. If we want to work with the state of Montana, we type MONTANA in the blank beside STATE:.

Press CTRL and C to tell PFS to continue.

e. PFS searches for the MONTANA form and puts it up on the screen. We are ready to update the MONTANA form.

f. Demonstrate typing name of CAPITAL, including how to correct errors. Press right arrow key to move the cursor down to the YEAR ENTERED UNION:.

g. Demonstrate typing entries for YEAR ENTERED UNION: and for FLOWER:. Point out that (NNNN) on the form means to enter four digits for the year.

h. When we've finished entering those data items, we press CTRL and C to tell PFS to continue. PFS stores the updated form on the disk, and gives us a message telling us it found one form that met our MONTANA specifications.

i. We press CTRL and C again, and we are ready to search for the next STATE form we need to update.

5. Review assignment sheets, procedures, and schedules for using the computer(s).

SAMPLE DATA-BASE LESSON 2 ☐ UPDATE: LAND AREA AND ALTITUDE

Objectives

Students use the PFS SEARCH/UPDATE function to retrieve STATES forms to enter data on land area and altitude (Using Programs 10)

Prerequisites

Students have done States Data-Base Lesson 1. They are also able to operate the computer keyboard easily and comfortably.

Materials

- ☐ PFS Computer Program
- ☐ PFS manual at the computer desk
- ☐ STATES data base on diskette, containing a form for each state
- ☐ Apple II computer with dual disk drive
- ☐ If possible, two large TV/monitors connected to the computer for the class demonstration, so all students can see information on a screen during demonstration
- ☐ Copy of *Information Please Almanac* for each pair of students (or equivalent information source), or a copy of the *Almanac* at the computer desk
- ☐ Copy of Data-Base Lesson #2 assignment sheet for each student.

Time for activity

Class demonstration and assignment — about 30 minutes; student work at computer — 15 minutes for each pair of students

Classroom management

Whole-class demonstration and partners on computer

Teacher

1. Review with class the work that was accomplished in Lesson 1. Have a student demonstrate to the class the retrieval of a STATE form she or he has updated.
2. Hand out Lesson 2 assignment sheets to all students, have them fill in names of partners and states they are responsible for. (Partners and states are the same as in Lesson 1.)
3. Discuss the data items to be entered on the STATES forms:
   - 1980 LAND AREA IN SQ. MILES (page 646 of *Almanac*) (NNN,NNN)
   - STATE FORESTS, PARKS (ACRES) (total acres from the *Almanac* entries for state forests and for state parks, starting on page 646 of *Almanac*) (N,NNN,NNN)

- MEAN ALTITUDE (FT) (page 468 of *Almanac*)
  (N,NNN)
- HIGHEST POINT (name)
- ALTITUDE at highest point
  (NN,NNN)
- LOWEST POINT (name)
- ALTITUDE at lowest point (if answer is Sea Level, enter SEA LEVEL)
  (N,NNN)

4. Discuss the following with the students:

   In PFS we must make the numeric data for all states the same length for a particular entry. Why?

   Later on, we will want to ask PFS to print out a list of all states, in order of their land area. Utah has a land area of 82,096 square miles. Alaska has a land area of 566,432 square miles. Which is larger? We know that Alaska is larger, because it has over 500,000 square miles, and Utah only has over 80,000 square miles.

   PFS, however, is not as smart as we are. PFS doesn't know about the place value of numeric digits. So when PFS looks at these two numbers, it sees only that 8, the first digit in 82,096, is bigger than 5, the first digit in 566,432. So PFS will think that Utah is bigger in land area than Alaska.

   When we use PFS, we must use fixed-length data for all numeric items. Thus, the land area for Utah becomes 082,096. And the land area for Alaska is 566,432.

   Then, later, when we ask PFS to list the states in order by their land area, PFS will see that Utah has a zero in the hundred-thousands position, whereas Alaska has a 5 in the hundred-thousands position.

   For this reason, we have designed our STATES forms such that all numeric data items are fixed-length. You must put zeroes in front of all data items to make them the specified length.

   To make the items more readable for people, we are also using commas in our numeric data.

5. Demonstrate on the computer the PFS program and the procedure the students will follow when they do their assignment for this lesson:

   a. Load PFS on the computer, according to instructions in Chapter I of the PFS manual.

b. When the PFS menu appears on the screen, remove the PFS program disk and insert the STATES data base disk in drive 1.

c. Choose SEARCH/UPDATE function (4), and the STATES file.

Press CTRL and C to tell PFS to continue.

d. PFS puts "RETRIEVE SPEC" on the screen. PFS is waiting for us to tell it what form to retrieve. Suppose we want to work with the state of Oregon. Type OREGON in the blank beside STATE:.

Press CTRL and C to tell PFS to continue.

e. PFS searches for the OREGON form and puts it up on the screen. We are ready to update the OREGON form.

f. One student looks up 1980 land area in square miles for Oregon in the *Almanac*. Remember that this data item has a fixed length of seven characters, including a comma in the middle. The student calls out the data in the correct form — i.e. "zero nine six comma one eight four." This will be typed in as the student reads it aloud.

g. This procedure will be continued for the remaining data items in the assignment, with all of you taking turns reading out the data.

Notice that many states have "sea level" as their lowest point. Type SEA LEVEL for those.

h. When we've finished entering those data items, we press CTRL and C to tell PFS to continue. PFS stores the updated form on the disk, and gives us a message telling us it found one form that met our OREGON specifications.

i. We press CTRL and C again, and we are ready to search for the next STATE form we need to update.

6. Review assignment sheets, procedures, and schedules for using the computer(s).

SAMPLE DATA-BASE LESSON 3 ☐ RETRIEVAL: SELECTING, SORTING AND REPORTING

Objectives

Students use the PFS PRINT function to retrieve selected STATE forms, and to print a report of the data. (Using Programs 10; Procedures 12)

Prerequisites

Students have done STATES Data-Base Lessons 1 and 2.

Materials

- ☐ PFS Computer Program
- ☐ PFS manual at the computer desk
- ☐ STATES data base on diskette, containing a form for each state with the data entered in Lessons 1 and 2
- ☐ Apple II computer with dual disk drive and printer
- ☐ If possible, two large TV/monitors connected to the computer for the class demonstration, so all students can see information on a screen during demonstration
- ☐ Copy of Data-Base Lesson 3 assignment sheet for each student

Time for activity

Class demonstration and assignment — about 30 minutes; student work at computer — 15 to 20 minutes for each pair of students

Classroom management

Whole-class demonstration and partners on computer

Teacher

1. Review with the class the work that was accomplished in Lesson 2. Have a student demonstrate to the class the retrieval of a STATE form he or she has updated.
2. Hand out Lesson 3 assignment sheets to all students, and have them fill in names of their partners.
3. "Now that we have some data in our STATES data base, we can begin to do some more interesting retrievals. For example, suppose I want to know what states entered the Union after the year 1900." First, demonstrate the use of the SEARCH/UPDATE function to find all the states with YEAR ENTERED UNION > 1900.

Then demonstrate use of SEARCH/UPDATE to find all the states with more than a million acres of STATE FORESTS, PARKS.

4. Tell the students that when they are writing a report or term paper, they will want PFS to print some information on paper, so that they can include the information in their written report. Explain that this can be done through the PFS PRINT function.

Demonstrate selecting the PRINT function from the main menu. The PRINT menu appears.

5. Explain that if we choose 1, "PRINT FORMS," and ignore choice 2 for now, a blank RETRIEVE SPEC will appear on the screen. If we want to retrieve all the states that entered the union before 1800, we'd put <1800 in the entry for YEAR ENTERED UNION. Then we press CTRL and C.

Next, PFS provides a list of PRINT OPTIONS.
Ignore the PRE-DEFINED PRINT SPEC for now.
Discuss the options.

Explain that LINES PER PAGE is a little tricky. If it is left at 66, PFS will print only one form's data per page. Tell students that they will only be printing two lines of data per state, and we'd like to have several states' data on one page. Specify 4 here, instead of 66, and see how it works out.

"Continue" with CTRL and C.

PFS provides the blank form again, this time with the words "PRINT SPEC" on the bottom. "This time we'll tell PFS what data items they want printed on our list. This is done by typing an X in the blank beside the item we want printed. For the purpose of a list of states that entered the union before 1800, what items do we want printed?" Probably just the name of the state and the year it entered the union.

Demonstrate typing X+ in the STATE entry and then an X in the YEAR ENTERED UNION entry.

"It might be nice, in our report, to have the states listed in the order in which they entered the union. We can ask PFS to do this by typing an S beside the X in the YEAR ENTERED UNION entry (S stands for "Sort")."

When all print specifications have been entered, students should check to make sure the printer is turned on and the paper is properly loaded, then press CTRL and C. PFS proceeds to search for the states that have been requested, sort them, and print them out.

Figure 7 – 4 shows a sample printout for states that entered the union between 1800 and 1850, sorted by year.

6. Review assignment sheets, procedures, and schedules for using the computer(s).

7. After students have completed the assignment, have them present their results to the class. Discuss how we draw conclusions from our data. For example, are there any similarities among states that entered the union between 1800 and 1850? Among states with highest mean altitude?

```
OHIO 1803
LOUISIANA 1812
INDIANA 1816
MISSISSIPPI 1817
ILLINOIS 1818
ALABAMA 1819
MAINE 1820
MISSOURI 1821
ARKANSAS 1836
MICHIGAN 1837
TEXAS 1845
FLORIDA 1845
IOWA 1846
WISCONSIN 1848
CALIFORNIA 1850
```

Figure 7 – 4 ☐ Sample printout for states that entered the union 1800 – 1850

SAMPLE DATA-BASE LESSON 4 ☐ UPDATE: STATES POPULATIONS

Objectives

Students add information on state populations to STATES data base. (Using Programs 10)

Prerequisites

Students have done States Data-Base Lessons 1, 2, and 3. They are also able to operate the computer keyboard easily and comfortably.

Materials

- ☐ PFS Computer Program
- ☐ PFS manual at the computer desk
- ☐ STATES data base on diskette, containing a form for each state and the data entered in Lessons 1 and 2
- ☐ Apple II computer with dual disk drive and printer

- ☐ If possible, two large TV/monitors connected to computer for the class demonstration, so that all students can see information on a screen during demonstration
- ☐ Copy of *Information Please Almanac* (or equivalent information source) at the computer desk
- ☐ Copy of Data-Base Lesson 4 assignment sheet for each student

Time for activity

Class demonstration and assignment — about 30 minutes; student work at computer — 10 to 20 minutes for each pair of students

Classroom management

Whole-class demonstration and partners on computer

Teacher

1. Review with the class the work that was accomplished in previous lessons. Have a student demonstrate to the class the procedure the partners will follow in updating the data base to add populations data. Use the procedure shown in the student assignment for this activity. Partners will continue to be responsible for the same states.
2. Hand out Lesson 4 assignment sheets to all students, have them fill in names of partners. Make sure all students understand the procedures.

```
        STATES DATA BASE
STATE: OREGON              ABBREV: OR
CAPITAL: SALEM
FLOWER: OREGON GRAPE
YEAR ENTERED UNION (NNNN): 1859

1980 LAND AREA IN SQUARE MILES
              (NNN,NNN) : 096,184
STATE FORESTS, PARKS IN ACRES
            (N,NNN,NNN) : 0,915,330
MEAN ALTITUDE IN FEET
                (N,NNN) : 3,300
HIGHEST POINT         ALTITUDE
  NAME                (NN,NNN)
: MOUNT HOOD        .: 11,239
LOWEST POINT          ALTITUDE
  NAME                 (N,NNN)
: PACIFIC OCEAN     .: SEA LEVEL

PRESS CTRL AND N FOR PAGE 2 POPULATIONS
PRESS CTRL AND C FOR MENU.
```

```
        POPULATION DATA
STATE ABBREV: OR

1980 STATE POPULATION
            (NN,NNN,NNN): 02,632,663
1980 POPULATION PER SQUARE MILE
                  (NNN): 027
PERCENT CHANGE 1970 TO 1980
             (+ OR -NN.N): +25.9

LARGEST CITY             POPULATION
  NAME                  (NN,NNN,NNN)
: PORTLAND            .: 00,346,303
.
1980 PER CAPITA INCOME
               (NN,NNN) : 09,400

TO GET PAGE 1 FOR THIS STATE, PRESS
CTRL AND P.
TO RETURN TO MAIN MENU PRESS CTRL AND C.
```

Figure 7 – 5 ☐ Sample state form filled in with all data

3. A sample state form filled in with all data is shown as Figure 7 – 5.
4. Set up a quality control process to ensure accuracy of the data the students have entered. For example, pick 10 states at random and assign one state to each team. Have teams verify accuracy of data for the state.

SAMPLE DATA-BASE LESSON 5 ☐ EXPLORING THE DATA BASE

Objectives

Students use their STATES data base to explore facts and ideas about state populations. (Procedures 12, Using Programs 10)

Prerequisites

Students have done STATES Data-Base Lessons 1 through 4.

Materials

- ☐ PFS Computer Program
- ☐ PFS manual at the computer desk
- ☐ STATES data base on diskette, containing a form for each state with the data entered in Lessons 1 through 4
- ☐ Apple II computer with dual disk drive and printer
- ☐ If possible, two large TV/monitors connected to the computer for the class demonstration, so all students can see information on a screen during demonstration
- ☐ Copy of Data-Base Lesson 5 assignment sheet for each student

Time for activity

Class demonstration, assignment, and follow-up — two class periods; student work at computer — 15 to 20 minutes for each pair of students

Classroom management

Whole-class demonstration and partners on computer

Teacher

1. Review with the class the work that was accomplished in Lesson 4. Have a student demonstrate to the class the retrieval of a STATE form she or he has updated.
2. Hand out Lesson 5 assignment sheets to all students; have them fill in names of partners.
3. Introduce this activity by telling students:

> Now that we have some more data in our STATES data base, we can begin to do some more interesting retrievals and

explore some interesting questions. For example, I noticed when we were entering the data that some states had a much larger population growth than others between 1970 and 1980. Some states actually lost population while Nevada, for example, grew by 63.5 percent.

Does our little data base have information in it that would help us see patterns concerning which states grew and which didn't? I thought, perhaps people moved away from states with a high population density to states with a low density (population per square mile).

4. Demonstrate the procedure followed for this experiment:
   a. Select PRINT option from main menu and PRINT FORMS option from print menu.
   b. On RETRIEVE SPEC, use CTRL and N to get page 2.
   c. Specify > +30.0 for percent change 1970 to 1980. This will tell PFS to select only those states that grew 30 percent or more in population between 1970 and 1980.
   d. Press CTRL plus C to get the PRINT OPTIONS.
   e. Leave all the default values as they are except change LINES PER PAGE to 6.
   f. CTRL plus C will yield the PRINT SPEC.
   g. Tell PFS what items to print.
      - Put an X in the field for STATE.
      - Press CTRL plus N to get page 2 of the PRINT SPEC.
      - Put an X in the field for 1980 STATE POPULATION.
      - Put an X in the field for 1980 POPULATION PER SQUARE MILE.
      - To ask PFS to sort on this field, put an S beside the X.
      - Finally, put X in the field for PERCENT CHANGE 1970 to 1980.
      - CTRL plus C will tell PFS to carry out these instructions.

5. Discuss the printout. (See example, Figure 7 – 6.) Notice that all the states with the high population growth (except Florida) have very low population densities. Ask students: "What else do we notice about these high-growth states?" *(They are all in the west and south.)*

```
        POPULATION DATA
STATE ABBREV: AK  1980 STATE POPULATION
(NN,NNN,NNN): 00,400,481
1980 POPULATION PER SQUARE MILE
(NNN): 001
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +32.4
        POPULATION DATA
STATE ABBREV: WY  1980 STATE POPULATION
(NN,NNN,NNN): 00,470,816
1980 POPULATION PER SQUARE MILE
(NNN): 005
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +41.6
        POPULATION DATA
STATE ABBREV: NV  1980 STATE POPULATION
(NN,NNN,NNN): 00,799,184
1980 POPULATION PER SQUARE MILE
(NNN): 007
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +63.5
        POPULATION DATA
STATE ABBREV: ID  1980 STATE POPULATION
(NN,NNN,NNN): 00,943,935
1980 POPULATION PER SQUARE MILE
(NNN): 011
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +32.4
        POPULATION DATA
STATE ABBREV: UT  1980 STATE POPULATION
(NN,NNN,NNN): 01,461,037
1980 POPULATION PER SQUARE MILE
(NNN): 018
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +37.9
        POPULATION DATA
STATE ABBREV: AZ  1980 STATE POPULATION
(NN,NNN,NNN): 02,717,866
1980 POPULATION PER SQUARE MILE
(NNN): 024
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +53.1
        POPULATION DATA
STATE ABBREV: CO  1980 STATE POPULATION
(NN,NNN,NNN): 02,888,834
1980 POPULATION PER SQUARE MILE
(NNN): 028
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +30.7
        POPULATION DATA
STATE ABBREV: FL  1980 STATE POPULATION
(NN,NNN,NNN): 09,739,992
1980 POPULATION PER SQUARE MILE
(NNN): 180
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +43.4
```

Figure 7 – 6 ☐ PFS printout of states having greater than 30% population growth between 1970 and 1980, sorted by population density per square mile

6. It might be interesting to compare these high-growth states with a collection of low-growth states. Ask the students how that might be done, using PFS. Have them suggest retrieve, sort, and print specs that will provide selected information about states that had very low population growth. If they asked PFS to print out all states with population growth less than 5 percent, they would find that these states have high population densities and all are in the north and east. (See example, Figure 7 – 7.)

7. Review with the students the techniques for information retrieval used in this experiment as follows:

   First, we formulated a question concerning population growth. Then, we selected a figure for our retrieve specification — greater than 30 percent growth. How did we know to select 30 percent as the retrieve specification? We had to get a little familiar with the range of values in that data field. If we had asked to retrieve all states with 20 percent or greater growth, we would have had a much longer list of states to work with in our printout.

   Next, we decided what we wanted on the printout. We could have asked for all the data items on the form to be printed on our list. But we were only interested in populations just now. So we put X's only in those population fields that were of interest to us.

   Also, we decided about sorting the states by population density. Since we were interested in the relationship between population growth and population density, it seemed useful to ask PFS to print out the states in order of population density.

8. Hand out assignment sheets and go over the instructions.

9. After the students have completed their projects, have volunteers show the class their printouts, explain how they got them, and why they used the particular retrieve specs and print specs they used.

10. Invite students to evaluate the usefulness of a tool such as PFS. In what ways is it more or less useful than other information-retrieval methods such as looking something up in an encyclopedia?

```
POPULATION DATA
STATE ABBREV: X
1980 STATE POPULATION
(NN,NNN,NNN): X
1980 POPULATION PER SQUARE MILE
(NNN): XS
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): X
        POPULATION DATA
STATE ABBREV: PA
1980 STATE POPULATION
(NN,NNN,NNN): 11,866,728
1980 POPULATION PER SQUARE MILE
(NNN): 264
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +00.6
        POPULATION DATA
STATE ABBREV: OH
1980 STATE POPULATION
(NN,NNN,NNN): 10,797,419
1980 POPULATION PER SQUARE MILE
(NNN): 264
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +01.3
        POPULATION DATA
STATE ABBREV: NY
1980 STATE POPULATION
(NN,NNN,NNN): 17,557,288
1980 POPULATION PER SQUARE MILE
(NNN): 367
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): -03.8
        POPULATION DATA
STATE ABBREV: MA
1980 STATE POPULATION
(NN,NNN,NNN): 05,737,037
1980 POPULATION PER SQUARE MILE
(NNN): 733
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): +00.8
        POPULATION DATA
STATE ABBREV: RI
1980 STATE POPULATION
(NN,NNN,NNN): 00,947,154
1980 POPULATION PER SQUARE MILE
(NNN): 902
PERCENT CHANGE 1970 TO 1980
(+ OR -NN.N): -00.3
```

Figure 7 – 7 □ PFS printout of states having less than 2% population growth between 1970 and 1980, sorted by population density per square mile

SAMPLE WORD-PROCESSING LESSONS

Introduction

The reason for students to learn to use word processors is to help them to become better writers. Word-processing systems make it easy to edit and revise something one has written, without the laborious work of recopying the entire composition. Students can thus focus on the process of correcting errors and improving the composition.

The Sample WP Lesson Plans on the following pages are just that — samples. Your actual lessons will depend upon the word-processing program available, the number of machines (and therefore per-student machine time) available, your composition goals for the students, and the amount of time you can afford to spend on this topic.

Objectives

Students learn to use a word processing program to help improve their creative writing skills. They learn to operate the program without the teacher's assistance. (Using Programs 6, 11)

Prerequisites

Students should be comfortable using the computer keyboard. If they are not, provide a typing tutor program so they can practice their keyboard skills before starting the word-processing lessons.

Materials

- ☐ AppleWriter 1.1 Text Editing Program, published by Apple Computer, Inc.
- ☐ Tutorial file on the AppleWriter disk
- ☐ Demo file prepared by teacher
- ☐ AppleWriter manual
- ☐ Extra diskettes for storing students' files
- ☐ Apple II computer with large monitor or TV
- ☐ Printer
- ☐ Copies of student handouts (provided at end of this chapter)

Program description

The Sample WP Lesson Plans are based on AppleWriter, a fairly simple text editing program. AppleWriter was not specifically designed for students, and the Apple II keyboard is not ideal for word processing. You may be able to get a more suitable program for your machines.

$

Note: You need to know how to move the cursors around in order to use this demo. You can learn that from the tutorial file on the AppleWriter program disk.

There are six exercises in this demo.

1. Delete this this extra word.

Get a white cursor on the s in "this," and press the left arrow key four times.

2. Use CTRL-W to delete this word word.

Get a wh te cursor on the d in "word" and press CTRL-W.

3. Replace all the instances of the word "the" with the word "our":

   CTRL-B (puts cursor at beginning of page)
   CTRL-S
   /the/our/

4. Demonstrate wrapping by typing a paragraph here:

5. Move this sentence to the top of the page. Here's how:

   Put cursor at end of sentence 5. (After "page")
   CTRL-Y
   5. is origin marker.
   $ is destination marker.
   Use CTRL-B to see top of page.

6. Print out this demo file:

   ESC ESC CTRL-Q gets the editor menu.
   P gets the print menu.

(Teacher, insert here details of using the print menu with your printer.)

Figure 7 – 8 □ Demo file

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Teacher preparation

Before beginning Lesson 1 with the class, you need to do the following:

1. Become familiar with and comfortable using the program. Use the tutorial file provided on the AppleWriter program disk to get started.
2. Create a demo file that you will use when demonstrating AppleWriter to the class. Suggested contents of the Demo file are shown in Figure 7 – 8. You may need to experiment with your printer and the print menu in AppleWriter before you get your printouts the way you want them.
3. Select one or two students to serve as your assistants in demonstrations and to serve as consultants to other students. Have the assistants become familiar with AppleWriter.
4. Make sure all your students have the prerequisite keying (typing) skills. They don't need to be "touch" typists, but they need to be very familiar and comfortable with the keyboard.
5. Arrange for equipment to be set up "demonstration" style in the classroom. This will mean at least one computer and one or two large TV screens so that all students can watch the demonstration.
6. Arrange a schedule for individual students to get hands-on experience on the computer over the next few days, so they can do their assignments.

Time for activities

Since the purpose for having students use a word processor is to help them learn to write, the sample activities will take place over a period of time — perhaps a whole semester or at least several weeks. Students must become thoroughly facile in the mechanics of using the word processor, and must have time to complete several revisions of their composition.

Class management

Students will work in small groups of two or three.

Recommended reading

"Word Processing: Can It Make Even Good Writers Better?", by Collette Daiute; *Electronic Learning*, 1, no. 4 (March/April 1982), 29 – 31.

"Beyond the Typewriter: An English Teacher Looks at the Word Processor," by Robert J. Gula; *Classroom Computer News*, 2, no. 5 (May/June 1982) 31 – 32.

"Word Processors for Teachers," by William Hedges; *Classroom Computer News*, 1, no. 2 (November 1980).

"Word Processing Software Roundup," by Steven Jong; *Personal Computing* (January 1981), p. 26.

"Word Processing in the Classroom: Is It Really Practical?", by Dorothy H. Judd; *Educational Computer Magazine* (June 1982), pp. 18 – 19.

"One Child's Learning: Introducing Writing with a Computer," by R. W. Lawler; *SigCue Bulletin*, 14, no. 3 (July 1980), 18 – 28.

Teacher's Guide to Computers in Education, by David Moursund; International Council for Computers in Education, 1980, p. 23.

Mindstoms, by Seymour Papert; Basic Books, 1980, pp. 30 – 31.

"Microcomputer-based Environments for Writing: A Writer's Assistant," by J. A. Levin, M. J. Boruta, and M. T. Vasconcellos; *Classroom Computers and Cognitive Science*, A. C. Wilkinson (ed); Academic Press, 1982.

SAMPLE WP LESSON 1 ☐ USING APPLEWRITER

Objectives

Students will be able to use the following AppleWriter features without referring to the manual:

- ☐ Editor menu
- ☐ Load file
- ☐ Cursor control
- ☐ Delete, insert characters and words
- ☐ Upper and lower case
- ☐ Move blocks of text
- ☐ Save file
- ☐ Print file

(Using Programs 6, 11)

Prerequisites

The student should be familiar with locations of all alphanumeric and special keys on the keyboard, and be able to use them without searching for them.

The student should be comfortable using the computer, including loading programs, handling disks, etc.

Materials

- ☐ Apple II computer with two large monitors or TVs set up so all students can see demonstration
- ☐ AppleWriter 1.1 Text Editing Program, published by Apple Computer, Inc.

- ☐ Tutorial on AppleWriter disk and demo file prepared by teacher
- ☐ AppleWriter manual or some other equivalent configuration of software and hardware
- ☐ Copy of WP Lesson 1 handout for each student

Time for activity

Teacher preparation about 8 hours; whole-class demonstration one class period; individual student work on computer 30 to 60 minutes

Class management

Whole-class demonstration; individual work on computer

Teacher

1. Introduce the activity. Explain that this is the first in a series of word-processing activities students will engage in over the next several weeks.

Hand out WP Lesson 1 handout. The demonstration will follow the procedure given in the handout.

2. Have a student assistant operate the computer while you talk through the demonstration to the class. Make sure everyone can see a screen comfortably.

Begin with computer turned off.

Demonstrate loading the AppleWriter program.

Talk about the Editor menu. It provides an overview of the kinds of things you do when you use AppleWriter.

Load the tutorial file from disk. Say out loud what keys the assistant is pressing.

Go through the tutorial. It is hard to read, so talk it through. Have assistant follow the instructions and exercises.

When tutorial is finished, demonstrate going back to Editor menu and saving the file under a new name.

Load the demo file. Talk through the demo as the assistant or another student does the keying.

Print the demo file. Talk about the print menu selections needed to get a double-spaced printout on your printer.

3. Tell students their assignment, which is to follow the procedure given on the WP Lesson 1 handout. Make sure students all know the rules and schedules for using the computer(s). Student assistants should be available as much as possible to help their classmates, but each student needs individual "hands-on" time in order to become facile in the use of the program.

SAMPLE WP LESSON 2 ☐ APPLEWRITER EXPERIMENTS

Objectives

Students work together in small groups to do the following in AppleWriter:

- ☐ Create a new file.
- ☐ Input a short composition a student has previously prepared.
- ☐ Make changes in spelling, grammar, and punctuation.
- ☐ Modify original composition by adding, deleting, or moving words, sentences, and paragraphs.
- ☐ Name and save the composition created by the group.
- ☐ Print out the results of the group's work.

(Using Programs 6, 11)

Prerequisites

Students have done WP Lesson 1. They should also have prepared short (handwritten) compositions in advance of this class.

Materials

- ☐ Apple II computer with two large monitors or TVs set up so all students can see demonstration
- ☐ AppleWriter Text Editing Program, published by Apple Computer, Inc.
- ☐ An initialized file diskette for saving student compositions
- ☐ AppleWriter manual or some other equivalent configuration of software and hardware
- ☐ WP Lesson 2 handout for each student

Time for activity

Teacher preparation about 1 hour; whole-class demonstration one class period; small-group student work on computer 30 minutes per group

Class management

Whole-class demonstration; small groups of two to four students

Teacher

1. Introduce the activity, which should be approached in a spirit of experimentation and playfulness. The students will work in small groups (two to four students per group). Challenge students to be experimental and inventive, discovering ways they can use AppleWriter to create and change their compositions.
2. Hand out the WP Lesson 2 handout, and go over it with the class. Give them a few minutes to get together in their groups and agree on their procedures.
3. While the other groups are getting ready, select a first group to begin inputting their composition.
4. Have the first group demonstrate use of AppleWriter features to experiment with the composition. If the students follow the pro-

cedures outlined in the handout, they will not have to be concerned about making mistakes or destroying their composition, since a copy is kept on disk as backup. Encourage the student to be creative, trying out different ways of organizing and expressing their ideas.

5. Time permitting, invite a second group to "perform" for the class.
6. Tell students that their assignment is to perform experiments on their compositions as outlined in the handout, and to turn in the original and the final versions of the composition. Review the rules and schedules for teams using the computer(s).

SAMPLE WP LESSON 3 ☐ APPLEWRITER EDITING

Objectives

Students work together as partners to do the following in AppleWriter:

- ☐ Create a new file.
- ☐ Input a short composition a student has previously prepared.
- ☐ Review and edit partner's composition.
- ☐ Modify original composition by changing, adding, deleting, or moving words, sentences, and paragraphs.
- ☐ Name and save compositions created by the team.
- ☐ Print out the results of the team's work.

(Using Programs 6, 11)

Prerequisites

Students have done WP Lessons 1 and 2. They should also have prepared short (handwritten) compositions in advance of this class.

Materials

- ☐ Apple II computer with two large monitors or TVs set up so all students can see demonstration
- ☐ AppleWriter Text Editing Program, published by Apple Computer, Inc.
- ☐ An initialized file diskette for saving student compositions
- ☐ Applewriter manual or some other equivalent configuration of software and hardware
- ☐ WP Lesson 3 handout

Time for activity

Teacher preparation about 1 hour; whole-class demonstration one class period; small-group student work on computer 30 minutes per group

Class management

Whole-class demonstration; partners on computer

Teacher

Each student comes to class with a short composition already written, from a short list of teacher-assigned topics.

1. Introduce the activity. Students will work in teams of two.

Challenge students to be experimental and inventive, discovering ways they can use EasyWriter to create and change their compositions.

2. Hand out the WP Lesson 3 handout, and go over it with the class. Give the students a few minutes to get together as partners and agree on their procedures.
3. While the other pairs are getting ready, select a first pair to begin inputting their composition.
4. Have the first group demonstrate the assigned procedure. If the students follow the procedures outlined in the handout, they will not have to be concerned about making mistakes or destroying their composition, since a copy is kept on disk as backup. Encourage the students to be creative, trying out different ways of organizing and expressing the ideas.
5. Time permitting, invite a second pair to "perform" for the class.
6. Tell the students that their assignment is to perform experiments on their compositions as outlined in the handout, and to turn in the original and the final versions of the composition. Review the rules and schedules for teams using the computer(s).

Reference

Suggested editing procedures are based on Richard Cramer's "editing workshop" as described in his book, *Children's Writing and Language Growth*, Charles Merrill, 1978.

SAMPLE WP LESSON 4 ☐ APPLEWRITER PROJECTS

Objectives

Students will work together in small groups to do the following in AppleWriter:

- ☐ Outline a composition.
- ☐ Insert text into the outline.
- ☐ Make changes in spelling, grammar, and punctuation.
- ☐ Modify original composition by adding, deleting, or moving words, sentences, and paragraphs.
- ☐ Name and save the several versions of the composition created by the group.
- ☐ Periodically print out the results of the group's work.
- ☐ Manage the group's word-processing files on the disk.

(Using Programs 6, 11)

Prerequisites

Students have done WP Lessons 1 and 2.

Materials

- ☐ Apple II computer
- ☐ AppleWriter Text Editing Program, published by Apple Computer, Inc.
- ☐ For each group, an initialized file diskette for saving student compositions
- ☐ AppleWriter manual or some other equivalent configuration of software and hardware
- ☐ WP Lesson 4 handout for each student

Teacher preparation

Decide on a selection of writing projects appropriate for your students. The projects should be of challenging length and of interest to your students. Topics related to computer technology, journalism, or current events might be selected. Offer several alternatives from which the students can select their project.

Time for activity

Teacher preparation about 1 hour; small-group student work on computer several hours per group over a period of six weeks

Class management

Small groups of two to four students per group

Teacher

1. Hand out the assignment sheet (WP Lesson 4 handout) and discuss it with the class.

Stress that the end product of each group's work is to be a high-quality composition. All members of each team will contribute to the research, the organization of ideas, the content, the grammar, and the physical format of the printed report or composition. At the end of each week, the teams will turn in to the teacher a printout of the latest version of their compositions.

2. Make sure all students are clear on rules and schedules for use of the computer(s).
3. Monitor the students' projects. Have teams report to the class on the progress they are making in working together.

Related activities

Have students prepare articles for the school newsletter using their word processing skills to edit, format, and print out the newsletter.

Have students prepare on the word processor, the weekly bulletin or other memoranda your school sends out to parents.

SAMPLE ACTIVITY ☐ JUNK MAIL

Objectives

Students describe one or more ways in which word processing is used in fields such as business. (Applications 6)

Prerequisites

This activity is best understood by the students if they have used a text editor or word processor.

Time for activity

One or more class periods

Teacher

1. Allow about two weeks for students to respond to your request that they bring to class a letter they or their parents have received in the mail, and that students believe was written by a computer or word processor. Have a few samples of your own on hand for students who are not able to bring one to class.
2. Ask the class these questions about their letters:
   - Does it look like a personal letter that a person wrote to you or to your parents?
   - Who wrote the letter?
   - Why did he or she write it?
   - About how many other people might have received letters that look almost exactly the same as your letter?
   - What words or parts of the letter would be different if the letter was received by someone else?
   - How did the person who wrote the letter get your name and address?
   - Do you or your parents know the person who wrote the letter?
   - How was a computer used to prepare this letter?
   - What do we call this kind of computer application? *(word processing)*

Assignment

Suggest that the students write an answer to the person whose name is signed on the letter. They might, for example, ask a question about something that was said in the letter (A postage-paid return envelope is usually enclosed with these kinds of mailings. Have the students write on that envelope the name of the person who signed the letter.) Do they think the person will write back to them? Why or why not? Do they think the computer will write back to them? Ask students to report back to class if they get any response to their letters.

SAMPLE ACTIVITY ☐ TIME LINE

Objectives

Students identify events and factors affecting the pace of change in computer technology. (Impact 5)

Prerequisites

The students should be generally familiar with computer capabilities and limitations, through their use of computer programs.

Materials

- ☐ Large time line on 36" Kraft paper for bulletin board
- ☐ Time-line worksheets
- ☐ 5 × 8 cards, each containing a heading such as the following:
  - First stored-program computer
  - Computer is the size of a large room
  - Computer costs about a million dollars
  - Computer can do a thousand additions a second
  - Computer can store a thousand characters of information in memory
  - About ten computers exist in the world
  - Computer is about the size of a refrigerator
  - Computer costs about $100,000
  - About 10,000 computers exist in the world
  - Over 100,000 computers exist in the world
  - Computer is about the size of a typewriter
  - Four-function calculator costs several hundred dollars
  - Four-function calculator costs under $10
  - First internal combustion engine automobile
  - Automobile travels about 25 miles per hour
  - Automobile costs about $5,000
  - About a hundred automobiles exist in the world
  - About a million automobiles exist in the world
  - Automobile travels about 50 miles per hour
  - First electric light bulb
  - First airplane flies
  - Airplanes fly about 100 miles per hour
  - Airplanes fly about 500 miles per hour
  - My grandfather is born
  - My mother is born
  - I am born
- ☐ Books, newspaper and magazine articles, and posters on history of computers
- ☐ Short film or sound filmstrip on history of computers such as the first filmstrip in Guidance Associates' kit "Computers: From Pebbles to Programs"
- ☐ Miscellaneous art supplies, such as cards, colored markers, construction paper

Classroom management

Whole-class and small-group activity

Time for activity

Two to three class periods

Teacher

1. Begin by showing a film on the history of computers and/or other inventions to be used on your time line. Ask students to make notes regarding the size, speed, capacity, and cost of computers at different points in time.
2. Introduce the activity by giving each pair of students a few 5 × 8 cards with headings such as those listed above. Tell them to find out when the event listed on the card first happened. They are to write the date on the card and illustrate the event if they desire. Explain that the purpose of this activity is to have students produce a large time line that shows the pace of development of computers in relation to other events the students know about.
3. Introduce the research materials to be used. Allow an interval of time for the research. When finished, each group pins their cards on the time line at the appropriate location. When all cards have been put on the time line, one person from each group, in historical sequence from the time line, reports orally on his or her group's research while the remaining students take notes and place the event or topic on their own time-line worksheets. There are a number of different indicators of the information explosion that could be placed on the time line, such a numbers of new book titles published annually, size of the gross national product, size of world population, size of large corporations in terms of numbers of employees or annual gross income.

For ease of reading, different-colored markers might be used on the time line for different kinds of events — e.g., all computer events in red; other inventions in blue; indicators of the information explosion in green.

4. Several topics for class discussion are possible to help students interpret and understand the significance of the time line. For example: Why have computers become so much cheaper and more powerful, whereas cars and airplanes have become more expensive and only somewhat more powerful? *(The invention of transistors and large-scale integration; cars and airplanes need expensive raw materials such as steel and rubber.)*

Ask the students to give arguments for and against the statement, "Necessity is the mother of invention."

Recommended reading

Computers in Society, by Donald Sanders; McGraw-Hill, 1981, esp. Chap. 2.

SAMPLE ACTIVITY ☐ COMPUTERS AND ETHICS

Objectives

Students analyze and discuss computer ethics and copyright issues. (Impact 1, 4)

Prerequisites

The students should have experience using and copying programs. This activity is best introduced at a point in time when an ethical issue involving computers arises in the classroom.

Materials

Lesson 1 in "Computers and Ethics" Computer Literacy Instructional Module developed by Minnesota Educational Computing Consortium

Time for activity

One or two class periods

Teacher

Acquire and read the MECC instructional module on "Computers and Ethics." Lesson 1 of the MECC module includes three main activities, supported by transparencies and student handouts:

1. Have a general discussion with the class about "computer wrongs," such as copying programs without rights or permission, taking another's program and saying it's yours, or reading someone's private data.
2. Have the students read and interpret a story, "Copying Joe's Game," in which they calculate such things as the number of copies of a program Joe will have to sell in order to recover his investment of time in writing a computer program, and how much Joe will lose if his friends copy the program without paying him for it.
3. Have the students read a handout that summarizes information about computing and copyright law, and take a quiz on the subject.

Recommended readings

"To Copy or Not to Copy: A Moral Dilemma," by Tim Barry; *Infoworld*, 2, no. 17 (September 29, 1980), 5 – 6.

"Fair Payment for Fair Use in Future Information Technology Systems," by Daniel Callison; *Educational Technology*, January 1981, pp. 20 – 25.

"Washington Tackles the Software Problem," by Christopher Kern; *BYTE*, May 1981, pp. 128 – 38.

"Copying Software — Crime in the Classroom?", by Lauren Letellier; *Electronic Learning*, 6, no. 12 (January/February 1982), 42 – 51.

"The Legal Protection of Computer Programs," by Ross Olmstead; *Creative Computing*, 6, no. 12 (December 1980), 114, 116 – 17.

SAMPLE ACTIVITY ☐ COMPUTERS AND CRIME

Objectives

Students analyze and discuss social issues related to computer crime. (Impact 1, 4)

Prerequisites

The students should have had experience using computers.

Materials

"Computer Crime," Computer Literacy Instructional Module developed by Minnesota Educational Computing Consortium

Time for activity

One or two class periods

Teacher

Acquire and read the MECC instructional module on "Computer Crime." Lesson 1 of the MECC module includes four main activities, supported by student handouts:

1. Have a general discussion with the class about misuses of computers, computer crime, and its potential effects on society.
2. Ask the students to read and interpret a handout that defines computer crime and gives examples of computer crimes, such as larceny, embezzlement, and fraud.
3. Have the students read and answer questions on a series of three case studies of computer crimes.
4. Ask students to write essays on topics such as "Reasons why it is difficult to prevent computer crime" and "How does computer crime affect the economy?"

Recommended reading

"Computer Fraud," Chap. 7 in *Computers and Social Controversy*, by Tom Logsdon; Computer Science Press, 1980.

SAMPLE ACTIVITY ☐ SCHOOL CASE STUDY

Objectives

Students research and describe a computer application found in their school district or local government. (Applications 8)

Prerequisites

Students should have been introduced to concepts from Applications objectives 1 and 2, and Fundamentals 1 through 5.

Time for activity

About two class periods over two weeks

Teacher

This activity assumes that your school and school district has some computer-based applications. If it does not, you might substitute a local business firm or government agency for the school case study.

1. Divide the class into small groups of three or four students. If your school has enough different computer applications, give the students a list of the applications and allow each group to choose one of the applications to study. Your list might include:
   - Pupil attendance
   - Payroll
   - Inventory
   - Budget
   - Class scheduling
   - Grade reporting
   - Library
   - Test scoring
2. Tell the students that their assignment will be to describe a computer application and its limitations. Each group will produce a report on its application. The report will contain the following items:
   - Name of the application or system
   - Who uses it (names or titles of people who use information from the system or application)
   - What information the user gets (include sample printout)
   - How he or she uses this information
   - How often the user gets this information from the computer
   - Whether or not the user usually finds the information to be accurate
   - Whether or not the information is available when the user needs it

- Whether or not the user has complaints about the system; if so, things that he or she can do about it
- The person responsible for writing the computer programs used in this application
- The source of the original data processed by the computer
- The location of the computer that processes the data
- Details about how the information gets from the computer to the user

The students should interview at least one person who is a user of their application. Other questions they might ask the user:

- Do you remember when the computer application was first installed?
- If so, how was your work done previously, without the computer?
- Does this computer application make your job easier?
- How would you do your job now if you didn't have the computer?
- Can you remember having any problems with the computer system? How were the problems solved?

3. Have the groups present their reports to the class. If possible, a member of the school or school district data-processing department should be present. He or she may be able to answer questions about the systems or clarify points that are brought up by the students. Ask the data-processing person to help explain why certain limitations or problems exist with the applications. For example, if a group of students reports that a user finds a lot of errors in a computer printout, ask the data-processing person how such errors arise.

SAMPLE ACTIVITY ☐ THE COMPUTER DID IT!

Objectives

Students analyze social issues in which people blame computers for errors and problems. (Impact 4)

Prerequisites

Students need to understand that computers must be given instructions by people in order to operate. (Fundamentals 1)

Materials

- ☐ Collection of newspaper and magazine articles illustrating attitudes toward computers, both pro and con, in which "the computer" is claimed to be the cause of a problem such as late paychecks (there are many examples in the daily press, and in *The Compleat Computer* by Van Tassel)
- ☐ Collection of cartoons illustrating attitudes toward computers, with the captions removed

Time for activity

One or two class periods

Class management

Whole-class discussion; small-group work

Teacher

1. Review with the students their understanding of the capabilities and limitations of computers. Stress the idea that computers must have instructions from human beings in order to operate.

2. Divide the students into groups of three or four. Give each student at least one newspaper or magazine article. Have groups read and discuss the articles, determining what the situation is, what attitude toward computers is present in the situation, and whether or not the attitude is justified, given the capabilities and limitations of the computer. Have them summarize their discussion and clip it to the article.

Each group should select one of their articles to share with the class. Ask a student from each group to report orally, describing the situation and attitude and why the group has decided whether the attitude is appropriate or not. You may encourage class reaction and discussion after each report.

3. After all the groups have reported, give each group some cartoons with the captions removed. Their task is to write original captions demonstrating some attitude toward computers. Put the student-captioned cartoons on the bulletin board, with a title such as "But the computer didn't do it!" Students may also be encouraged to write original cartoons and to submit them to the school newspaper.

SAMPLE ACTIVITY ☐ OPINION SURVEY ON EDUCATIONAL PROGRAMS

Objectives

Students investigate people's opinions about the usefulness of certain computer programs. (Impact 4)

Prerequisites

Students need to have had experience in using computer programs in school. (Using Programs 1)

Materials

A sample set of interview questions prepared by teacher

Time for activity

About two class periods over two weeks

Class management

Whole-class discussions and small group projects

Teacher

1. This activity assumes that students in your class, as well as a substantial number of students in your school, have used computer programs in school. Divide the class into groups of three or four. Provide lists of frequently used programs available in the school. Tell the students that they are going to study student and teacher opinion of the educational value of one or more specific computer programs. Each student group should interview at least one teacher and five students familiar with each program to be studied. Discuss how to locate students and teachers who have used or are using particular programs. You may have done a little work ahead of time finding out what classes are using what programs.
2. Hand out a sample set of interview questions. Students should make up an interview sheet for each person they interview. Sample questions might include:
   - Which programs have you used? For each one please tell:
     - — Why you used it (e.g., for fun, teacher assigned it, I thought it would help me learn about . . .)
     - — How much time you spent using it (e.g., minutes, hours, etc.)
     - — Was the program useful?
     - — What did you learn from it?
     - — Could you have learned the same thing from a book?

— Was it fun?

— Was it a waste of time? Why or why not?

— Would you recommend this program to other students?

3. Have students report orally on their findings. What disagreements did they find among the people they interviewed?

Why might a program be useful or fun for one person and not for another?

Are there differences between boys and girls in opinions about programs?

Recommended reading

"A Study of Intrinsically Motivating Computer Games: What Makes Things Fun to Learn," by Thomas Malone; Xerox Palo Alto Research Center, 1982.

SAMPLE ACTIVITY ☐ ELECTRONIC MONEY

Objectives

Students learn about electronic money systems and explore social issues concerning electronic money, such as the need to restrict access to such systems. (Applications 7; Impact 2, 5, 6)

Prerequisites

No prerequisites for this activity

Materials

"Electronic Money" Computer Literacy Instructional Module developed by Minnesota Educational Computing Consortium. Module includes two lessons, Teacher's Manual, transparency masters and student handouts, computer program ELEC $$, and Apple II computer.

Time for activity

Three to four class periods

Class management

Whole class; small-group decision making and work on computer

Teacher

1. Prepare for the lessons by acquiring and reading The Teacher's Manual, copying student handouts, and running the program. The program is ELEC $$. It simulates an electronic banking system.
2. Conduct the lessons described in the Teacher's Manual.
3. Conduct a class discussion summarizing the aspects of the social impact of electronic money systems. For example, ask:

- What have we learned about the importance of restricting access to computer systems and data bases?
- The role of computers in our system of handling money is an example of our society's increasing dependence on computers. What are some of the reasons why we are using computers more and more in our banking and money transactions?
- Who might be affected if a large bank's computer failed to operate for a day? In what ways? What if a Federal Reserve Bank's computer went down — who might be affected?

Recommended reading

"Computers and our Monetary System," Chap. 12 in *Computers and Social Controversy*, by Tom Logsdon; Computer Science Press, 1980.

SAMPLE ACTIVITY ☐ THE FEELING OF POWER

Objectives

Students discuss issues concerning relationships between human abilities and computer abilities. (Impact 4)

Prerequisites

No prerequisites for this activity

Materials

For each student, a copy of the story "The Feeling of Power," by Isaac Asimov, from the book *The Mathematical Magpie*, Clifton Fadiman, ed.; Simon & Schuster, 1962, pp. 3 – 14.

Time for activity

For preparation 15 minutes; for teaching lesson 30 minutes; for student work 30 minutes

Classroom management

Class discussion and individual student reading

Teacher

1. Hand out copies of the story to the students, and a set of discussion questions for them to consider as they read the story.
2. After the students have read the story, conduct a class discussion concerning interpretations and issues. Some suggested questions for discussion (with some possible answers) are as follows:
   - What was the unusual gift of Myron Aub? *(He could perform mathematical operations on paper without using a computer.)*
   - What were the feelings of the congressional committee members investigating Aub? *(Disbelief — they thought it must be a trick or an illusion.)*

- Who was Loesser? (pp. 9, 10.) Was he a person or a computer?
- How did Loesser describe the difference between human minds and computers? *(The computer gives the same answer to the same problem each time. Human minds are capricious.)*
- What did they call the new method? *(Graphitics, from the old European word "grapho," meaning "to write".)*
- Why did Aub use an "artist's stylus" instead of a pencil or pen? *(p. 5.; Perhaps people did not use pencils or pens any more.)*
- In the story, who builds computers? (p. 9; Computers design computers: *"The rational use of computers to design more advanced computers. . . ."*)
- Why did the president think it strange that a person could know how a computer works? *(p. 9; Computers design computers.)*
- Could this story take place in your lifetime?
- Could it ever happen that people would not know how to compute?
- Have you seen a person who could not compute because he or she was dependent on machines? *(Checkout clerk in a store; kids in a math class; parents balancing checkbook.)*
- What was the feeling of power that Shuman had? *(He was able to compute without a computer.)*
- Why was General Weider in favor of Project Number? *(pp. 12, 13; "A man is much more dispensable than a computer.")*

Related activities

Have students write an essay on one of the issues raised in this story.

Ask students to discuss and/or debate this issue: As computers get smarter, do human beings have more power or less power?

Have students write a science fiction story about computers in the future.

WRITING COMPUTER PROGRAMS

The section on Writing Computer Programs in Chapter 3 discusses objectives and approaches to providing instruction in computer programming. There we suggested providing a special course or unit to teach programming skills.

The following pages discuss programming languages and learning materials available to use in such a course or unit.





Ms. Abler finds the chalkboard is a useful teaching aid in her seventh grade programming class—and so is the computer (Redland Middle School, Montgomery County, MD)

Languages

There is no single "best" choice of programming language for students to learn. The choice will depend largely on the skills and interests of available teachers, and on the availability of particular languages on the school's machines at any given point in time. The following four languages are good candidates:

1. BASIC is the most common language for microcomputers. One advantage for teaching students BASIC is that many of the programs they use are written in BASIC, so it's helpful for the students to be able to read and modify those programs. Another advantage of BASIC is that many teachers have learned the language and are comfortable with it. Third, it is easy to enter and execute BASIC programs on most microcomputers.
2. Logo is available in several different versions for many common microcomputers. It is easy to design well-structured programs in Logo. Also, its turtle graphics make it easy for beginners to create graphic displays. Third, Logo has list-processing features that are very powerful tools for learning a wide variety of concepts and applications involving symbol manipulation.
3. PILOT is also available on several microcomputers. An advantage of PILOT for introducing programming is that it was designed for the purpose of authoring interactive programs. Therefore it contains many powerful features that help in writing programs with which other people, such as classmates and friends, can interact. Some versions of PILOT also have good graphics capabilities.
4. Pascal is the language of choice for computer science education. A dialect of Pascal, called "Rascal," was designed to provide an easy-to-learn programming environment for young people. An advantage of Rascal for teaching students programming is that it provides continuity with Pascal for students who wish to pursue studies in computer science. It also is highly graphics-oriented.

More details on published versions of Logo, PILOT and Pascal for various microcomputers are provided in the Appendix. The following are courses and learning materials recommended for use in teaching BASIC, Logo, PILOT, and Pascal.

BASIC

BASIC Discoveries: A Problem-Solving Approach to Beginning Programming, by Malone and Jackson; Creative Publications, 1982. Grades 5 and up.



Graphics are a key aspect of Ms. Pringle's eighth grade introductory programming classes (Hammond Junior High, Alexandria, VA)

Computer Literacy: A Hands-on Approach, by A. Luehrmann and H. Peckham; McGraw-Hill, 1982. This one-semester course has been field-tested with junior high school students. It emphasizes good techniques for programming structure and style. Nonmathematical in orientation, it provides extensive hands-on experience. Versions available for Apple II and TRS-80.

Computeronics: Problem Solving with Computers, Leon County Public Schools. Designed for gifted upper elementary and junior high students. A teacher's guide, designed for inexperienced teachers of programming, it provides guidance on classroom management and equipment as well as course objectives, content, and pedagogy. The course addresses all of the Programming strand objectives plus several Procedures strand objectives, including Procedures objective 13. The course is not tied to any particular machine.

PET BASIC: Training Your PET Computer, by Ramon Zamora, William Scarvie, and Bob Albrecht; Reston Publishing Co., 1981. Subtitled *The Complete Guide to Hassle-Free PET Programming*, this book

takes an interesting approach to introductory computer programming (for example, in problems involving animation and graphics). Appropriate for teachers and some junior high students. Addresses Programming strand objectives 1 and 2.

Radio Shack BASIC Programming, Radio Shack, Inc. Designed for students in grades 4 through 8 and their teachers. Complete package includes binders containing over 300 transparencies, teacher's guide, and student workbooks. Designed for teachers with little programming experience. Part I introduces commonly used BASIC statements and commands. Part II concentrates on Level II BASIC programming. Addresses Programming strand objectives 1 and 2.

Teaching BASIC Bit by Bit, B. Friedman and T. Slesnick, eds.; Math and Computer Education Project, Lawrence Hall of Science, University of California. Book for teachers of students in grades 5 through 8 which takes an activity approach to programming. A sequence of activities is designed for eight 1 1/2-hour lessons. Written for PET and Apple BASIC, but could be adapted to other computers. Book includes sample student worksheets and solutions to programming assignments. Addresses Programming strand objectives 1 and 2.

Math-Oriented BASIC. For a mathematics-oriented course in BASIC, the following books provide useful problems and projects:

Computers in Number Theory, by Donald Spencer; Computer Science Press, 1982.

Computers in Mathematics: A Sourcebook of Ideas, David Ahl, ed.; Creative Computing Press, 1979.

Logo

Learning with Logo, by Dan Watt; BYTE/McGraw-Hill, 1982. This book is designed for use by children from ages 9 to 14 who are learning Logo with the help of an adult (teacher, parent). It includes hands-on activities, projects, and prewritten "tool procedures" the students can use as tools to build other procedures. The tool procedures are available on disk for the TI, Apple, and Terapin versions of Logo.

Logo for the Apple II, by Harold Abelson; BYTE/McGraw-Hill, 1982. This book is a useful supplement to the manuals provided with Apple II Logo. It contains instructional material, activities, and projects for list processing as well as turtle graphics.

TI Logo Curriculum Guide, by Diane Musha, Coleta Lewis, and Theresa Overall; Texas Instruments, Inc., 1982. Provides Logo activites designed for children from prekindergarten through fifth grade. Package includes Logo programs on disk and tape for the TI Logo.

PILOT

Atari PiLOT, published by Atari, Inc. This package includes not only the Atari PILOT language cartridge but also a student manual, a tutorial PILOT primer, two demonstration tapes, and a pocket reference card of commands. The student manual is appropriate for junior high level students to learn to use the language.

Pascal

Computer Power: A First Course in Using the Computer, by Mike Moshell et al.; Gregg Div. McGraw-Hill, 1982. This course was designed to introduce programming to high school students. It teaches students to program in Rascal, an interpretive dialect of Pascal.

KAREL the ROBOT: A Gentle Introduction to the Art of Programming, by Richard E. Pattis; Wiley & Sons, 1981. Provides an introduction to structured programming. Used with the KAREL Simulator, software for teaching structured programming, in which students write programs that instruct a robot to perform tasks in his world. A special version of the program is available for use on computer network servers, such as the CORVUS. Publisher of the KAREL Simulator is Cybertronics International, Inc.

STUDENT HANDOUTS AND TRANSPARENCY MASTERS FOR CHAPTER 7

The following pages contain student handouts and transparency masters to be reproduced by the teacher. Table 7 – 2 lists the sample activities and corresponding handouts.

Table 7 – 2 ☐ Transparency masters and student handouts, Chapter 7

Sample activity	Transparency masters/handouts
ZEEP007 Mowing Lawns	Story — ZEEP007 Mowing Lawns
Line Up	Transparency master — picture of five people
Tellstar Lesson 1	Assignment for Tellstar Lesson 1
Tellstar Lesson 2	Assignment for Tellstar Lesson 2
States Data Base Lesson 1	Assignment for Data Base Lesson 1
States Data Base Lesson 2	Assignment for Data Base Lesson 2
States Data Base Lesson 3	Assignment for Data Base Lesson 3
States Data Base Lesson 4	Assignment for Data Base Lesson 4
States Data Base Lesson 5	Assignment for Data Base Lesson 5
WP Lesson 1	WP Lesson 1 Handout
WP Lesson 2	WP Lesson 2 Handout
WP Lesson 3	WP Lesson 3 Handout
WP Lesson 4	WP Lesson 4 Handout

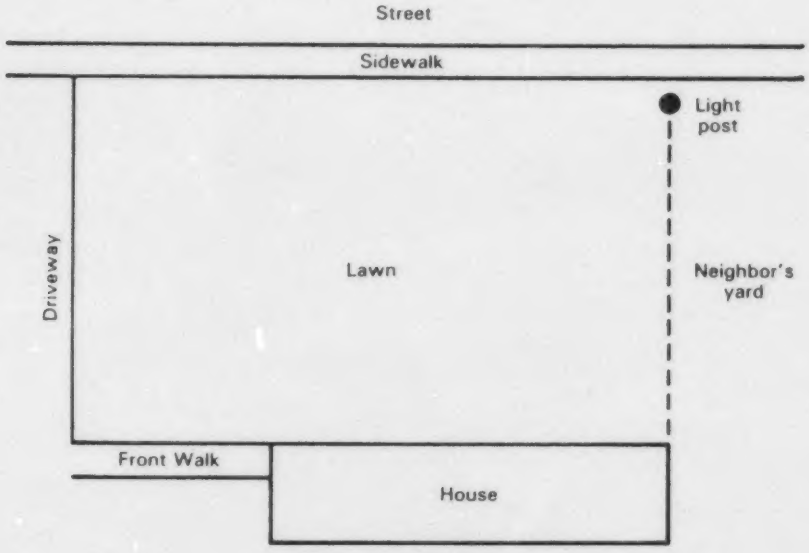
Story ☐ ZEEP007 Mowing Lawns, by John Burley and Beverly Hunter

ZEEP007 is a robot, a little fellow who looks something like R2D2 from *Star Wars*. ZEEP007 is my helper and friend. He goes places with me, helps me with my chores, and even helps others in my family. ZEEP007 is a friendly machine, so I usually find it pretty easy to work with him.

ZEEP007 is very good at doing some things, once he learns how to do them. He has a great memory. The hardest thing is to get him to learn to do new tasks because he has to have very specific directions. Every little step has to be explained carefully, and I don't dare leave out any steps in the instructions.

One day I decided to get ZEEP007 to mow lawns for me. I have several customers in my neighborhood, and ZEEP could really help me earn money.

I wasn't exactly sure how to tell him to mow all the lawns, so I decided to first teach him how to mow our family's lawn. Here is a diagram of our lawn:



I broke the problem down into three subproblems. I knew he'd need to be able to do at least three things:

- Check the mower for gas and fill it if it's empty.
- Get the mower started.
- Mow the grass.

So I made up a main procedure and three subprocedures:

Procedure: MOW-OUR-LAWN

1. Do CHECK-GAS.
2. Do START-MOWER.
3. Do MOW-GRASS.

Subprocedure: CHECK-GAS

1. Make sure the mower is not running.
2. Open the cap on the gas tank.
3. If there is enough gas in the tank, go to step 5.
4. If there is not enough gas in the tank, fill it.
5. END.

Subprocedure: START-MOWER

1. Make sure the mower is not running.
2. Push control lever on handle to start.
3. Pull starter cord.
4. If mower starts, go to step 6.
5. If mower doesn't start, go to step 3.
6. Push control lever to "RUN."
7. END.

Subprocedure: MOW-GRASS

1. Push mower to corner of driveway and front walk.
2. Facing street, push mower toward street along driveway.

3. Mow strip along driveway to sidewalk.
4. At sidewalk, turn right 90 degrees.
5. Mow strip along sidewalk to light post.
6. Turn right 90 degrees.
7. Mow strip to corner of house.
8. Turn right 90 degrees.
9. Mow strip along house and front walk to driveway.
10. If front lawn is all mowed, go to step 12.
11. Go to step 1.
12. END.

I watched as ZEEP007 started mowing the grass. He had no problems, so I left him to continue on his own. Can you imagine what I saw when I returned an hour later? ZEEP007 was pushing the mower, with the engine not running, around the outer perimeter of the front lawn. He had mowed the same strips repeatedly, even after the mower ran out of gas.

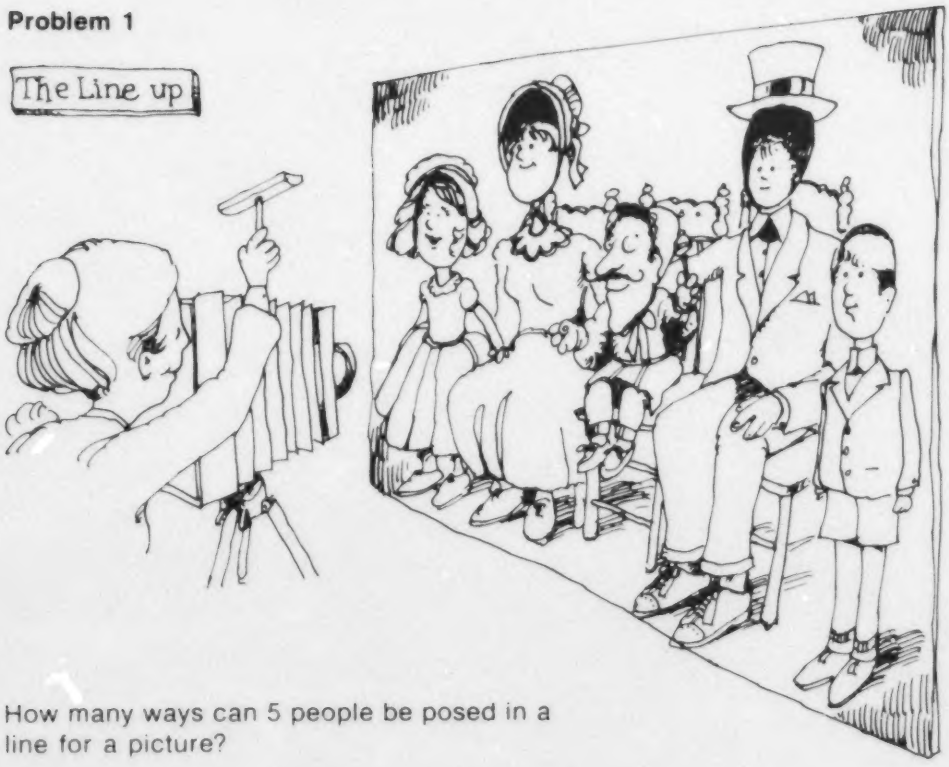
I realized I would have to improve my procedure.

How would you change the instructions so that the task could be completed successfully? Write a complete procedure, with subprocedures. Then trade procedures with a partner. Pretend you are ZEEP007 and try to follow your partner's procedure by pushing a pencil lawnmower around on the drawing. Does your partner's procedure work? Help debug your partner's procedure by checking for the following:

- Can you understand each instruction?
- Do you know which instruction to execute next?
- Are any instructions missing?
- When you follow the procedure, do you get all of the lawn mowed?

Line Up (transparency master)*

Problem 1



How many ways can 5 people be posed in a line for a picture?

*Reproduced with permission of the D. C. Heath Co. from 1981 Heath Mathematics Program, Grade 6, Teachers Edition

Assignment for Tellstar Lesson 1

1. Locate and identify two of the greatest-magnitude stars that are visible to us tonight. Record on a sheet of paper the following information about your stars:

   STAR NAME: MAGNITUDE:
   RIGHT ASCENSION: HEADING:
   DECLINATION: ELEVATION

   When does it rise? When does it set?

2. Locate the Ursa Minor constellation. Identify two stars in Ursa Minor. What are their names?

Assignment for Tellstar Lesson 2

1. With your partner, choose two cities that are far apart in longitude but similar in latitude. Find out the actual latitude and longitude for those two cities. Choose three celestial objects (sun, moon, stars, or planets) and predict how they might differ between those two cities.
2. Choose a time and date for making observations from those two cities. Use the same time and date for both cities.
3. Start up TellStar, giving it the longitude and latitude for your first city and the time and date for your observations.
4. Locate the celestial objects you are studying, and record on paper the data for those objects.
5. Change the latitude and longitude to your second city.
6. Locate the same celestial objects, and record on paper the data for those objects.
7. Compare your observations from the two cities. How do the celestial objects differ between the two? Explain the relationship of longitude to the differences in your observations.

Assignment for Data Base Lesson 1

PARTNER NAMES:

STATES ASSIGNED:

1. Partner 1 loads PFS program and STATES data-base diskette, and requests a search for the first STATE form to be updated.
2. Partner 2 finds in the *Almanac* the following information for that state:
   CAPITAL CITY; YEAR ENTERED UNION; FLOWER
3. Partner 2 reads the information to Partner 1, who keys in the data.
4. Partner 2 proofreads the entries to make sure they are correct.
5. Partner 1 enters CTRL and C to complete the update process for the state, and requests a search for the next state to be updated.
6. Continue updating until all your states have correct entires for CAPITAL, YEAR ENTERED UNION, and FLOWER.

Assignment for Data Base Lesson 2

PARTNER NAMES:

STATES ASSIGNED:

1. Partner 1 loads PFS program and STATES data-base diskette, and requests a search for the first state to be updated.
2. Partner 2 finds in the *Almanac* the following information for that state:

ITEM	FORMAT
1980 LAND AREA IN SQ. MILES:	NNN,NNN
STATE FORESTS, PARKS (ACRES):	N,NNN,NNN
MEAN ALTITUDE (FT):	N,NNN
HIGHEST POINT:	xxxxxxxxxxxx
ALTITUDE:	NN,NNN
LOWEST POINT:	xxxxxxxxxxxx
ALTITUDE:	N,NNN

3. Partner 2 reads the information to Partner 1, who keys in the data.
4. All numeric data items must be exactly the length specified for the FORMAT.
5. Partner 2 proofreads the entries to make sure they are correct.
6. Partner 1 enters CTRL and C to complete the update process for the state, and requests a search for the next state to be updated.
7. Continue updating until all your states have correct entries for the ITEMS listed above.

Assignment for Data Base Lesson 3

PARTNER NAMES:

Work together to obtain a PFS report that will answer one of the following questions, or a similar question that is of interest to you.

Questions

1. What states entered the union between 1800 and 1850? *Hint:* Use =1800..1850 in your RETRIEVE SPEC.
2. What states have more than a million acres of state forest and parkland?
3. What states have a land area larger than Colorado? *Hint:* SEARCH for COLORADO; find its land area; use that number in your RETRIEVE SPEC.
4. Utah is mountainous. Do any states have a higher mean altitude than Utah?
5. What is the highest point in the U.S., and in what state is it located?

Procedure Summary To have PFS print out a list of selected state data we:

1. Choose the PRINT function from the main menu.
2. Choose the PRINT FORMS choice on the PRINT menu.
3. Fill in the blank form with RETRIEVE SPECIFICATIONS, according to the rules listed at the end of the SEARCH/UPDATE chapter of the PFS manual.
4. On the PRINT OPTIONS screen, change the LINES PER PAGE from the standard 66 to just the number of lines you want printed for each state.
5. Fill in the blank PRINT SPEC form with an X beside each item you want printed. Also type an S in an item if you want to sort on this item.

Refer to the PFS manual chapter on PRINT for assistance.

Assignment for Data Base Lesson 4

PARTNER NAMES:

Work together to update the STATES data base with the population data for page 2 of each STATE form.

Procedure summary To add population data to a state data form we:

a. Choose the SEARCH/UPDATE option from the main menu.

b. Type in the name of the state to be updated on the RETRIEVE SPECIFICATIONS.

c. When the STATE form appears on the screen, press CTRL and N to get the second page for that state.

d. Fill in the population data for the state. You may need to get the data from several different places in the *Almanac* or other source you are using. Fill in all the data on page 2.

Be sure you use the correct number of digits, including leading zeroes, for each numeric data field.

e. When the data items are all filled in for that state's population, press CTRL and C. You will get the main menu again. Repeat the procedure for the next state on your list, until all your states have been updated.

Assignment for Data Base Lesson 5

Work together to obtain a PFS report that will provide information to help you in answering one of these questions, or a similar question that is of interest to you.

Questions

1. I'd like to live in a state that has a low population density and a high per capita income. Suggest five states to me.
2. I'd like to visit a state that has a high altitude and a large amount of state forest and parkland. Suggest five states to me.
3. Are there any states that have a per capita income greater than 10,000 and a population per square mile of less than 100?

Procedure summary To have PFS print out a list of selected states data we:

1. Choose the PRINT function from the main menu.
2. Choose the PRINT FORMS choice on the PRINT menu.
3. Fill in the blank form with RETRIEVE SPECIFICATIONS, according to the rules listed at the end of the SEARCH/UPDATE chapter of the PFS manual.
4. On the PRINT OPTIONS screen, change the LINES PER PAGE from the standard 66 to just the number of lines you want printed for each state.
5. Fill in the blank PRINT SPEC form with an X beside each item you want printed. Also type an S in an item if you want to sort on this item.

Refer to the PFS manual chapter on PRINT for assistance.

Keep notes on paper of the retrieve, sort, and print specifications you used for each printout, so you can explain it to the class later.

WP Lesson 1 Handout: Using AppleWriter

1. Load the AppleWriter program.

(Teacher: insert here details of how to load the program on your computer, if students need this level of detail.)

2. From the Editor menu, load the tutorial file. Press:

   L **RETURN**
   type: TUTORIAL **RETURN**

   (The disk will whirr for a few seconds.)

3. From the Editor menu, press:

   E **RETURN**

4. Read the tutorial and do what it says to do.
   IF YOU GET MESSED UP, press:

   ESC ESC CTRL-Q

   to return to the Editor menu, and then go back to step 2 and start over.

5. When finished with the tutorial, return to the Editor menu and load the demo file. Press:

   L **RETURN**
   DEMO **RETURN**

6. From the Editor menu, press:

   E **RETURN**

7. Do the exercises in the demo file.
8. Print the demo file, using the instructions given there.
9. Repeat any or all of the above until you are able to perform each step easily and comfortably. You may want to refer to the AppleWriter manual, which should be located beside the computer.

WP Lesson 2 Handout: AppleWriter Experiments

By working together as a team, your group may be able to write a more interesting and complete composition than any one of you could by yourself.

1. Look at all the compositions the students in your group have prepared. Pick one person's composition to be put on the computer first.
2. Student 1: Type your composition on the computer using AppleWriter. Don't worry about misspellings or grammar errors for now.

   Give your composition a file name (such as BIRD1).
   Save your file on a disk using that name.

3. Student 2: Try to improve the composition by using EasyWriter to:
   - Correct the spelling and grammar
   - Insert new sentences and paragraphs
   - Delete words or sentences
   - Move paragraphs or sentences
   - Use "search and replace"

   Give your version of the composition a new name (such as BIRD2).
   Save your file on disk using your new name.

4. Student 3: Try to improve the composition produced by student 2 by using EasyWriter to make corrections, insertions, deletions; to add or move paragraphs, or to "search and replace."

   Give your version of the composition a new name (such as BIRD3).
   Save your file on disk using your new name.

5. Print out all three versions of the composition. Which do you like best? Are there improvements you can make?

6. Make the improvements, and print out a final copy of your team's composition. Have all the names of your team members at the beginning of the composition, a title for the composition, and a date.
7. Hand in the following to the teacher:
   - The original composition (say, BIRD1).
   - The final version (say, BIRD4).

WP Lesson 3 Handout: AppleWriter Editing

By working together as a team, you may be able to write a more interesting and complete composition than you could by yourself.

1. Look at the compositions the both of you have prepared. Pick one person's composition to be put on the computer first. That person will be called "author" and the other person will be called "editor."
2. Author: Type your composition on the computer using AppleWriter. Don't worry about misspellings or grammar errors for now.

   Give your composition a file name (such as BIRD1).
   Save your file on disk using that name.

3. Editor: Read author's composition on the computer. First, add a message at the bottom of the composition, telling the author the things you like about the composition. Praise ideas, word choices, and particular parts of the composition that you think he or she wrote especially well.

Editor: Try to improve or change the composition, by using EasyWriter to:

- Change some sentences. Make them shorter, or longer, or more descriptive, or less repetitive, etc. Show that there are different ways to say similar things.
- Move paragraphs or sentences.
- Correct the spelling and grammar.

Give your version of the composition a new name (such as BIRD2).

Save your file on disk using your new name.

4. Author: Read the edited version of your composition, and compare it to your original. Try to make some of the changes your "editor" has suggested. Then check

for any more corrections needed in spelling, grammar, etc.

Give your version of the composition a new name (such as BIRD3).

Save your file on disk using your new name.

5. Print out all three versions of the composition. Which do you like best? Are there more improvements you can make?
6. Trade places. The author becomes the editor and vice versa.

Go back to step 2.

When you are all finished, your team should have three different versions of both compositions. The name of the author and the editor should be on all copies.

Hand in all three versions to the teacher.

WP Lesson 4 Handout: AppleWriter Projects

By working together as a team, your group may be able to write a more interesting and complete composition than any of you could by yourself. This project will involve several weeks of work.

Week one

1. Discuss with your teammates the writing projects your teacher has suggested to you. Choose a project for your team to work on.
2. Each member of the team will prepare a page of notes of ideas about the project. You may need to go to the library first, and look up the topic in reference books.

Week two

3. Meet together with your notes, and prepare a rough draft outline for your project report.
4. Create an AppleWriter file for your project outline. Include in the file:
   - Name of the group
   - Names of the team members
   - Title of project
   - Today's date
   - Outline of topics
   - References to be used

Give the file a name, save it on a disk, and print out a copy for each team member and for the teacher. Turn in a copy to the teacher.

Week three

5. Agree on an assignment for each team member. For example, you might divide up the outline of topics, assigning one or more of the topics to each person.

6. Using AppleWriter, each team member will update the project outline by writing text or more detailed notes under the topic he or she has been assigned, and by adding to the list of project references.
7. After each team member has added detail to the outline, print out copies for all team members and for the teacher. Hand in the new detailed outline to the teacher.

Week four

8. The team will meet and discuss the new outline. Make new assignments for each team member. Reorganize the outline if needed. Using AppleWriter, insert the team member's name beside each topic he or she is responsible for.
9. Using AppleWriter, write a complete first draft of the report. Print out copies for each team member and for the teacher. Date and save the draft on a disk under a new name. Turn in a copy to the teacher.

Week five

10. Get the teacher's comments on your draft. Meet as a team and discuss improvements to be made, and make the improvements to your composition.
11. Consider the physical appearance of the report on the paper. Can you improve it? The AppleWriter manual, in the chapter on printing, has some ideas about formatting. For example the manual tells about FILL JUSTIFY MODE, RIGHT JUSTIFY MODE, and CENTER JUSTIFY MODE. Experiment with different margins; justify modes, headings, and so forth. Try several printouts until you get one you like.

Week six

12. Finally, prepare a final version of your composition. Make sure it is dated and contains all your references and citations. Print out copies of this new version for each member of the team and for the teacher. You may want to print out extra copies for classmates, the school magazine, or parents.
13. By this time, you may have many old versions of your project files on your disk. Learn how to delete unwanted files. See the "helpful hints" in Appendix B of the AppleWriter manual.

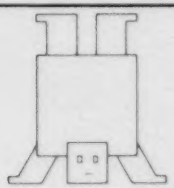
Throughout this book there are references to books, periodicals, computer programs, and a variety of other documents and materials. The main purpose of this Appendix is to provide handy summary lists of these materials and suppliers. This is not a comprehensive, current directory of educational computing resources. For that purpose, you should have on hand a current version of, for example, *Directory of Educational Computing Resources*, published periodically by Classroom Computer News.

RECOMMENDED BOOKS FOR TEACHERS AND ADMINISTRATORS

Computer-related books are asterisked. Other books listed are noncomputer books referenced in lesson plans.

* *Are You Computer Literate?*
  Karen Billings and David Moursund
  Dilithium Press, 1979
* *Bits 'n Bytes About Computing: A Computer Literacy Primer*
  Rachelle S. Heller and C. Dianne Martin
  Computer Science Press, 1982
* *Calculators, Computers and Elementary Education*
  David Moursund, 1977
  The Math Learning Center
  325 13th St., NE, Unit 302
  Salem, OR 97301
* *The Compleat Computer*
  Dennie L. Van Tassel
  SRA, 1976

Appendix: Resources



* *Computer Education for Elementary and Secondary Schools*
  Education Board of the Association for Computing Machinery, 1981
  ACM Order Department, P.O. Box 64145
  Baltimore, MD 21264
* *Computer Literacy: Issues and Directions for 1985*
  Robert Seidel, Ronald Anderson, and Beverly Hunter
  Academic Press, 1982
* *Computer Power and Human Reason*
  J. Weizenbaum
  W. H. Freeman, 1976
* *The Computer in the School: Tutor, Tool, Tutee*
  Robert P. Taylor, ed.
  Teachers College Press
  Columbia University, 1981
* *Computers and Privacy*
  Biological Sciences Curriculum Study, 1980
* *Computers and Social Controversy*
  Tom Logsdon
  Computer Science Press, 1980
* *Computers in Society*
  Donald Sanders
  McGraw-Hill, 1981
* *Computers in Teaching Mathematics*
  John Burton, Peter Coburn, and Frank Watson
  Addison-Wesley, 1982

Concepts in Science: Green (3)
Brandwein et al.
Harcourt Brace & World, 1980

* *Designing a Computer Support System for Schools: A Handbook for Administrators*
  Carleton K. Finch and David Dennen
  Addison-Wesley, 1980

Designs from Mathematical Patterns
Bezuzka, Kenney, and Silvey
Creative Publications

Fractions with Pattern Blocks
Matthew Zullie
Creative Publications

* *Goodbye Gutenberg: The Newspaper Revolution of the 1980's*
  Anthony Smith
  Oxford University Press, 1980

* *The Guide to Simulations/Games for Education and Training*
R. E. Horn and A. Cleaves, eds.
Sage Publications, 1980

* *Heath Mathematics Teachers Guide Grade 6*, 1981 ed.
Illinois Series on Educational Applications of Computers
College of Education, Dept. of Secondary Education
University of Illinois

* *Introduction to Computer Simulation*
Nancy Roberts, D. F. Andersen, R. M. Deal, M. S. Garet, and W. A. Shaffer
Addison-Wesley, 1982

Kaleidoscope Math
Joe Kennedy and Diane Thomas
Creative Publications

* *Microcomputer Courseware for the Classroom: Selecting, Organizing, and Using Instructional Software*
Ann Lathrop and Bobby Goodson
Addison-Wesley, 1982

* *Microcomputers and the 3 R's: A Guide for Teachers*
Christine Doerr
Hayden Book Co., 1979

* *Microcomputers in Education*
Lee Marvin Joiner, G. Vensel, J. D. Ross, and Burton Silverstein
Learning Publications, 1982
P.O. Box 1326
Holmes Beach, FL 33509

* *The Micro Millennium*
Christopher Evans
Viking Press, 1980

* *Mindstorms: Children, Computers, and Powerful Ideas*
Seymour Papert
Basic Books, 1980

* *A Practical Guide to Computers in Education*
Peter Coburn, Peter Kelman, Nancy Roberts, Thomas Snyder, Daniel Watt, and Cheryl Weiner
Addison-Wesley, 1982

* *Running Wild: The Next Industrial Revolution*
Adam Osborne
Osborne-McGraw Hill Publishers, 1982

* *School Administrator's Introduction to Instructional Use of Computers*
David Moursund
International Council for Computers in Education, 1980

Stem: Level 3, Addison-Wesley Science
Addison-Wesley, 1980

* *Stimulating Simulations*
C. W. Engle
Hayden Book Co., 1979

* *Teacher's Guide to Computers in Education*
David Moursund
Internat'l Council for Computers in Education, 1980

* *Teacher's Guide to Computers in the Elementary School*
David Moursund
Internat'l Council for Computers in Education, 1980

Tessalations: The Geometry of Patterns
Stanley Bezuzka
Creative Publications

* *The Third Wave*
Alvin Toffler
Bantam Books, 1980

* *The Wired Society: A Challenge for Tomorrow*
James Martin
Prentice-Hall, 1978

RECOMMENDED BOOKS FOR STUDENTS

The following is a list of the books recommended throughout this book as suitable for students. The asterisked books are computer-related.

* *Atari PILOT*
Atari, Inc., 1982

* *BASIC Discoveries: A Problem-Solving Approach to Beginning Programming*
Malone and Jackson
Creative Publications, 1982

Choose Your Own Adventure (series of books)
Bantam Books

* *Computer Literacy: A Hands-On Approach*
A. Luehrmann and H. Peckham
McGraw-Hill, 1982

* *Computer Literacy: Problem-Solving with Computers*
Carin Horn and James L. Poirot
Sterling Swift Publishing Co., 1981

* *Computer Power: A First Course in Using the Computer*
Mike Moshell et al.
McGraw-Hill, Gregg Division, 1982

* *Computeronics Problem Solving with Computers, 1978*
Leon County Public Schools
2757 West Pensacola St.
Tallahassee, FL 32304

* *Computers Are Fun*
Jean Rice and Sandy O'Connor
Denison, 1981

* *Computers in Mathematics: A Sourcebook of Ideas*
David Ahl, ed.
Creative Computing Press, 1979

* *Computers in Number Theory*
Donald Spencer
Computer Science Press, 1982

* *Exploring the World of Computers*
Donald D. Spencer
Camelot, 1982

* *Famous People of Computing — A Book of Posters*
Donald D. Spencer
Camelot, 1982

Freedom's Ground
Holt, Rinehart & Winston, 1977

* *History of Computers*
Donald D. Spencer
Camelot, 1981

* *Illustrated Computer Science Dictionary for Young People*
Donald D. Spencer
Camelot, 1982

Impressions
J. R. Mitchell and A. L. Ryle
D. C. Heath

Information Please Almanac
Simon and Schuster, 1982

Joys and Journeys
American Book Co., 1968

* *KAREL the ROBOT: A Gentle Introduction to the Art of Programming*
Richard E. Pattis
Wiley & Sons, 1981

Keystone
Houghton-Mifflin, 1976

* *Learning with Logo*
Dan Watt
BYTE/McGraw-Hill, 1982

* *Living with Computers*
Barry Blakeley and Robert Lewis
Wayland Publishers, Ltd., 1978
49 Lansdowne Place
Hove, East Sussex
England BN 31 HF

* *Logo for the Apple II*
Harold Abelson
BYTE/McGraw-Hill, 1982

* *The Mathematical Magpie*
Clifton Fadiman, ed.
Simon and Schuster, 1962

* *My Friend The Computer*
Jean Rice
Denison, 1981

* *PET BASIC: Training Your PET Computer*
Ramon Zamora, William Scarvie, and Bob Albrecht
Reston Publishing Co., 1981

* *Radio Shack BASIC Programming*
Radio Shack, Inc.
One Tandy Center
Fort Worth, TX 76102

The Solar System
Scientific American, Inc.
W. H. Freeman, 1975

Solving Problems Kids Care About
Randall Souviney
Goodyear, 1981

* *Tales of the Marvelous Machine*
R. Taylor and B. Green, eds.
Creative Computing Press, 1980

* *Teaching BASIC Bit by Bit*
B. Friedman and T. Slesnick, eds.
Math and Computer Education Project
University of California

* *TI Logo Curriculum Guide*
Diane Musha, Coleta Lewis, and Theresa Overall
Texas Instruments, 1982

* *What Can She Be? A Computer Scientist*
Career Unit
Gloria and Esther Goldreich
Lothrop, Lee & Shepard, 1979

* *What Computers Can Do*
Donald D. Spencer
Camelot, 1977

RECOMMENDED PERIODICALS

The periodicals indicated with an asterisk are especially useful to teachers of grades K through 8.

* *ACM SIGCUE Bulletin*
Association for Computing Machinery
P.O. Box 12015
Church Street Station, NY 10249

* *AEDS Journal* and *AEDS Monitor*
Ass'n for Educational Data Systems
1201 Sixteenth St., NW
Washington, DC 20036

BYTE Magazine (McGraw-Hill)
Byte Publications, Inc.
70 Main St.
Peterborough, NH 03458

* *Classroom Computer News*
P.O. Box 266
Cambridge, MA 02138

Compute
Small Systems Services, Inc.
P.O. Box 5406
Greensboro, NC 27403

* *Computer Education*
Mrs. P. Jackson, The Computer Education Group
North Staffordshire, Polytechnic Computer Ctr.
Blackheath Lane, Stafford, England

ComputerTown, USA!
People's Computer Company
P.O. Box E
Menlo Park, CA 94025

* *The Computing Teacher*
Internat'l Council for Computers in Education
Dep't Computer and Information Science, University of Oregon
Eugene, OR 97403

Courseware Quarterly
Academic Computing Ass'n.
P.O. Box 27561
Phoenix, AZ 85061

Creative Computing
Elizabeth Styles, ed.
P.O. Box 789-M
Morristown, NJ 07960

CURSOR
P.O. Box 550
Goleta, CA 93017

* *Educational Computer Magazine*
P.O. Box 535
Cupertino, CA 95015

Educational Technology
140 Sylvan Ave.
Engelwood Cliffs, NJ 07632

Electronic Education
Electronic Communications, Inc.
1311 Executive Ctr. Dr., Suite 220
Tallahassee, FL 32301

* *Electronic Learning*
Scholastic, Inc.
902 Sylvan Ave.
Englewood Cliffs, NJ 07632

InfoWorld
530 Lytton Ave.
Palo Alto, CA 94301

Instructional Innovator
AECT
1126 Sixteenth St., NW
Washington, DC 20036

Interface: The Computer Education Quarterly
Stephen Mitchell, ed.
915 River St.
Santa Cruz, CA 95060

Journal of Computer-Based Instruction
ADCIS
409 Miller Hall
Western Washington University
Bellingham, WA 98225

Journal of Computers in Mathematics & Science Teaching
P.O. Box 4455
Austin, TX 78765

Journal of Educational Technology Systems
Baywood Publishing Co., Inc.
120 Marine St., Box D
Farmingdale, NY 11735

Microcomputers in Education
QUEUE
5 Chapel Hill Dr.
Fairfield, CT 06432

Microcomputing
80 Pine St.
Peterborough, NH 03458

On Computing
P.O. Box 307
Martinsville, NJ 08836

Personal Computing
P.O. Box 1408
Riverton, NJ 08077

Popular Computing
Byte Publications, Inc.
P.O. Box 307
Martinsville, NJ 08836

Purser's Magazine
P.O. Box 466
El Dorado, CA 95623

Recreational Computing
People's Computer Company
1263 El Camino Real, Box E
Menlo Park, CA 94025

SIGCUE Bulletin
ACM, Inc.
P.O. Box 12115
Church St. Station, NY 10249

SoftSide
P.O. Box 68
Milford, NH 03055

Source World
Source Telecomputing Corp.
1516 Anderson Rd.
McLean, VA 22102

T.H.E. Journal
P.O. Box 992
Acton MA 01720

DIRECTORIES OF SOFTWARE

The following are fairly comprehensive directories, and do not include the many catalogs available from suppliers of software.

Addison-Wesley Book of Apple Computer Software
The Book Company
16720 Hawthorne Blvd.
Lawndale, CA 90260

The Apple Software Directory, Vol. 3: Education
WIDL Video
5245 W. Diversey Ave.
Chicago, IL 60639

Atari Program Exchange
Atari, Inc.
P.O. Box 427
155 Moffett Park Dr.
Sunnyvale, CA 94086

The Book of Apple Computer Software 1981
The Book Co.
16720 Hawthorne Blvd.
Lawndale, CA 90260

Commodore Software Encyclopedia
Commodore Business Machines, Inc.
681 Moore Rd.
King of Prussia, PA 19406

Educational Software Directory
Sterling Swift Publishing Co.
P.O. Box 188
Manchaca, TX 78632

Hewlett-Packard Series 80 Software Catalog
Series 80 Users Library
1010 NE Circle Blvd.
Corvallis, OR 97330

International Microcomputer Software Directory
Imprint Software
420 S. Howes St.
Fort Collins, CO 80521

K-12 Micro Media
P.O. Box 17
Valley Cottage, NY 10989

Microcomputers in Education
5 Chapel Hill Drive
Fairfield, CT 06432

Purser's Magazine and Software Directory
Robert Purser, ed.
P.O. Box 466
El Dorado, CA 95623

QUEUE
5 Chapel Hill Dr.
Fairfield, CT 06432

Radio Shack TRS-80 Educational Software Sourcebook
P.O. Box 17400
Fort Worth, TX 76102

RICE Resources in Computer Education
Computer Technology Program
Northwest Regional Educational Laboratory
300 SW Sixth Ave.
Portland, OR 97204

School Microware Directory
Dresden Associates
P.O. Box 246
Dresden, ME 04342

Skarbeks Software Directory
11990 Dorsett Rd.
St. Louis, MO 63043

TRS-80 Software Source
COMPUTERMAT
P.O. Box 1664
Lake Havasu City, AZ 86403

Wernegreen Directory
Jack Wernegreen, Dep't. of Natural Sciences
Eastern Kentucky University
Richmond, KY 40475

REVIEWS AND EXCHANGES OF EDUCATIONAL SOFTWARE

The asterisked items are devoted to reviews of educational software.

AEDS Monitor
Ass'n. for Educational Data Systems

The Computing Teacher
Internat'l. Council for Computers in Education†

* *Courseware Report Card*
150 West Carob St.
Compton, CA 90220

Educational Products Information Exchange (EPIE)
SUNY, Stonybrook
P.O. Box 620
Stonybrook, NY 11794

Educational Software Exchange Library (EDSEL)
c/o Stanford Ave. School
2833 Illinois Ave.
South Gate, CA 90281

Electronic Learning Magazine
Scholastic, Inc†

* *The Apple Journal of Courseware Review*
P.O. Box 28426
San Jose, CA 95159

†See next section for address.

* *Materials Review and Evaluation Center*
Computer Courseware Project, Div. of Educational Media
State Dep't. Public Instruction
Raleigh, NC 27611

Michigan Association for Computer Users in Learning (MACUL)
c/o WCISD
33500 Van Born Rd.
Wayne, MI 48184

* *Microcomputer Courseware for the Classroom: Selecting, Organizing and Using Instructional Software*
Ann Lathrop and Bobby Goodson
Addison-Wesley,† 1982

* *Microcomputer Resource Center*
Teachers College, Columbia University
P.O. Box 18
New York, NY 10027

* *MicroSIFT*
Northwest Regional Educational Laboratory
300 SW Sixth St.
Portland, OR 97204

Peelings II
The Magazine of Apple Software Evaluation
Peelings II, Inc.
2260 Oleander
Las Cruces, NM 88001

Purser's Magazine
P.O. Box 466
El Dorado, CA 95623

* *RICE Resources in Computer Education*
Computer Technology Program
NWREL
300 SW Sixth Ave.
Portland, OR 97204

* *School Microware Reviews*
Evaluations of Educational Software
Dresden Associates
P.O. Box 246
Dresden, ME 04342

Softalk
10432 Burbank Blvd.
North Hollywood, CA 91601

* *Softswap*
San Mateo County Office of Education
333 Main St.
Redwood City, CA 94063

TABS Project
Dr. Suzanne K. Damarin, Director
Arps Hall 202-A
1945 N. High St.
Columbus, OH 43210

* *TALMIS Courseware Ratings*
115 North Oak Park Ave.
Oak Park, IL 60301

Technical Education Research Center (TERC)
8 Eliot St.
Cambridge, MA 02138

SUPPLIERS OF SOFTWARE AND EDUCATIONAL MATERIALS

Publishers and suppliers of programs, books, and other learning materials mentioned or recommended throughout this book are indicated with an asterisk.

* Academic Press
111 Fifth Ave.
New York, NY 10003

* Addison-Wesley Publishing Co.
2725 Sand Hill Rd.
Menlo Park, CA 94025

* Apple Computer, Inc
10260 Bandley Dr.
Cupertino, CA 95014

ASK Enterprises
825 W. Rosewood St.
Rialto, CA

* Atari, Inc.
1272 Borregas Ave.
Sunnyvale, CA 94086

Atari Consumer Div.
P.O. Box 427
Sunnyvale, CA 94086

Automated Simulations
1988 Leghorn St.
Mountain View, CA 94043

Avant-Garde Creations
P.O. Box 30160
Eugene, OR 97403

Bell & Howell
7100 N. McCormick Rd.
Chicago, IL 60645

* Biological Sciences Curriculum Study
P.O. Box 930
Boulder, CO 80306

* Bolt Beranek & Newman, Inc.
10 Moulton St.
Cambridge, MA 02138

Borg-Warner Educational Systems
600 W. University Dr.
Arlington Heights, IL 60004

Brain Box
601 W. 26th St.
New York, NY 10003

* BYTE Books (McGraw-Hill)
70 Main Street
Peterborough, NH 03458

Cambridge Development Laboratory
36 Pleasant St.
Watertown, MA 02172

* Camelot Publishing Co.
P.O. Box 1357
Ormond Beach, FL 32074

Computer Curriculum Corp. (CCC)
P.O. Box 10080
Palo Alto, CA 94303

Computer Information Exchange
P.O. Box 159
San Luis Rey, CA 92068

* Computer Science Press
9125 Fall River La.
Potomac, MD 20854

Conduit
P.O. Box 388
Iowa City, IA 52244

Control Data Corp.
8100 34th Ave. South
P.O. Box O
Minneapolis, MN 55440

* Cook's Computer Co.
1905 Bailey Dr.
Marshalltown, IA 50158

Courseware Magazine
4919 North Millbrook #222
Fresno, CA 93726

* Creative Computing Press
P.O. Box 1139
Morristown, NJ 07960

* Creative Publications
P.O. Box 10328
Palo Alto, CA 94303

Cybertronics International
999 Mount Kemble Ave.
Morristown, NJ 07960

* Denison & Co., Inc.
Minneapolis, MN 55431

* dilithium Press
P.O. Box 606
Beaverton, OR 97075

* Dresden Associates
P.O. Box 246
Dresden, ME 04342

* Education Development Center
Cognitive Research Group
55 Chapel St.
Newton, MA 02160

Encyclopedia Britannica
425 North Michigan Ave.
Chicago, IL 60611

Entelek
P.O. Box 1303
Portsmouth, NH 03801

* Gentleware, Inc.
P.O. Box 8301
University Station
Knoxville, TN 37996

Guidance Associates
Communications Park
Box 3000
Mount Kasco, NY 10547

* J. L. Hammett, Microcomputer Div.
P.O. Box 545
Braintree, MA 02184

* Hayden Book Co.
50 Essex St.
Rochelle Park, NJ 07662

Holt, Rinehart & Winston
School Marketing Dep't.
383 Madison Ave.
New York, NY 10017

* Houghton Mifflin Co.
One Beacon Street
Boston, MA 02107

* Information Unlimited Software, Inc.
281 Arlington Ave.
Berkeley, CA 94707

* International Council for Computers in Education
Dep't. Computer & Information Science
University of Oregon
Eugene, OR 97403

* K-12 Micromedia
P.O. Box 17
Valley Cottage, NY 10989

* The Learning Company
4370 Alpine Rd.
Portola Valley, CA 94025

* Lightning Software
P.O. Box 11725
Palo Alto, CA

* Logo Computer Systems, Inc.
222 Brunswick Blvd.
Point Claire, Quebec, Canada H9R1A6

Marck Educational Software
280 Linden Ave.
Branford, CT 06405

* McDonald & Entwhistle
19104 Wooten Ave.
Poolesville, MD 20837

* McGraw-Hill
1221 Ave. of the Americas
New York, NY 10020

* MECC Publications
2520 Broadway Dr.
St. Paul, MN 55113

Med Systems Software
P.O. Box 2674-D
Chapel Hll, NC 27514

* Michigan Association for Computer Users in Learning (MACUL)
Larry Smith, Wayne Intermediate School Distr.
22500 Van Born Rd.
Wayne, MI 48184

* Micro-Ed
P.O. Box 24156
Minneapolis, MN 55440

Microsoft Consumer Products
400 108th Ave. NE, Suite 200
Bellevue, WA 98004

Milliken Publishing
1100 Research Blvd.
St. Louis, MO 63132

* Milton-Bradley Co.
Shaker Rd.
E. Longmeadow, MA 01028

* Muse Software, Inc.
330 N. Charles St.
Baltimore, MD 21201

* National Science Teachers Ass'n.
1742 Connecticut Ave., NW
Washington, DC 20009

Opportunities for Learning, Inc.
8950 Lurline Ave., Dept 26CD
Chatsworth, CA 91311

Powersoft
P.O. Box 157
Pitman, NJ 08701

Program Design, Inc. (PDI)
11 Idar Ct.
Greenwich, CT 06830

Project LOCAL Software
Dresden Associates
P.O. Box 246
Dresden, ME 04342

* Radio Shack Education Div.
1600 One Tandy Ctr.
Fort Worth, TX 76102

Random House School Div.
2970 Brandywine Rd.
Atlanta, GA 30341

Reader's Digest Services
Educational Div.
Pleasantville, NY 10570

* Reston Publishing Co.
11480 Sunset Hills Rd.
Reston, VA 22090

Robbinsdale Area Schools
Microcomputers in Education
4148 Winnetka Ave., N.
Minneapolis, MN 55427

Science Research Associates
155 North Wacker Dr.
Chicago, IL 60606

Scott, Foresman & Co.
1900 East Lake Ave.
Glenview, IL 60025

Software Exchange
P.O. Box 68
Milford, NH 03055

* Software Publishing Corp.
1901 Landings Dr.
Mountain View, CA 94043

Steketee Educational Software
4639 Spruce St.
Philadelphia, PA 19139

• Sterling Swift Publishing Co.
1600 Fortview Rd.
Austin, TX 78704

Synergistic Software
5221 120th Ave., SE
Bellevue, WA 98006

Teach Yourself by Computer Software (TYC)
40 Stuyvesant Manor
Geneseo, NY 14454

T.H.E.S.I.S.
P.O. Box 147
Garden City, MI 48135

Time Share Corp.
Mount Support Rd.
Hanover, NH 03755

• Weston Walch
P.O. Box 658
Portland, ME 04104

SOFTWARE: LANGUAGES

The following are language packages referenced in this book, and their suppliers:

Kidstuff

Kidstuff turtle graphics for the PET
Supplier: J. L. Hammett, Microcomputer Div.
P.O. Box 545
Braintree, MA 02184
(617) 848-1000
$59.95
Computer: 8K Commodore PET or CBM, cassette recorder
Included: Cassette containing both 8K and 16K versions

Logo

Apple Logo
Distributor: Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

Developer: Logo Computer Systems, Inc.
222 Brunswick Blvd.
Point Claire, Quebec, Canada H9R 1A6
(514) 694-2885
$175
Computer: Apple II or Apple II Plus with 16K memory card
Included: Two Logo disks (copy protected)
Apple Logo: An Introduction to Programming Through Turtle Graphics, 153 pp.
Apple Logo Reference Manual, 186 pp.

Krell Logo
Distributor: Krell Software Corp.
1320 Stony Brook Rd.
Stony Brook, NY 11790
(516) 751-5139
$149.95
Computer: Apple II or Apple II Plus with 16K memory card
Included: Two copies of MIT Logo (copy protected)
Utilities disk with MIT and Krell utilities "Alice in Logoland" disk
Logo for the Apple: Technical Manual, 57 pp.
Logo for the Apple, 228 pp.
Poster-sized summary sheet for Krell Logo *Alice in Logoland Primer*
1-year (5 issues) subscription to *The Logo and Educational Computing Journal*
Teacher's Manual

TI Logo
Texas Instruments
POB 53
Lubbock, TX 79408
$129.95
Computer: TI-99/4 or TI-99/4A with 32K-byte memory expansion option and cassette recorder or floppy disk
Included: One Command Module containing TI Logo; cassette and floppy disk containing TI Logo demonstration programs, 83-pg. manual

TRS-80 Color Logo
Radio Shack, Education Div.
400 Atrium, One Tandy Ctr.
Fort Worth, TX 76102
(817) 390-3302
$99

Computer: TRS-80 color computer with 32K memory and disk drive
Included: Language reference manual and teacher's guide; turtle graphics

Terrapin Logo
Terrapin, Inc.
678 Massachusetts Ave., #205
Cambridge, MA 02139
(617) 492-8816
$149.95
Computer: Apple II or Apple II Plus with 48K memory and 16K memory card
Included: Logo language disk (copy protected; backup $15)
Utilities disk with MIT and Terrapin utilities
Terrapin Logo Tutorial, 86 pp.
Logo for the Apple: Technical Manual, 55 pp.

Cyberlogo
Cybertronics International
Morristown, NJ
Computer: Apple II with 48K memory

PILOT

Apple PILOT, Apple SuperPILOT, Apple Co-PILOT, and Apple SuperPILOT Log.
Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, CA 95014
(408) 996-1010
Computer: Apple II 48K
Included: Apple PILOT includes manuals, PILOT authoring language, and a sample lesson disk. Co-PILOT is an interactive tutorial on using PILOT. SuperPILOT is an enhanced version of Apple PILOT, with features such as program control of a videotape recorder or videodisk. SuperPILOT log is a student record-keeping system.

Atari PILOT
Atari, Inc.
P.O. Box 427
Sunnyvale, CA 94086
$129.95
Computer: Atari 400 or 800, 16K
Included: PILOT in ROM cartridge; demonstration programs on tape; student manual; tutorial manual; reference card

Pascal

Rascal and Interpas, interpretive dialect of Pascal
Gentleware, Inc.
P.O. Box 8301, University Sta.
Knoxville, TN 37996
$125
Computer: Apple II with 48K memory; 16K language card with Pascal
Included: Interpas Interpreter on disk; DEMO programs on disk; Utility program for creating compilable programs; DISKTOOL, a teachers' program for setting up student disks

SOURCES AND HELPFUL ORGANIZATIONS

The list and description of local, state, regional, national, and international organizations involved in educational computing could fill an entire book. See, for example, the *Classroom Computer News Directory of Educational Computing Resources*, published periodically by Intentional Educations, Inc. The following are just a few of the major national organizations of interest at the elementary and junior high school level.

Association for the Development of Computer-Based Instructional Systems (ADCIS)
ADCIS Headquarters
409 Miller Hall
Western Washington University Computer Center
Bellingham, WA 98225

Association for Educational Communications and Technology (AECT)
1126 16th St., NW
Washington, DC 20036

Association for Educational Data Systems (AEDS)
1201 16th St., NW
Washington, DC 20036

ERIC Clearinghouse on Information Resources
Syracuse University
School of Education
130 Huntington Hall
Syracuse, NY 13210

Directory of On Line Information Resources
CSG Press
11301 Rockville Pike
Kensington, MD 20795

International Council for Computers in Education (ICCE)
Dep't. of Computer and Information Science
University of Oregon
Eugene, OR 97403

National Council for the Social Studies (NCSS)
3501 Newark St., N.W.
Washington, DC 20016

National Council of Teachers of English
Dr. Bernard O'Donnell
1111 Kenyon Rd.
Urbana, IL 61801

National Council of Teachers of Mathematics (NCTM)
1906 Association Dr.
Reston, VA 22091

National Science Teachers Association (NSTA)
1742 Connecticut Ave., NW
Washington, DC 20009

School Science and Mathematics Association
126 Life Sciences Bldg.
Bowling Green State University
Bowling Green, OH 43403

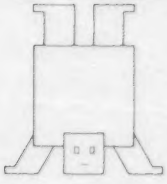
Special Interest Group for Computer Use in Education (SIGCUE)
Ass'n. for Computing Machinery (ACM)
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