Operate a Nuclear Power Plant

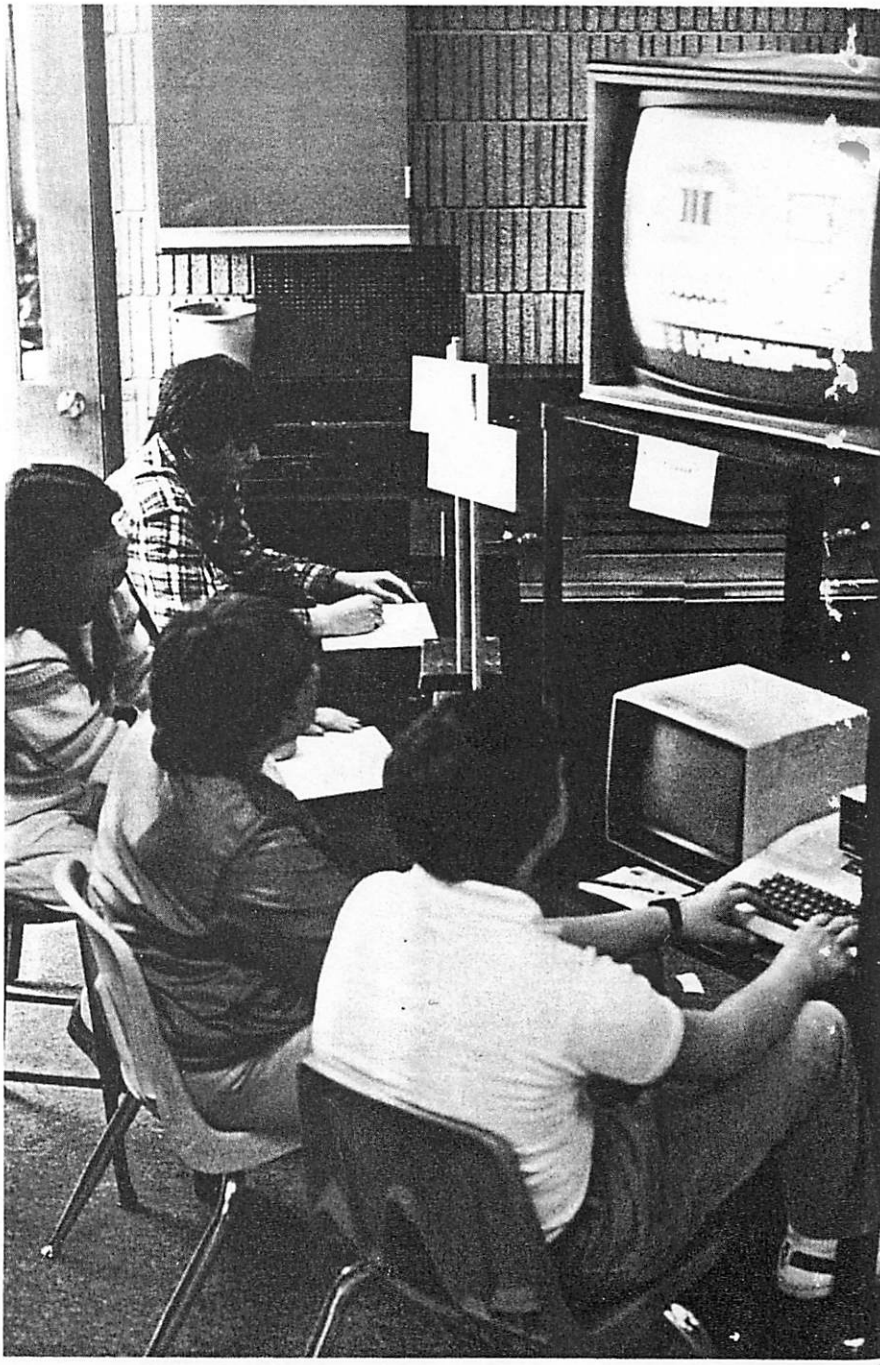
Bonnie J. Frimpter
Royal E. Doughty
Gerald L. Abegg

What are we trying to accomplish in our science classes? Emerging definitions of our goals urge us to "humanize" science—to make the knowledge and the process of science useful and beneficial to both our students and society.

Paul DeHart Hurd stresses that science education must provide students with opportunities to apply their knowledge through decision making: "There is a growing recognition that the measure of general education in the sciences is one's ability to apply knowledge wisely in the context of intelligent thought and action. This means that as much effort in teaching should be given to the use of knowledge as to its attainment. To be able to use what is learned means crossing the barrier from learning to logical reasoning and decision making [2]." An emphasis on decision making can help students understand the many ways in which science, technology, and society relate to one another.

How can we help our students learn to make decisions? How can they learn to distinguish between

Bonnie J. Frimpter and Royal E. Doughty are research associates at Boston University and physical science teachers at Jonas Clarke Junior High School, Lexington, MA 02173. Gerald L. Abegg is an associate professor of science education at Boston University, Boston, MA 02215.



—B. J. Frimpter/R. E. Doughty

facts and personal opinion and to use each appropriately? How can they relate science and technology to their future?

We offer one classroom activity—using a microcomputer—that provides a format that may help you and your students realize all of these goals.

You are the "plant owner." Once the plant is staffed with trained personnel, you retire to a vacation spot. We usually choose the Bahamas!

Computing with a purpose

"The Apple Nuclear Power Plant," a computer program that simulates the operation of a nuclear generating station, requires students to make many decisions as they assume the task of managing the plant. The program teaches them about the practical side of science and technology and introduces them to the use of computers in the classroom. The program requires no previous knowledge of or experience with computers.

Learning to *use* a computer, as distinct from *programming* one, is simple. To run the program, you need an Apple II with a 48K memory and display capability (preferably color). If you are unfamiliar with computers, find a faculty member, parent, or student who can show you how to set up the system, load (boot) a disc, and run a program and who will help answer operational questions when necessary. Students often know more about computers than teachers, and both can benefit from a little role reversal.

The Nuclear Power Plant Program list was published in *Creative Computing* magazine [1]. Have it typed onto a disc, and spend an hour or two playing with the program. Now you're ready to try it with your students.

The object of "The Apple Nuclear Power Plant" is to generate as much power as possible, without a plant shutdown, until you exhaust the fuel. You can do so by adjusting the control rods in the reactor core. The primary radioactive coolant transfers heat to the heat exchanger. The secondary coolant carries heat onto the turbine/generator. The pumping rates of both coolants can be controlled from the computer keyboard. A cooling tower helps to dissipate excess heat. Emergency coolant is available to the reactor.

Students are given an initial color display of the power plant from reactor core to cooling tower. The monitor displays each "day" individually, with options for decisions about the level of the control rods, the flow of primary and secondary coolants, and the use of emergency coolant.

Each day as the students make choices, the computer displays the operating conditions of the plant: daily power output, average power output, reactor temperature, heat exchanger temperature, and cooling tower temperature. Maximum operating temperatures are suggested, and the daily report includes warnings of leakage and damage. (See Figures 1 and 2.) Successful operation involves keeping power production high while maintaining temperatures within a safe range. When the plant's fuel is exhausted, after about 120 days, the program evaluates the total run based on average output and assesses any damage that has occurred during operation.

Generating enthusiasm

This program provides enough information to involve an entire class or even two competing classes if two computers are available. It encourages both intense individual involvement *and* group cooperation as students strive for the highest kilowatt output possible without a shutdown or as two "power companies" using two computers compete.

As participants learn to operate the plant, they also learn to form hypotheses, to see the relationship between cause and effect, and to make decisions based on observed and analyzed data. They put their science process skills to use in collecting data; recording, graphing, reporting, and evaluating results; recommending courses of action; planning and controlling variables; and allowing for delayed results.

Be sure to familiarize students with the object of the plant's operation before you run the program. A diagram of the plant should be available for student reference for those times when the graphics cannot be displayed on the monitor.

You will also need to set up a graph for each group, with the x-axis representing the days of plant operation and the y-axis showing the temperature or kilowatts for each plant function. Draw a red line across the graph at the maximum temperatures recommended for each function to serve as a warning guide.

Assign observing and recording tasks to groups of students. Each group should assume responsibility for one of the categories reported on the daily operations report: reactor temperature, heat exchanger temperature, cooling tower temperature, daily power output, and average power output. Using masking tape, place signs identifying each group on lab ring stands.

Appoint a "plant supervisor" in each group to receive reports and recommendations from the members of the group. The supervisor makes decisions about the levels of the cool-

Apple Nuclear Power Plant
Status Report—Day 1

Warnings:
Power Output Low

Damage:

Indicators:
Reactor Temp. (Max 800) 25
Heat Exchanger Temp. (Max 500) 25
Cooling Tower Temp. (Max 300) 25
Power Output (Max 2000 kw) 0 kw
Average Power Output 0 kw/day
Control Rods—0
Coolants
Emergency Level—300 Flow—0
Primary Level—120 Flow—0
Secondary Level—120 Flow—0

Figure 1. Day 1

Status Report—Day 58

Warnings:
Power Output Low
Emergency Coolant Low
Secondary Coolant Low

Damage:
Secondary Coolant Leak—21/day
Secondary Coolant Pump Leak—0%
Heat Exchanger Failure

Indicators:
Reactor Temp. (Max 800) 25
Heat Exchanger Temp. (Max 500) 25
Cooling Tower Temp. (Max 300) 25
Power Output (Max 2000 kw) 0 kw
Average Power Output 1443 kw/day
Control Rods—0
Coolants
Emergency Level—0 Flow—0
Primary Level—120 Flow—50
Secondary Level—0 Flow—0
Maintenance Shutdown—23 days

Figure 2. Problems arise!

Status Report—Day 91

Warnings:
Reactor Overheated
Heat Exchanger Overheated
Turbine Overloaded

Damage:
Reactor Core Damaged
Secondary Coolant Leak—7/day
Emergency Coolant Leak—8/day

Meltdown! Meltdown! Meltdown!

The reactor core has melted down and produced a steam explosion. The containment building has ruptured. Lethal radioactive gases and debris have escaped.

Initiate your evacuation and radiation cleanup plans and get medical assistance.

Figure 3. More experience required

ants and the position of the control rods. Another student, the "control room technician," operates the computer keyboard under the direction of the supervisor. Others in the group head various departments of the plant.

You are the "plant owner." Once the plant is staffed with trained personnel, you retire to a vacation spot (we usually choose the Bahamas!) where your only duties are to receive occasional progress reports or to hire, fire, or replace personnel as necessary.

As the days pass, the student supervisor receives recommendations from each department and tells the technician when to change the rods and the coolant levels. Each department records the function data displayed each day for its area of responsibility. When the graphs begin to show a pattern of temperatures and kilowatt production, the need to make changes becomes evident. Through group decision making, students influence the outcome they want by controlling the variables for which they are responsible.

You will find that it is often useful to run the program twice. As students learn from experience, they will suggest new hypotheses for better results. Computer feedback will indicate their success or failure. (See Figure 3.)

What shall we do next?

The generating plant simulation offers problem solving opportunities. Students can apply logic to concrete problems: "When we increase the coolant flow, the reactor cools down, but then the heat exchanger heats up! So what can we do to cool down the heat exchanger?"

Students who show competence in formal operational thinking can examine the effect of a combination of variables: "The amount of heat in the whole system is influenced by a combination of variables. Maybe temperature control determines the amount of electricity produced. Since temperature is a delayed reaction, let's try removing the control rods slowly and let the temperature approach the maximum point gradually. Maybe that way we'll get more kilowatts of electricity over a longer period of time."

The plant simulation can also be a springboard for examining the moral implications of energy decisions and for discussing dilemmas raised by the use of different types of energy production and their effects on living standards and the environment. Considering the effects of technology and scientific knowledge on society is, according to Hurd, a very worthwhile science classroom practice: "Issue-oriented laboratory problems take place in an ethical value or moral context and lead to decisions or consensus rather than conclusions. Ideally, laboratory activities will be but a beginning to thought, action, experience, and learning [3]."

After using the generating plant simulation with many classes over several years and with teachers in numerous institutes and workshops, we strongly recommend the activity. Reactions from teachers and their students from various parts of the country have been enthusiastic. The simulation activity promotes active student involvement in scientific exploration and group interaction and fosters an appreciation of the variables involved in generating nuclear electricity.

Our students have been heard to say, "That's a tough job! I wouldn't want to be responsible for running a power plant." But they also enjoy the challenge: "That was fun!" "We'll beat the other class tomorrow." "Can I be the control room operator?"

Using the simulation is a memorable and worthwhile teaching experience as well, even when the students tell us, "You 'owners' can go back to the Bahamas. We can handle this ourselves!"

* * *

If you need more information about the program, please write to us. ■

References

1. Berggren, Stephen R. "Apple Nuclear Power Plant." *Creative Computing* 16:130-137, December 1980.
2. Hurd, Paul DeHart. "Charting a Course for Precollege Science Education for the 1980s and Beyond." *The Status of Middle School and Junior High School Science*. Louisville, Colorado: Center for Educational Research and Evaluation, BSCS, 1981.
3. ______. "Biology Education." In *What Research Says to the Science Teacher*. Norris Harms et al., ed. Washington, D.C.: National Science Teachers Association, 1981.

NOTICE: This material may be protected by copyright law (Title 17 U.S. Code)

at the end of the program give the prefixes and suffixes used to create the variables. They also describe what each section is supposed to do.

Program Details

The program is written in Applesoft, Apple's floating point Basic, and fits in a 16K memory. Translation should be very easy with some exceptions. The diagram routines use color graphics. If your system does not have graphics, delete lines 6000 to 7060. You must also fix lines 220 and 222, since calling a deleted subroutine is an easy way to crash. The program also makes extensive use of logic evaluations within expressions. For example, (A 100) equals one if true, and zero if false. This is a quick and easy way to avoid IF statements. If your system does not have this capability, convert each of these expressions to IF statements. Many of the variables have percent signs following them. This is Applesoft's way of saying 'integer variable.' I used them to keep fractions out of the numbers printed in the status report. If your system can easily control the number of decimal places printed, forget the percent signs.

Before I could get the emergency coolant on, the reactor went out of control and disaster struck. Too bad, but I deserved it.

In Applesoft, the PEEK in line 910 returns the vertical position of the cursor. If you can't find your cursor, you will have to think up another way to input the control variable. Finally, the instructions and the status report are made to fit a 40 by 24 character screen. These can be easily modified to fill a wider screen.

I have some final words to engineers, nuclear technicians and other qualified readers. No, I have never seen a real power plant that was designed like this. Yes, I know it takes much less than a day for a reactor to respond to changes in coolant flow and control rod position. Besides, who ever heard of a reactor with only one emergency cooling system, and that one with a limited supply of coolant? And, blasphemy of blasphemies, no SCRAM mechanism? I am sure your list of discrepancies is far more complete. What I have tried to do is to incorporate characteristics and responses of a simplified and idealized nuclear power plant into a computer simulation game. Several concessions to accuracy were made in order to create a simulation that would provide realistic responses to simple inputs and make an interesting and instructive game. □

```
10  HOME
20  PRINT  SPC( 8)"APPLE NUCLEAR POWER PLANT"
30  PRINT  SPC( 9)"BY STEPHEN R. BERGGREN
40  PRINT
50  PRINT "THIS PROGRAM SIMULATES THE OPERATION OF"
60  PRINT "A NUCLEAR POWER REACTOR.  THE OBJECT"
70  PRINT "IS TO OPERATE THE PLANT AT A MAXIMUM"
80  PRINT "AVERAGE POWER OUTPUT WITHOUT CAUSING"
90  PRINT "A REACTOR MELTDOWN."
100  PRINT
110  PRINT "THE CONTROL RODS ADJUST THE AMOUNT OF"
120  PRINT "HEAT PRODUCED BY THE REACTOR.  PRIMARY"
130  PRINT "COOLANT TRANSFERS THIS HEAT TO THE HEAT"
140  PRINT "EXCHANGER.  SECONDARY COOLANT TRANSFERS"
150  PRINT "HEAT FROM THE HEAT EXCHANGER TO THE"
160  PRINT "TURBINE, WHERE POWER IS PRODUCED, AND"
170  PRINT "FINALLY TO THE COOLING TOWER.  THE"
180  PRINT "EMERGENCY COOLANT IS USED TO HELP SHUT"
190  PRINT "DOWN THE REACTOR WHEN OTHER SYSTEMS"
200  PRINT "FAIL.  UNLIKE THE OTHER COOLANTS, "
210  PRINT "EMERGENCY COOLANT IS NOT RECYCLED."
220  PRINT : INPUT "ENTER 'D' TO SEE REACTOR DIAGRAM    ENTER 'I' FOR WORKIN
G INSTRUCTIONS       ENTER 'S' TO START OPERATION      ";A$
221  IF A$ = "D" THEN  GOSUB 6000: GOTO 220
222  IF A$ = "S" THEN 390
225  TEXT : HOME
230  PRINT "THE CONTROLS ARE OPERATED BY TYPING IN"
235  PRINT "THE DESIRED CONTROL ROD SETTING AND"
240  PRINT "FLOW RATES.(USE VALUES FROM 0 TO 100)"
245  PRINT "IF NO ENTRY IS MADE, THE VALUES WILL"
250  PRINT "NOT CHANGE.  USE THE SPACE BAR TO STEP"
255  PRINT "TO THE DIFFERENT FUNCTIONS.  WHEN THE"
260  PRINT "DESIRED ENTRIES HAVE BEEN MADE, USE THE"
265  PRINT "'RETURN' KEY TO ADVANCE TO THE NEXT DAY."
270  PRINT "THE REACTOR CAN BE OPERATED UNTIL A"
275  PRINT "MELTDOWN OCCURS OR THE REACTOR FUEL IS"
280  PRINT "EXHAUSTED.  THE FUEL WILL LAST FOR"
285  PRINT "ABOUT 100 TO 150 DAYS.  WHEN THE FUEL"
290  PRINT "IS EXHAUSTED, YOUR PERFORMANCE WILL BE"
295  PRINT "EVALUATED.
298  PRINT : INPUT "    (PRESS RETURN TO CONTINUE)";A$: HOME
300  PRINT : PRINT "IF YOU WANT TO REPAIR DAMAGE OR REPLACE"
305  PRINT "COOLANT, BRING THE REACTOR TEMPERATURE"
310  PRINT "DOWN BELOW 100 AND SHUT OFF THE COOLANT"
315  PRINT "FLOWS.  THIS WILL CAUSE AN AUTOMATIC"
320  PRINT "MAINTENANCE SHUTDOWN AND ALL COOLANT"
325  PRINT "WILL BE REPLENISHED AND REPAIRS MADE."
330  PRINT "THE GREATER THE DAMAGE, THE LONGER THE"
335  PRINT "REPAIRS WILL TAKE."
340  PRINT
350  PRINT "      WARNING: THIS POWER PLANT HAS"
360  PRINT "      NO AUTOMATIC SAFETY DEVICES!!"
370  PRINT
380  GOTO 220
390  REM  INITIATE
400  GOSUB 2000
410 RH = 0
420 RL = 0
430 DAY% = 0
440 TT = 0
450 DMGE% = 0
455 A% = 0:A1% = 0:A2% = 0
460  REM WRITE REPORT
470  TEXT : HOME
475 DAY% = DAY% + 1
480  PRINT  SPC( 7)"APPLE NUCLEAR POWER PLANT"
490  PRINT  SPC( 8)"STATUS REPORT - DAY ";DAY%
500  PRINT
510  PRINT "WARNINGS:"
520  IF RT% > 800 THEN  PRINT " REACTOR OVERHEATED":RD% = RD% + 1 + (RT%
     > 850) + (RT% > 900) + 2 * (RT% > 950):PD% = PD% + 1:ED% = ED% + 1
     + (RT% > 850)
530  IF XT% > 500 THEN  PRINT " HEAT EXCHANGER OVERHEATED":XD% = XD% + 1
     + (XT% > 600):PD% = PD% + 1:SD% = SD% + 1
540  IF GO% > 2000 THEN  PRINT " TURBINE OVERLOADED":TD% = TD% + 1 + (GO%
     > 2500  ):SD% = SD% + 1
550  IF CT% > 300 THEN  PRINT " COOLING TOWER OVERHEATED":SD% = SD% + 1
560  IF GO% < 1000 THEN  PRINT " POWER OUTPUT LOW"
570  IF EV% < 200 THEN  PRINT " EMERGENCY COOLANT LOW"
580  IF PV% < 100 THEN  PRINT " PRIMARY COOLANT LOW":PD% = PD% + 1
590  IF SV% < 100 THEN  PRINT " SECONDARY COOLANT LOW":SD% = SD% + 1
600  PRINT
610  PRINT "DAMAGE:"
620  IF RD% > 3 THEN  PRINT " REACTOR CORE DAMAGED"
630  IF PD% > 4 THEN  PRINT " PRIMARY COOLANT LEAK - ";PD%;"/DAY":PV% =
     (PV% - P
D%) * ((PV% - PD%) > 0)
640  IF SD% > 4 THEN  PRINT " SECONDARY COOLANT LEAK - ";SD%;"/DAY":SV% =
```

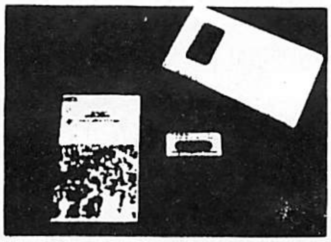
I FOR WORKIN

+ 1 + (RT%
= ED% + 1
= XD% + 1
+ 1 + (GO%
= SD% + 1
+ 1
% + 1
RY":PU% =
DAY":SU% =

COMPUTING

Ecology Simulations

The Ecology Simulations series are a unique educational tool. They are based on "simulation models" developed by the Huntington Two Computer Project at the State University of New York at Stony Brook under the direction of Dr. Ludwig Braun. The programs and accompanying documentation are written for self-teaching or classroom use and include background material, sample exercises and study guides. Graphic displays were specially developed by Jo Ann Comito at SUNY and Ann Corrigan at Creative Computing. The Ecology Simulations packages are a remarkable educational application of micro-computers.



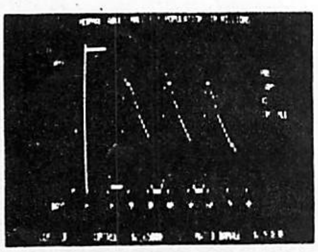
Ecology Simulations-1, CS-3201 (16K)

1. Pop

The POP series of models examines three different methods of population projection, including exponential, S-shaped or logistical, and logistical with low density effects. At the same time the programs introduce the concept of successive refinement of a model, since each POP model adds more details than the previous one.

2. Sterl

STERL allows you to investigate the effectiveness of two different methods of pest control—the use of pesticides and the release of sterile males into the fly population. The concept of a more environmentally sound approach versus traditional chemical methods is introduced. In addition, STERL demonstrates the effectiveness of an integrated approach over either alternative by itself.



3. Tag

TAG simulates the tagging and recovery method that is used by scientists to estimate animal populations. You attempt to estimate the bass population in a warm-water, bass-bluegill farm pond. Tagged fish are released in the pond and samples are recovered at timed intervals. By presenting a detailed simulation of real sampling by "tagging and recovery," TAG helps you to understand this process.

4. Buffalo

BUFFALO simulates the yearly cycle of buffalo population growth and decline, and allows you to investigate the effects of different herd management policies. Simulations such as BUFFALO allow you to explore "What if" questions and experiment with approaches that might be disastrous in real life.

Ordering Information

The series is designed for the 16K TRS-80 Level II and is attractively packaged in a vinyl binder with a complete study guide. *Ecology Simulations-I:* disk CS-3501, cassette 3201. *Ecology Simulations-II:* disk CS-3502, cassette CS-3204. *Social and Economic Simulations:* disk CS-3508, cassette CS-3204. At a modest $24.95 each, the series is an affordable necessity.

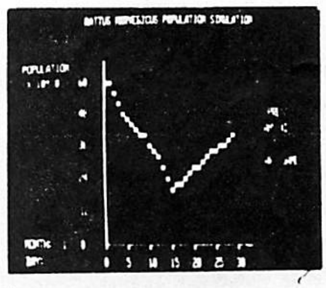
To order, send payment plus $1.00 shipping and handling to Creative Computing Software, Dept. ACGG, P.O. Box 789-M, Morristown, NJ 07960. For Faster Service, call in your order toll-free to our order hotline 800-631-8112. In NJ call 201-540-0445.

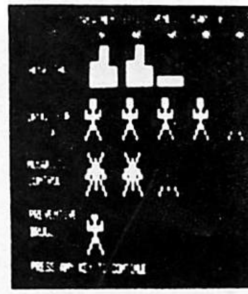
1. Pollute

POLLUTE focuses on one part of the water pollution problem; the accumulation of certain waste materials in waterways and their effect on dissolved oxygen levels in the water. You can use the computer to investigate the effects of different variables such as the body of water, temperature, and the rate of dumping waste material. Various types of primary and secondary waste treatment, as well as the impact of scientific and economic decisions can be examined.

2. Rats

In RATS, you play the role of a Health Department official devising an effective, practical plant to control rats. The plan may combine the use of sanitation and slow kill and quick kill poisons to eliminate a rat population. It is also possible to change the initial population size, growth rate, and whether the simulation will take place in an apartment building or entire city





3. Malaria

With MALARIA, you Health Official trying to c a malaria epidemic while into account financial siderations in setting program. The budgeted field hospitals, drugs for three types of pesticide preventative medication be properly combined effective control program

4. Diet

DIET is designed to e the effect of four substances, protein, calories and carbohydra your diet. You enter a lis types and amounts of foo in a typical day, as well a age, weight, sex, health physical activity factor particularly valuab indicating how a diet changed to raise or lowe weights and provide nutrition

Social and Economic Simulations CS-3204 (16K)

1. Limits

LIMITS is a micro-computer version of the well known "Limits to Growth" project done at MIT. It contains a model of the world that is built of five subsystems (population, pollution, food supply, industrial output, and resource usage) linked together by six variables: birth rate, death rate, pollution generation, resource usage rate, industrial output growth rate, and food production rate.

2. Market

Market allows two or more people to play the roles of companies who are competing for the market for a par product: in this case, bic

Each player makes m ing decisions quarterly i ing the production leve advertising budget, an unit price of the produ his/her company.

3. USPop

USPOP allows the u study many aspects United States' human graphy (population c including population g age and sex distri USPOP makes populati jections and investigat consequences of many ent demographic change

CIRCLE 300 ON READER SERVICE CA

```
      (SU% -  SD%) * ((SU% - SD%) > 0)
650   IF ED% > 2 THEN  PRINT " EMERGENCY COOLANT LEAK - ";2 * ED%;"/DAY":
      EV% = (E V% - 2 * ED%) * ((EV% - 2 * ED%) > 0)
660   IF PB% THEN  PRINT " PRIMARY COOLANT PUMP FAILURE - ";10 * PD% *
      (PD% < 10)  + 100 * (PD% >  = 10);"%"
670   IF SB% THEN  PRINT " SECONDARY COOLANT PUMP FAILURE - ";10 * SD% *
      (SD% < 1  0) + 100 * (SD% >  = 10);"%"
680   IF XB% THEN  PRINT " HEAT EXCHANGER FAILURE"
690   IF GB% THEN  PRINT " TURBINE FAILURE"
700   PRINT
710   IF RD% > 5 THEN  PRINT "       MELTDOWN!  MELTDOWN!  MELTDOWN!":
      GOTO 3000
720   PRINT "INDICATORS:"
730   PRINT " REACTOR TEMP. (MAX 800) ";RT%
740   PRINT " HEAT EXCHANGER TEMP. (MAX 500) ";XT%
750   PRINT " COOLING TOWER TEMP. (MAX 300) ";CT%
760   PRINT " POWER OUTPUT (MAX 2000KW) ";GO%;"KW"
765 KW% = TT / DAY%
770   PRINT " AVERAGE POWER OUTPUT  ";KW%;"KW/DAY
800   PRINT " CONTROL RODS- ";A%
810   PRINT " COOLANTS"
820   PRINT "  EMERGENCY  LEVEL- ";EV%;"  FLOW- ";EF%
830   PRINT "  PRIMARY    LEVEL- ";PU%;"  FLOW- "PF%
840   PRINT "  SECONDARY  LEVEL- ";SU%;"  FLOW- "SF%;
850   IF (100 - RL) < 5 THEN  PRINT : PRINT : PRINT "REACTOR FUEL
      EXHAUSTED": GOTO 4000
900   REM GET NEW CONTROL VALUES
910 P =  PEEK (37)
920   VTAB (P - 3)
930   HTAB (20)
950 A2% = A1%:A1% = A%
955 B$ = "": FOR I = 1 TO 4
960   GET A$:Z =  ASC (A$)
965   IF (Z <  > 13 AND Z <  > 32) AND (Z > 57 OR Z < 48) THEN 960
970 B$ = B$ + A$: IF Z = 13 THEN 1170
975   IF Z = 32 THEN 990
980 A% =  VAL (B$):A% = A% + (100 - A%) * (A% > 100)
985   PRINT A$;: NEXT I
990   VTAB (P - 1)
1000   HTAB (35)
1005 B$ = "": FOR I = 1 TO 4
1010   GET A$:Z =  ASC (A$)
1015   IF (Z <  > 13 AND Z <  > 32) AND (Z > 57 OR Z < 48) THEN 1010
1020 B$ = B$ + A$: IF Z = 13 THEN 1170
1025   IF Z = 32 THEN 1050
1030 EF% =  VAL (B$):EF% = EF% + (100 - EF%) * (EF% > 100)
1035   IF EF% > EV% THEN EF% = EV%
1040   PRINT A$;: NEXT I
1050   VTAB (P)
1060   HTAB (35)
1065 B$ = "": FOR I = 1 TO 4
1070   GET A$:Z =  ASC (A$)
1075   IF (Z <  > 13 AND Z <  > 32) AND (Z > 57 OR Z < 48) THEN 1070
1080 B$ = B$ + A$: IF Z = 13 THEN 1170
1085   IF Z = 32 THEN 1110
1090 PF% =  VAL (B$):PF% = PF% + (100 - PF%) * (PF% > 100)
1100   PRINT A$;: NEXT I
1110   VTAB (P + 1)
1120   HTAB (35)
1125 B$ = "": FOR I = 1 TO 4
1130   GET A$:Z =  ASC (A$)
1135   IF (Z <  > 13 AND Z <  > 32) AND (Z > 57 OR Z < 48) THEN 1130
1140 B$ = B$ + A$: IF Z = 13 THEN 1170
1145   IF Z = 32 THEN 1165
1150 SF% =  VAL (B$):SF% = SF% + (100 - SF%) * (SF% > 100)
1160   PRINT A$;: NEXT I
1165   HTAB (1): VTAB (P - 3): CALL  - 958: GOTO 800
1170   IF PF% = 0 AND SF% = 0 AND RH < 1 AND RT% < 100 AND A% = 0 THEN
       GOSUB 200 0: HTAB (1): VTAB (24): CALL  - 922: PRINT "
       MAINTENANCE SHUTDOWN - ";MD%;" DAYS": FOR I = 0 TO 5000: NEXT
1180   IF EF% > EV% THEN EF% = EV%
1200   REM DAMAGE ASSESSMENT AND OPERATION CALCULATIONS
1205 EV% = EV% - EF% - 2 * ED% * (ED% > 3)
1210 PD% = PD% + (PF% > 90) * ( RND (20) > .95)
1220 SD% = SD% + (SF% > 90) * ( RND (20) > .92)
1230 PB% = PD% > 5
1240 SB% = SD% > 5
1250   IF PF% > (100 - PD% * 10) AND PB% THEN PF% = (100 - PD% * 10) *
       (100 - PD%  * 10 > 0)
1260   IF SF% > (100 - SD% * 10) AND SB% THEN SF% = (100 - SD% * 10) *
       (100 - SD%  * 10 > 0)
1270 RL = RL + RH / 50
1280 RH = (A% * 30 + A1% * 60 + A2% * 10) / 2500 * (100 - RL)
1300 PH = PF% * (100 * (PU% > 100) + PU% * (PU% <  = 100)) / 350
1310 EH = EF% / 200 * (RT% - 25)
1320 RT% = RT% + RH - EH - PH - 5 * (RT% > 25)
1325 RT% = 25 + (RT% - 25) * (RT% > 25)
1330 XT% = ((RT% - 25) * PF% + (CT% - 25) * SF%) / (PF% + SF% + 1) + 25
```


This fall, Apple owners can call their own plays...

The strategy and graphics game for 48k Apples is at your dealers now.

Or, you may order direct. Send $13.95 for cassette, $17.95 for disk and $1 postage and handling to:

ShoeString Software
1235 Candlelight
Houston, Texas 77018

CIRCLE 248 ON READER SERVICE CARD

CompuBridge®
Contract Bridge Series
Programs That Work
For Apple II
(No special hardware needed)

Elementary 32K Cassette	$19.95
Complete 32K Cassette	$29.95
Complete 48K Diskette	$39.95

Each course includes a series of programmed lessons plus the unique QUIZMAKER which deals random hands, then checks your answers and quizzes you or supplies the correct answer. The complete course includes popular conventions such as Stayman and Jacoby.

NEW—DEFENDER'S PLAY

32K Cassette	$29.95
48K Cassette	$39.95

Instruction in opening leads against notrump and suit contracts, with QUIZMAKER to deal limitless random hands.

Available from your Apple Dealer or CompuBridge Division, Barclay Bridge, Port Chester, N.Y. 10573.

Please send ____________

____

for ___ 32K ___ 48K

Check Enclosed or charge to

VISA MC Card No. ____________

Name ____________

Address ____________

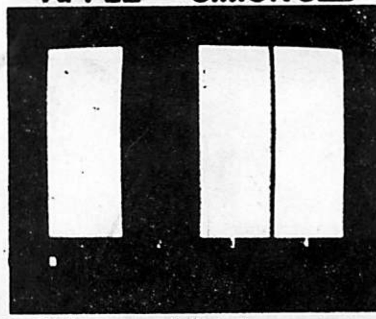
N.Y. Residents add Sales Tax

CIRCLE 117 ON READER SERVICE CARD

```
1340  IF XB% THEN XT% = RT% * .8 + 5
1350 SH = SF% * (100 * (PV% > 100) + PU% * (PU% <  = 100)) / 350 *
     (XT% - CT%) .
1360  IF XB% THEN SH = SH * .2
1370 GO% = SH / XT% * (XT% - CT%) * 2 / 3
1375  IF GO% > 2600 THEN GO% = 2600
1380 GO% = GO% * (GO% > 0) * (GB% = 0)
1390 CT% = 25 + ((XT% - 25) * (SH - GO%) / (SH + 1) * .75)
1395 CT% = 25 * (CT% <  = 25) + CT% * (CT% > 25)
1400  IF XB% < 1 THEN XB% = (XD% > 2) * ( RND (4) > .9)
1410  IF GB% < 1 THEN GB% = (GD% > 4) * ( RND (4) > .9)
1420 TT = TT + GO%
1430  GOTO 470
2000  REM MAINTENANCE REPAIR SUBROUTINE
2010 EV% = 300
2020 PV% = 120
2030 SV% = 120
2040 RT% = 25
2050 XT% = 25
2060 CT% = 25
2070 DMGE% = DMGE% + 2 * RD% + ED% + PD% + XD% + SD% + GD%
2080 MD% = 5 + 3 * (10 * (RD% > 3) + (ED% > 3) + (PD% > 3) + (SD% > 3)
     + 2 * PB%  + 2 * SB% + 3 * XB% + 3 * GB%):DAY% = DAY% + MD%
2090 RD% = 0
2100 ED% = 0
2110 PD% = 0
2120 XD% = 0
2130 SD% = 0
2140 GD% = 0
2150 PB% = 0
2160 SB% = 0
2170 XB% = 0
2180 GB% = 0
2190 EF% = 0:PF% = 0:SF% = 0
2195 GO% = 0
2200  RETURN
3000  REM  MELTDOWN ENDING
3010  PRINT
3020  IF RD% > 6 THEN 3100
3030  PRINT "THE REACTOR CORE HAS BEEN DISTROYED BY"
3040  PRINT "UNCONTROLLED THERMAL RUNAWAY.  HOWEVER,"
3050  PRINT "THE CONTAINMENT BUILDING HAS NOT YET"
3060  PRINT "RUPTURED.
3070  PRINT
3080  PRINT "INITIATE YOUR EVACUATION PLAN."
3090  GOTO 5000
3100  PRINT "THE REACTOR CORE HAS MELTED DOWN AND"
3110  PRINT "PRODUCED A STEAM EXPLOSION.  THE"
3120  PRINT "CONTAINMENT BUILDING HAS RUPTURED."
3130  PRINT "LETHAL RADIOACTIVE GASES AND DEBRIS"
3140  PRINT "HAVE ESCAPED."
3150  PRINT
3160  PRINT "INITIATE YOUR EVACUATION AND RADIATION"
3170  PRINT "CLEANUP PLANS AND GET MEDICAL"
3180  PRINT "ASSISTANCE."
3190  GOTO 5000
4000  REM  EVALUATION OF GAME RESULTS
4010  PRINT
4020  PRINT "OVER A PERIOD OF ";DAY%;" DAYS, YOU HAVE"
4030  PRINT "PRODUCED AN AVERAGE POWER OUTPUT OF"
4040  PRINT KW%;" KILOWATTS PER DAY."
4050 AKW% = 1 + (KW% > 1000) + (KW% > 1200) + (KW% > 1500) + (KW% > 1800)
4060  PRINT
4070  PRINT "YOUR AVERAGE POWER PRODUCTION RATE IS"
4080  ON AKW% GOTO 4090,4100,4110,4120,4140
4090  PRINT "HORRIBLE! FIND A LESS DEMANDING JOB.": GOTO 4200
4100  PRINT "WAY BELOW YOUR AREA'S POWER NEEDS.": GOTO 4200
4110  PRINT "ADEQUATE. YOU COULD DO BETTER.": GOTO 4200
4120  PRINT "EXCELLENT! POWER COSTS IN YOUR AREA"
4130  PRINT "WILL NOT BE INCREASED.": GOTO 4200
4140  PRINT "NEAR THE MAXIMUM!  POWER COSTS IN YOUR"
4150  PRINT "AREA WILL DROP SIGNIFICANTLY."
4200  REM DAMAGE EVALUATION
4210  PRINT
4215  GOSUB 2000
4220 D% = 1 + (DMGE% > 10) + (DMGE% > 20) + (DMGE% > 30)
4230  PRINT "THE EQUIPMENT DAMAGE SUSTAINED DURING"
4240  PRINT "THIS PERIOD WAS ";
4250  ON D% GOTO 4260,4270,4280,4290
4260  PRINT "VERY LIGHT.": GOTO 5000
4270  PRINT "MODERATE.": GOTO 5000
4280  PRINT "HEAVY.": GOTO 5000
4290  PRINT "SEVERE."
5000  REM END
5010  PRINT
5020  PRINT "WOULD YOU LIKE TO TRY AGAIN? (Y OR N)";
5030  INPUT A$
5040  IF A$ = "" THEN 5030
5050  IF A$ = "Y" THEN  GOSUB 2000: GOTO 390
5060  HOME
5070  END
5100 B$ = ""
```


INTRODUCING
for the APPLE II *

"APPLE — SIMON SEZ"



Challenge your wits by testing your memory and concentration. Repeat exactly the sequence of colors and sounds randomly generated by APPLE—SIMON SEZ and you win, or program your own sequence of colors and sounds to baffle your friends. Play with both colors and sounds or just colors or just sounds. If you lose, APPLE—SIMON SEZ'S humilating "razz" lets you and everyone around know.

Six game variations for your enjoyment.

Now available on cassette at the low introductory price of ONLY $9.95, please add $.75 shipping and handling.

SEND CHECK OR MONEY ORDER TO:

BARTON ENTERPRISES, INC.
1604 MARSH LANE
CARROLLTON, TEXAS 75006

** APPLE II is a registered trademark of Apple Computer, Inc.*

CIRCLE 111 ON READER SERVICE CARD

TRS-80™ SOFTWARE

PACKER: Automatically edits all or part of your Basic program to ease editing, run faster, or save memory. Has 5 sections: UNPACK—unpacks multiple statement lines into single statements maintaining program logic; inserts spaces and renumbers lines for easier editing. SHORT—shortens your program by editing out all REM statements, unnecessary words and spaces. PACK—executes UNPACK and SHORT, then packs lines into multiple statement lines; maintains program logic. RENUM—renumbers program lines including all GOTO's, etc. You specify increment. MOVE—moves any line or block of lines to any new location in the program and renumbers lines. Written in machine language; supplied on tape in 3 versions for 16K, 32K, and 48K.
For Level II or Disk Basic $29.95

DISASSEMBLER: Read, write, and copy system tapes. Display and modify memory contents. Disassemble ROM, DOS, and system tapes into Z-80 mnemonics. Search for strings in memory. Much more!! Includes 32 pages of documentation and information.
For 16K Level II $19.95

SYSTEM TAPE DUPLICATOR: Copy your system format tapes. Includes verify routine
For any Level II $14.95

CHESDISK: Transfers your copy of Microchess to disk for quick and easy access.
For any Level II Disk system $9.95

CASSETTE LABEL MAKER: A mini-word processor to print cassette labels on a line printer. Includes manual and 50 peel-and-stick labels on tractor feed paper.
For 16K Level II and printer $15.95

INSTRUCTION MANUALS for any Cottage Software original programs available for 20% of program list price. Refundable when program purchased.

TRS-80™ repairs and modifications. Call or write for info. MANY MORE items available. Call or write for catalog. DEALER inquires invited.
Kansas residents add 3% sales tax.
Foreign orders in US Currency only.
Call our 24 hour phone: (316) 683-4811 or write:

COTTAGE SOFTWARE
614 N. Harding
Wichita, KS 67208

TRS-80 is a trademark of Radio Shack, A Tandy Corporation.

CIRCLE 161 ON READER SERVICE CARD

LEARN MATHEMATICS THE FUN WAY!

Programs that develop mathematical reasoning and estimation skill beyond drill and practice!! All ages will enjoy these games that teach:

The Estimation Game (Animated!)

Cassette	$9.95
Diskette	$14.95

The Distance Game

Cassette	$9.95
	$14.95

We take Visa or Master Charge (include card# and expiration date), checks, money orders.

EDUCATIONAL PROGRAMS
Programs that Teach

P.O. 2345
West Lafayette, IN 47906
(317) 463-4778

CIRCLE 206 ON READER SERVICE CARD

FOR APPLE II!
The Patient Professor™

- Helpful for any subject—at home or in the classroom
- Easy entry of questions, clues, and class roll
- Variety in question format:
  - Multiple choice
  - True/false
  - Matching
  - Fill-in
  - Direct answer
- Useful in practice and tests
- Knowledge of computer programming not required

Pre-programmed versions:
- Bible facts
- U.S. History

AVAILABLE AT YOUR LOCAL COMPUTER STORE

innerglo™

P. O. Box 622 El Toro, California 92630

CIRCLE 218 ON READER SERVICE CARD


```
5105  FOR I = 1 TO 4
5110  GET A$
5130  IF  ASC (A$) <  > 32 THEN 5140
5134  IF B$ = "" THEN  RETURN
5136 OUT% =  VAL (B$)
5138  RETURN
5140  IF  ASC (A$) = 13 THEN  POP : GOTO 1170
5150 B$ = B$ + A$
5160  PRINT A$;
5170  NEXT I
5180  RETURN
6000  GR : COLOR= 15: FOR I = 0 TO 39: HLIN 0,39 AT I: NEXT I
6005 DE = 6000
6010  HOME : UTAB 23
6020  PRINT "  THIS IS THE REACTOR VESSEL"
6030  RESTORE
6035  COLOR= 1
6040  FOR I = 1 TO 29
6050  READ X1,X2,Y
6060  HLIN X1,X2 AT Y
6070  NEXT I
6080  DATA 7,9,6,15,17,6,6,18,7,5,19,8,5,7,9,17,19,9,5,6,10,18,19,10,5,
      11,18,19,11,5,6,12,18,19,12,5,6,13,18,19,13,5,6,14
6090  DATA 18,19,14,5,6,15,18,19,15,5,6,16,18,19,16,5,6,17,18,19,17,5,6
      18,18,19 ,18,5,7,19,17,19,19,6,18,20,7,17,21,8,16,22
6100  COLOR= 0
6110  HLIN 13,14 AT 6
6120  COLOR= 12
6130  HLIN 14,15 AT 5
6140  HLIN 14,16 AT 4
6150  HLIN 15,16 AT 3
6160  FOR I = 1 TO DE: NEXT I
6170  VTAB 23
6180  PRINT "  THIS IS THE REACTOR CORE     "
6190  COLOR= 8
6200  FOR I = 9 TO 15
6210  VLIN 11,17 AT I
6220  NEXT I
6230  FOR I = 1 TO DE: NEXT I
6240  VTAB 23
6250  PRINT "  THESE ARE THE CONTROL RODS   "
6260  COLOR= 13
6270  VLIN 2,17 AT 11
6280  VLIN 2,17 AT 13
6290  FOR I = 1 TO DE: NEXT I
6300  VTAB 23
6310  PRINT " THE EMERGENCY COOLANT CAN COOL THE"
6320  PRINT " REACTOR IN AN EMERGENCY."
6330  COLOR= 2
6340  FOR I = 1 TO 36
6350  READ Y,X
6360  PLOT X,Y
6370  FOR J = 1 TO 200: NEXT J
6380  NEXT I
6390  DATA 4,2,4,4,5,2,5,3,5,4,6,2,6,3,6,4,7,3,8,3,9,3,10,3,11,3,12,3,
      12,4,12,5, 12,6,12,7,12,8,12,9
6400  DATA 13,9,14,9,15,9,16,9,16,8,16,7,16,6,16,5,16,4,16,3,17,3,18,3,
      19,3,20,3 ,22,3,24,3
6410  FOR I = 1 TO DE: NEXT I
6420  HOME : UTAB 23
6430  PRINT " THE PRIMARY COOLANT CARRIES HEAT RROM"
6440  PRINT " THE REACTOR CORE TO THE HEAT EXCHANGER"
6450  FOR I = 1 TO 52
6460  READ Y,X
6470  PLOT X,Y
6480  FOR J = 1 TO 200: NEXT J
6490  NEXT I
6500  FOR I = 1 TO DE: NEXT I
6510  DATA 4,25,4,27,5,25,5,26,5,27,6,25,6,26,6,27,7,26,8,26,9,26,10,26
      11,26,12 ,26,12,25,12,24,12,23,12,22,12,21,12,20,12,19
6515  DATA 12,18,12,17,12,16,12,15,13,15,14,15,15,15,16,15,16,16,16,
      17,16,18
6520  DATA  16,19,16,20,16,21,16,22,16,23,16,24,16,25,16,26,16,27,16,28
      16,29,16 ,30,15,30,14,30,13,30,13,30,12,30,12,29,12,28,12,27
6540  HOME : UTAB 23
6550  PRINT " THIS IS THE HEAT EXCHANGER"
6560  COLOR= 5
6570  HLIN 28,34 AT 10
6580  VLIN 10,18 AT 34
6590  HLIN 28,34 AT 18
6600  VLIN 10,18 AT 28
6605  COLOR= 2: PLOT 28,12: PLOT 28,16: COLOR= 5
6610  FOR I = 1 TO DE: NEXT I
6620  UTAB 23
6630  PRINT " THIS IS THE GENERATOR TURBINE"
6640  HLIN 5,18 AT 30
6650  VLIN 30,36 AT 18
6660  HLIN 5,18 AT 36
6670  VLIN 30,36 AT 5
```

```
6680  COLOR= 0
6690  HLIN 2,17 AT 33
6700  FOR I = 7 TO 15 STEP 2
6710  PLOT I,34: PLOT I + 1,32
6720  NEXT I
6730  FOR I = 1 TO DE: NEXT I
6740  VTAB 23
6750  PRINT " THIS IS THE COOLING TOWER
6760  COLOR= 5
6770  VLIN 23,25 AT 24
6780  VLIN 23,25 AT 36
6790  VLIN 25,26 AT 25
6800  VLIN 25,26 AT 35
6810  VLIN 26,28 AT 26
6820  VLIN 26,28 AT 34
6830  VLIN 28,36 AT 27
6840  VLIN 28,36 AT 33
6850  PLOT 34,36
6860  PLOT 26,36
6870  HLIN 25,35 AT 38
6880  FOR I = 1 TO DE: NEXT I
6890  VTAB 23
6900  PRINT " THE SECONDARY COOLANT CARRIES HEAT"
6910  PRINT " FROM THE HEAT EXCHANGER TO THE "
6920  PRINT " TURBINE AND THEN TO THE COOLING TOWER"
6925  COLOR= 2
6930  FOR I = 1 TO 123
6940  READ Y,X
6950  PLOT X,Y
6960  FOR J = 1 TO 200: NEXT J
6970  NEXT I
6980  DATA 4,35,4,37,5,35,5,36,5,37,6,35,6,36,6,37,7,36,8,36,9,36,10,36,
      11,36,12,36,12,35,12,34,12,33,12,32,13,32,14,32,15,32,16,32
6990  DATA 16,33,16,34,16,35,16,36,17,36,18,36,19,36,20,36,20,35,20,34,
      20,33,20, 32,20,31,20,30,20,29,20,28,20,27,20,26,20,25,20,24,20,23,
      20,22,20,21
7000  DATA 21,21,22,21,23,21,24,21,25,21,26,21,27,21,27,20,27,19,27,18,
      27,17,27, 16,27,15,27,14,27,13,27,12,27,11,27,10,27,9,27,8,27,7
7010  DATA 28,7,29,7,30,7,31,7,32,7,34,10,32,13,34,16,35,16,35,17,35,18,
      35,19,35,20,35,21,35,22,35,23,35,24,35,25,35,26,35,27,35,28
7020  DATA 34,28,34,29,34,30,35,30,35,31,35,32,34,32,34,33,34,34,34,35,
      34,36,34, 37,34,38,33,38,32,38,31,38,30,38,29,38,28,38,27,38,26,38,
      25,38,24,38,23,38
7030  DATA 22,38,21,38,20,38,19,38,18,38,17,38,16,38,15,38,14,38,13,38,
      12,38,12, 37
7040  HOME : VTAB 23
7060  RETURN
9000  REM VARIABLE PREFIXES
9010  REM A-CONTROL RODS, C-COOLING TOWER, E-EMERGENCY COOLANT,
      G-TURBINE, P-PRIMARY COOLANT, R-REACTOR, S-SECONDARY COOLANT,
      X-HEAT EXCHANGER
9020  REM VARIABLE SUFFIXES
9030  REM B-BROKEN, D-DAMAGE, F-FLOW RATE, H-HEAT FLOW, L-LIFE, O-OUTPUT,
      T-TEMPERATURE, V-VOLUME
9040  REM OTHER VARIABLES TOT-TOTAL POWER OUTPUT, KW-AVERAGE POWER
      OUTPUT, DAY-DAY OF OPERATION, DMGE-TOTAL EQUIPMENT DAMAGE
9050  REM PROGRAM DISCRIPTION BY LINE NUMBER
9060  REM 10-220 INTRODUCTION
9070  REM 225-380 INSTRUCTIONS
9080  REM 390-455 VARIABLE INITIATION
9090  REM  460-850 WRITE REPORT AND ASSESS DAMAGE
9100  REM  900-1165 INPUT NEW CONTROL VARIABLES
9110  REM 1170 MAINTENANCE SHUTDOWN EVALUATION
9120  REM 1200-1260 PUMP FAILURE ASSESSMENT
9130  REM 1270-1430 PLANT OPERATING ALGORITHMS
9140  REM 2000-2200 MAINTENANCE SHUTDOWN SUBROUTINE
9150  REM 3000-3190 MELTDOWN ENDING
9160  REM 4000-4290 EVALUATION OF GAME RESULTS
9170  REM 5000-5070 END
9180  REM 6000-7060 PLANT DIAGRAM SUBROUTINE
9190  REM 9000-9190 REMARKS
9200  REM  APPLE NUCLEAR POWER PLANT
9210  REM  BY STEPHEN R BERGGREN
```

```
RUN

         APPLE NUCLEAR POWER PLANT
          BY STEPHEN R. BERGGREN

THIS PROGRAM SIMULATES THE OPERATION OF
A NUCLEAR POWER REACTOR.  THE OBJECT
IS TO OPERATE THE PLANT AT A MAXIMUM
AVERAGE POWER OUTPUT WITHOUT CAUSING
A REACTOR MELTDOWN.

THE CONTROL RODS ADJUST THE AMOUNT OF
HEAT PRODUCED BY THE REACTOR.  PRIMARY
COOLANT TRANSFERS THIS HEAT TO THE HEAT
EXCHANGER.  SECONDARY COOLANT TRANSFERS
HEAT FROM THE HEAT EXCHANGER TO THE
TURBINE, WHERE POWER IS PRODUCED, AND
FINALLY TO THE COOLING TOWER.
```


Huntington Computing

ALL PROGRAMS LISTED BELOW ARE ON DISK

The Wizzard and the Princess -- HI-RES Adv. #2 from On-Line. Over 100 rooms. $32.95 now $28.00
The Prisioner--New from Edu-Ware. Inspired by the British TV series. Hurry. $29.95 now $25.45
Paddle Graphics $39.95 now $33.95
Tablet Graphics $49.95 now $42.50
Asteroids in Space $19.95 now $16.95
Touch Typing Tutor $20.95 now $17.80
Menu Cookbook $20.95 now $17.80
Sahara Warriors $7.95 now $6.75
The Temple of Apshai $29.95 now $25.45
The Datestones of Ryn $19.95 now $16.95
Morloc's Tower $19.95 now $16.96
Rescue at Rigel $24.95 now $21.20
Fracas $24.95 now $21.20
Battleship Commander $19.95 now $16.95
Fastgammon $24.95 now $21.20
Dungeon Campaign $17.50 now $14.85
Wilderness Campaign $20.00 now $17.00
Dungeon/Wilderness one disk $32.50 now $27.60
Higher Graphics $25.00 now $21.25
Higher Text $35.00 now $29.75
Screen Machine $19.95 now $16.95
Computer Bismark $59.95 now $50.95
Don Budge's Trilogy $29.95 now $25.45
Master Catalog (Programma) $29.95 now $26.95
Compu-Read $24.95 now $21.20
Compu-Math I: Fractions $39.95 now $33.95
Three Mile Island $39.95 now $33.95
Super Text $99.95 now $85.00
Magic Window $99.95 now $85.00
Desktop Plan $99.95 now $85.00
CCA Data Management $99.95 now $85.00
VisiCalc $150.00 now $119.00
"Mystery House" HI-RES Ad. $24.95 now $21.20
Gomoku $14.95 now $12.70
Acanthopterygian Fortune-telling $15.00
Horriblescope $15.00

15% off

apple SOFTWARE

Free Catalog

We take MasterCharge or VISA (include card # and expiration date), checks, money orders. No cash or C.O.D. Calif. residents add 6% tax. Include $1.50 for postage and handling. Mail to: HUNTINGTON COMPUTING, Dept. CC-11, 2020 Charles, Corcoran, CA 93212
Call in your order (209) 992-5411

CIRCLE 144 ON READER SERVICE CARD

EDUCATIONAL SOFTWARE

For TRS-80 & Pet Micro Computers

80 + Programs in:

ELEMENTARY, SCIENCE, GEOGRAPHY, ECONOMICS, FOREIGN LANG., ENGLISH, MATH, BIOLOGY, HISTORY, ACCOUNTING, BUSINESS ED., FARM RECORDS

Programs are grouped into packages of 4 to 7 programs priced at $24.95 per package including shipping and handling. Available on disk or tape.

Write for catalog:
MICRO LEARNINGWARE BOX 2134
N. MANKATO MN 56001, 507-625-2205

Visa & MasterCard Accepted

"TRS-80 is a registered

Pet is a Trademark of Commodore Business Machines

CIRCLE 212 ON READER SERVICE CARD

OSI

Video Games 1 .... $15 Three games. Head-On is like the popular arcade game. Tank Battle is a tank game for two to four. Trap! is an enhanced blockade style game.

Video Games 2 .... $15 Three Games. Gremlin Hunt is an arcade-style game for one to three. Gunfight is a duel of mobile artillary. Indy is a race game for one or two.

Dungeon Chase .... $10 A real-time video game where you explore a twenty level dungeon.

Adventure: Marooned in Space $12 An adventure that runs in 8K! Save your ship and yourself from destruction.

Board Games 1 .... $15 Two games. Mini-Gomoku is a machine language version of five-stones gomoku. Cubic is a 3-D TTT game. Both with graphics.

Super! Biorhythms ...... $15 A sophisticated biorhythm program with many unique features.

For all BASIC-in-ROM systems

Send for free catalog listing many more programs.

ORION SOFTWARE ASSOCIATES
147 Main Street Ossining, NY 10562

CIRCLE 166 ON READER SERVICE CARD

RACET computes — RACET SORTS — RACET UTILITIES

SUPER QUALITY

FROM THE LEADER

IN UTILITY SOFTWARE FOR THE TRS* COMPUTERS

RACET COMPUTES
702 Palmdale, Orange CA 92665

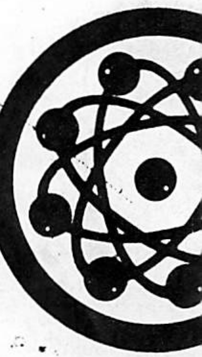
* TRS-80 IS A REGISTERED TRADEMARK OF TANDY CORPORATION

RACET UTILITIES — RACET computes — RACET SORTS

CIRCLE 244 ON READER SERVICE CARD

Power Plant cont'd...

```
THE EMERGENCY COOLANT IS USED TO HELP SHUT
DOWN THE REACTOR WHEN OTHER SYSTEMS
FAIL.  UNLIKE THE OTHER COOLANTS,
EMERGENCY COOLANT IS NOT RECYCLED.

ENTER 'D' TO SEE REACTOR DIAGRAM      ENTER 'I' FOR WORKING
ENTER 'S' TO START OPERATION
THE CONTROLS ARE OPERATED BY TYPING IN
THE DESIRED CONTROL ROD SETTING AND
FLOW RATES.(USE VALUES FROM 0 TO 100)
IF NO ENTRY IS MADE, THE VALUES WILL
NOT CHANGE.  USE THE SPACE BAR TO STEP
TO THE DIFFERENT FUNCTIONS.  WHEN THE
DESIRED ENTRIES HAVE BEEN MADE, USE THE
'RETURN' KEY TO ADVANCE TO THE NEXT DAY.
THE REACTOR CAN BE OPERATED UNTIL A
MELTDOWN OCCURS OR THE REACTOR FUEL IS
EXHAUSTED.  THE FUEL WILL LAST FOR
ABOUT 100 TO 150 DAYS.  WHEN THE FUEL
IS EXHAUSTED, YOUR PERFORMANCE WILL BE
EVALUATED.

   (PRESS RETURN TO CONTINUE)

IF YOU WANT TO REPAIR DAMAGE OR REPLACE
COOLANT, BRING THE REACTOR TEMPERATURE
DOWN BELOW 100 AND SHUT OFF THE COOLANT
FLOWS.  THIS WILL CAUSE AN AUTOMATIC
MAINTENANCE SHUTDOWN AND ALL COOLANT
WILL BE REPLENISHED AND REPAIRS MADE.
THE GREATER THE DAMAGE, THE LONGER THE
REPAIRS WILL TAKE.

      WARNING: THIS POWER PLANT HAS
      NO AUTOMATIC SAFETY DEVICES!!


ENTER 'D' TO SEE REACTOR DIAGRAM   ENTER 'I' FOR WORKING IN
ENTER 'S' TO START OPERATION          S
     APPLE NUCLEAR POWER PLANT
       STATUS REPORT - DAY 1

WARNINGS:
 POWER OUTPUT LOW

DAMAGE:

INDICATORS:
 REACTOR TEMP. (MAX 800) 25
 HEAT EXCHANGER TEMP. (MAX 500) 25
 COOLING TOWER TEMP. (MAX 300) 25
 POWER OUTPUT (MAX 2000KW) 0KW
 AVERAGE POWER OUTPUT  0KW/DAY
 CONTROL RODS- 0
 COOLANTS
  EMERGENCY  LEVEL- 300  FLOW- 0
  PRIMARY    LEVEL- 120  FLOW- 0
  SECONDARY  LEVEL- 120  FLOW- 01
       STATUS REPORT - DAY 2

WARNINGS:
 POWER OUTPUT LOW

DAMAGE:

INDICATORS:
 REACTOR TEMP. (MAX 800) 26
 HEAT EXCHANGER TEMP. (MAX 500) 25
 COOLING TOWER TEMP. (MAX 300) 25
 POWER OUTPUT (MAX 2000KW) 0KW
 AVERAGE POWER OUTPUT  0KW/DAY
 CONTROL RODS- 1
 COOLANTS
  EMERGENCY  LEVEL- 300  FLOW- 0
  PRIMARY    LEVEL- 120  FLOW- 0
  SECONDARY  LEVEL- 120  FLOW- 0100


      APPLE NUCLEAR POWER PLANT
       STATUS REPORT - DAY 19

WARNINGS:

DAMAGE:
 SECONDARY COOLANT LEAK - 5/DAY

INDICATORS:
 REACTOR TEMP. (MAX 800) 778
 HEAT EXCHANGER TEMP. (MAX 500) 465
```



```
COOLING TOWER TEMP. (MAX 300) 254
POWER OUTPUT (MAX 2000KW) 1858KW
AVERAGE POWER OUTPUT  1478KW/DAY
CONTROL RODS- 9
COOLANTS
 EMERGENCY  LEVEL- 300  FLOW- 0
 PRIMARY    LEVEL- 120  FLOW- 70
 SECONDARY  LEVEL- 105  FLOW- 100
       STATUS REPORT - DAY 20


       APPLE NUCLEAR POWER PLANT
        STATUS REPORT - DAY 23

WARNINGS:
 HEAT EXCHANGER OVERHEATED
 COOLING TOWER OVERHEATED
 POWER OUTPUT LOW
 SECONDARY COOLANT LOW

DAMAGE:
 SECONDARY COOLANT LEAK - 11/DAY
 SECONDARY COOLANT PUMP FAILURE - 100%

INDICATORS:
 REACTOR TEMP. (MAX 800) 783
 HEAT EXCHANGER TEMP. (MAX 500) 667
 COOLING TOWER TEMP. (MAX 300) 327
 POWER OUTPUT (MAX 2000KW) 790KW
 AVERAGE POWER OUTPUT  1487KW/DAY
 CONTROL RODS- 9
 COOLANTS
  EMERGENCY  LEVEL- 300  FLOW- 0
  PRIMARY    LEVEL- 120  FLOW- 70
  SECONDARY  LEVEL- 76  FLOW- 20

       APPLE NUCLEAR POWER PLANT
        STATUS REPORT - DAY 30

WARNINGS:
 POWER OUTPUT LOW
 EMERGENCY COOLANT LOW
 PRIMARY COOLANT LOW
 SECONDARY COOLANT LOW

DAMAGE:
 PRIMARY COOLANT LEAK - 7/DAY
 SECONDARY COOLANT LEAK - 19/DAY
 PRIMARY COOLANT PUMP FAILURE - 70%
 SECONDARY COOLANT PUMP FAILURE - 100%
 HEAT EXCHANGER FAILURE

INDICATORS:
 REACTOR TEMP. (MAX 800) 96
 HEAT EXCHANGER TEMP. (MAX 500) 81
 COOLING TOWER TEMP. (MAX 300) 25
 POWER OUTPUT (MAX 2000KW) 0KW
 AVERAGE POWER OUTPUT  1140KW/DAY
 CONTROL RODS- 0
 COOLANTS
  EMERGENCY  LEVEL- 0  FLOW- 0
  PRIMARY    LEVEL- 82  FLOW- 0
  SECONDARY  LEVEL- 0  FLOW- 0
       MAINTENANCE SHUTDOWN - 32 DAYS
       APPLE NUCLEAR POWER PLANT
        STATUS REPORT - DAY 63

       APPLE NUCLEAR POWER PLANT
        STATUS REPORT - DAY 69

WARNINGS:
 REACTOR OVERHEATED
 TURBINE OVERLOADED

DAMAGE:
 REACTOR CORE DAMAGED
 EMERGENCY COOLANT LEAK - 10/DAY

     MELTDOWN!  MELTDOWN!  MELTDOWN!

THE REACTOR CORE HAS MELTED DOWN AND
PRODUCED A STEAM EXPLOSION.  THE
CONTAINMENT BUILDING HAS RUPTURED.
LETHAL RADIOACTIVE GASES AND DEBRIS
HAVE ESCAPED.

INITIATE YOUR EVACUATION AND RADIATION
CLEANUP PLANS AND GET MEDICAL
ASSISTANCE.

WOULD YOU LIKE TO TRY AGAIN? (Y OR N)?N
```


Combine accurate flight characteristics with the best in animation graphics and you'll have SubLOGIC's

A2-FS1 Flight Simulator

for the Apple II

now on cassette or disk!

SubLOGIC's A2-FS1 is the smooth, realistic simulator that gives you a real-time, 3-D, out-of-the-cockpit view of flight.

Thanks to fast animation and accurate representation of flight, the non-pilot can now learn basic flight control, including take-offs and landings! And experienced pilots will recognize how thoroughly they can explore the aircraft's characteristics.

Once you've acquired flight proficiency, you can engage in the exciting British Ace 3-D Aerial Battle Game included in the package. Destroy the enemy's fuel depot while evading enemy fighters.

Computer and aviation experts call the A2-FS1 a marvel of modern technology. *You'll* simply call it *fantastic!*

Special Features:
- 3 frame-per-second flicker free animation
- Keyboard or joystick input

\$25.00

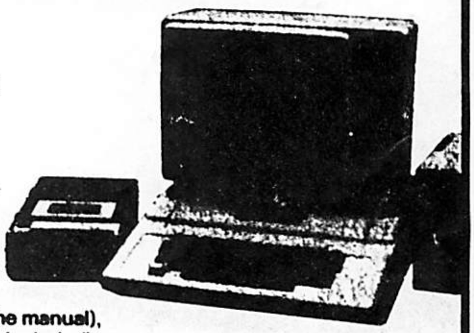
on cassette, usable on all systems (16Kmemory required)

\$33.50

on disk, usable on DOS 3.2, DOS 3.3, or Language System (32K memory required)

Present cassette users may send back their cassette (but *not* the manual), along with \$10 (first class shipping included), and receive the disk version.

See your dealer or order direct. For direct order, include \$1.25 and specify UPS or first class mail. Illinois residents add 5% sales tax. Visa and Mastercard accepted.



subLOGIC
Distribution Corp.
Box V, Savoy, IL 61874
(217) 359-8482

CIRCLE 187 ON READER SERVICE CARD