Appendix A: Development Committee for the Problem Solving in Technology-Rich Environments (TRE) Study

List of Committee Members

Paul Cohen	Director of Curriculum Pascack Valley Regional High School District, New Jersey
Karen Cooper	Librarian and Technology Coordinator Montgomery Middle School, New Jersey
Lamont Fuchs	Technology Director Buncombe County Schools, North Carolina
Kathleen Gibbs	Middle School Science Teacher John Witherspoon Middle School, New Jersey
Cheryl Lemke	President and CEO, The Metiri Group, California
Christopher Manno	Assistant Superintendent Montgomery Township Schools, New Jersey
Kevin Mattingly	Middle School Science Teacher The Lawrenceville School, New Jersey
Joan Mazur	Assistant Professor University of Kentucky Department of Curriculum & Instruction, Kentucky
Diane Reed	Technology Teacher in Residence Portage Path School of Technology Akron, Ohio
Ismael Salas	Career and Technology Instructor Fabens Independent School District, Texas
Martha Veale	Director Technology/Career Education Canutillo Independent School District, Texas
Randy Bennett	ETS Staff
Bob Evans	NCES Project Monitor
Vonda Kiplinger	NCES Project Monitor
Hilary Persky	ETS Staff
Holly Spurlock	NCES Project Monitor

Appendix B: Sample Selection

The TRE study samples comprised nationally representative groups of eighth-grade students selected through a multistage probability-based procedure. This procedure used counties and county equivalents or groups of counties (primary sampling units, or PSUs) as the first-stage sampling units, and schools as the second-stage units.[1] The third and final stage involved selection of students within schools and their assignment to either the Search scenario or the Simulation scenario.

Fifty-two primary sampling units (PSUs) were included in the first stage, with the 10 largest PSUs being certainty PSUs and the remaining 42 noncertainty PSUs. The schools were selected systematically from a sorted list with probabilities proportional to assigned measures of size. To increase cost-efficiency in sampling, samples were designed to include more relatively large schools. Also, because the TRE administration was so different from the traditional NAEP assessment, school selection probabilities were adjusted so that the TRE sample overlapped as little as possible with the main 2003 NAEP assessment. The selection procedure resulted in a sample of 270 schools, 222 of which participated in the assessment, for a weighted cooperation rate of 85.1 percent.

From the 222 participating schools, 2,409 students were selected to participate in the study. Of these students, 150 were nonrespondents. An additional 125 students were excluded who could not participate in the assessment as it was normally conducted. The weighted exclusion rate for such students was 4.8 percent. After accounting for excluded students and nonrespondents, the total number of students assessed was 2,134, resulting in a weighted student participation rate of 93.5 percent. Combining the effects of school nonparticipation and student nonparticipation resulted in an overall weighted participation rate of 79.6 percent, comparable to the weighted participation rate for the NAEP 2000 grade 8 science assessment of 78 percent.

When resulting data files were examined, it was found that, for unknown reasons, 25 students did not have scenario data and that 1 student, who was mistakenly coded as a nonrespondent, actually did have scenario data but no sampling weights. This resulted in a total number of students with data of 2,110 but sampling weights for only 2,109. Results reported in chapters 5 and 6 used the sample of 2,109.

Assignment to the Search and Simulation scenarios within schools was random. The number of students taking the Search scenario was 1,077. The number taking the Simulation scenario was 1,033, including the student without a sampling weight.

[1] County equivalents refer to the Anchorage Municipality and all Boroughs and Census Areas in Alaska, the District of Columbia, all Parishes in Louisiana, and all Independent Cities in Virginia, as well as Baltimore City, Maryland; St. Louis, Missouri; and Carson City, Nevada.

Appendix C: Technical Specifications for Participating Schools

Hardware

- Internet connection: Dedicated line (non-dial up) 200Kb per second or greater
- Computers: PC with Pentium Class 266 megahertz microprocessor or better (Macintosh computers were not acceptable.)
- Memory: 32MB or greater for Windows 95 and 98; 64MB or greater for other operating systems
- Operating system: Windows 95, Windows 98, Windows ME, Windows NT, Windows 2000, or Windows XP
- Hard drives: 10MB free disk space
- Graphics capabilities: SVGA support – 1024 x 768 resolution with minimum 65536 (16 bit) colors

Software

- Web browser: Microsoft's Internet Explorer Version 5.0 or later.[1]

[1] Some minor enhancements to Internet Explorer were required. These were installed during the certification process if they were not already present. The enhancements included:
- Macromedia Flash 5.0 Player
- Microsoft Virtual Machine (Java)

Appendix D: Prior Knowledge and Background Questions for Search and Simulation Scenarios

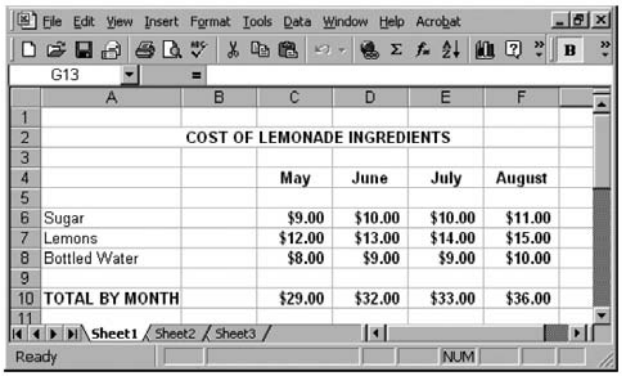
The correct answers to prior knowledge questions in this appendix are shown in bold.

Problem Solving in Technology-Rich Environments (TRE) Search Scenario and Simulation Scenario Prior Computer Knowledge Questions

1. What is the main role of a computer program?
   - A. To put data into the computer
   - B. To give the computer a memory
   - **C. To tell the computer what to do**
   - D. To let the computer know if it is doing a good job

> Put dough in a pie dish. Grease pie dish. Open can of cherry pie filling and pour it in pie dish. Bake at 350 degrees for 45 minutes and let cool.

2. In the recipe above, the words "Grease pie dish" should go before "Put dough in a pie dish." What is the best way to fix this problem using your word processor?
   - A. Search and Replace
   - **B. Move (or Cut and Paste)**
   - C. Insert
   - D. Delete



3. Pat has made the spreadsheet above to calculate the cost of supplies for a lemonade stand open from May through August.

   What should Pat do to calculate the total cost of lemons for all four months?
   - A. Calculate the sum of cells F6 through F10.
   - B. Calculate the sum of cells A7 through C7.
   - C. Calculate the sum of cells C6 through F6.
   - **D. Calculate the sum of cells C7 through F7.**

4. Your teacher has asked you to do a web search to find out about what African elephants eat. Which of the following search terms would likely return the most relevant pages?
   - A. African elephant
   - B. Elephant diet
   - C. Elephant
   - **D. Diet African elephant**

5. What does the web search query elephant OR tiger mean?
   - A. Find pages with references to both elephants and tigers.
   - **B. Find pages with references to either elephants or tigers.**
   - C. Find pages with references to elephants or tigers, but not both.
   - D. Find pages with elephant and tiger in the page title.

6. When talking about the Internet, what is a "link"?

   A. The cables connecting computers together
   B. The missing information in a document
   C. A connection between web pages
   D. A kind of email message

7. After you enter a search query, you get a list of hits. Where in the list of hits are you likely to find information most related to your query?

   A. At the bottom of the list
   B. In the middle of the list
   C. Anywhere on the list
   D. At the top of the list

8. In order to automatically repeat the same text at the bottom of each page of a multipage report you need to

   A. use a footer
   B. use a header
   C. place it in a table
   D. type in outline mode

9. By clicking and dragging on the point indicated by the arrow, the user will be able to

   A. change the color
   B. cut the graphic
   C. resize the graphic
   D. paste the graphic

10. What is a "URL"?

    A. A computer processor
    B. A security password
    C. An internet address
    D. A computer monitor

Problem Solving in Technology-Rich Environments (TRE) Simulation Scenario Prior Science Knowledge Questions

1. Which of the following is the best example of the concept of mass?

   A. The amount of space that a liquid takes up
   B. The energy it takes a person to carry an object
   C. The amount of material in an object
   D. The length of a piece of material

2. Which statement best describes what happens to a specific amount of gas when it is moved from a larger to a smaller closed container?

   A. The mass of the gas decreases.
   B. The temperature of the gas decreases.
   C. The density of the gas increases.
   D. The volume of the gas increases.

3. A rubber gas balloon can hold 10 cubic feet of helium. Ellen puts 5 cubic feet of helium inside the balloon, so its starting volume is 5 cubic feet. The balloon rises and expands. When the balloon stops rising, its final volume is 10 cubic feet.

   Why did the balloon volume change from start to finish?

   A. As the balloon rises, decreasing air pressure allows the amount of helium gas inside the balloon to increase.
   B. As the balloon rises, decreasing air pressure allows the helium inside the balloon to expand and push out the sides of the balloon.
   C. As the balloon rises, increasing air pressure makes the helium gas inside the balloon denser and therefore heavier.
   D. As the balloon rises, increasing air pressure makes the helium gas inside the balloon less dense so it expands.

4. Brad thinks that water will evaporate at different rates depending on the temperature of a room. If he wants to do an experiment to test his idea, what would be the best experimental set up?

   A. Put equal amounts of water at the same temperature in bowls of different sizes, each in a different room with each room having a different temperature and a different humidity.

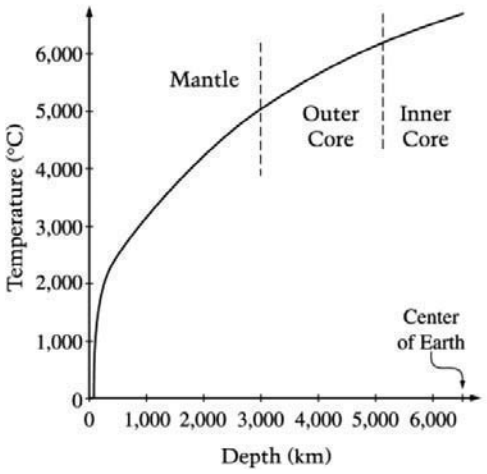
   B. Put equal amounts of water at the same temperature in bowls of equal size, each in a different room with each room having a different temperature but the same humidity.

   C. Put equal amounts of water at the same temperature in bowls of equal size, each in a different room with each room having the same temperature but different humidity.

   D. Put equal amounts of water at the same temperature in bowls of different sizes, each in a different room with each room having the same temperature and the same humidity.

The graph below shows the change in temperature inside the Earth as the depth below the surface increases.

Graph 1: Change in Temperature with Increasing Depth Below Earth's Surface



5. Which of the following is true of the temperature inside the Earth?

   A. It increases rapidly with depth near the surface, then remains constant.

   B. It increases rapidly with depth near the surface, then it increases more slowly in the inner layers.

   C. It increases slowly with depth near the surface, then it increases more rapidly in the inner layers.

   D. It increases with depth at a constant rate.

6. Which statement best describes what makes a gas balloon rise into the air?

   A. The gas inside the balloon decreases in volume as the balloon rises into the air.

   B. The temperature of the air increases as the balloon rises into the air.

   C. The mass of the balloon material is greater than the mass of the gas inside the balloon.

   D. The density of the air surrounding the balloon is greater than the density of the gas inside the balloon.

Questions 7–9 refer to the description below.

A scientist questioned the ability of fish raised in a hatchery (farm) to survive in the wild. She believed the fish raised in hatcheries had lost their fear of predators.

To test her idea, she placed 15 hatchery salmon and 15 wild salmon of the same age into two separate but identical tanks. She then placed a clear piece of plastic into each tank. In each tank, she put the salmon on one side of the plastic and a large predatory fish, the cod, on the other side of the plastic. She then recorded the amount of time it took the salmon in each tank to move to the back of the tank away from the cod.

She found that the hatchery fish were much slower in moving away than the wild fish. This led her to believe that the hatchery fish have less fear of predators than do wild fish.

7. What is a control in the experiment?

A. The hatchery salmon
B. The wild salmon
C. The time it took the wild salmon to move away from the cod
D. The time it took the hatchery salmon to move away from the cod

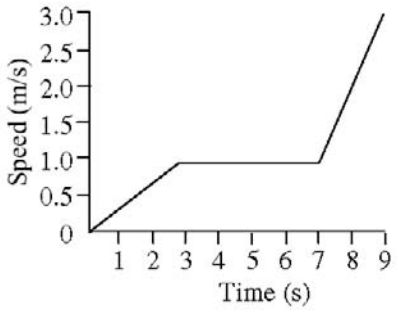
8. What is the hypothesis in the experiment?

A. Wild fish have less fear of predators than hatchery fish.
B. Hatchery fish have lost their fear of predators.
C. Hatchery fish will move rapidly away from predators placed in their tanks.
D. Wild fish will survive attacks from predators more often than hatchery fish.

9. What is the conclusion of the experiment?

A. Wild fish swim more rapidly than do hatchery fish.
B. Wild fish take more time to move away from predators than do hatchery fish.
C. Hatchery fish have less fear of predators than do wild fish.
D. Hatchery fish will be able to survive in a wild environment.

The graph below contains information about the movement of a bicycle.



10. At which time is the bicycle's speed constant?

A. At 1 second
B. At 2 seconds
C. At 4 seconds
D. At 8 seconds

Problem Solving in Technology-Rich Environments (TRE) Search Scenario Prior Science Knowledge Questions

1. Which statement best describes what happens to a specific amount of gas when it is moved from a larger to a smaller closed container?
   A. The mass of the gas decreases.
   B. The temperature of the gas decreases.
   C. The density of the gas increases.
   D. The volume of the gas increases.

2. What kind of gas would most likely be used to lift a balloon 10 miles into the sky?
   A. Helium
   B. Oxygen
   C. Hot Air
   D. Nitrogen

3. The main reason a scientist might prefer to observe distant stars from high above earth than from on the ground is because
   A. the force of gravity is weaker
   B. it is always nighttime high above earth
   C. there is less interference from the atmosphere
   D. it shortens the distance to the stars being observed

4. Which of the following physical forces is mostly responsible for pulling a balloon toward the ground?
   A. Air resistance
   B. Gravity
   C. Atomic force
   D. Magnetic force

5. A rubber balloon filled with air will sink to the ground. Which of the following actions would make the balloon rise?
   A. Release the balloon from the top of a mountain.
   B. Make the balloon out of lighter material.
   C. Put more air into the balloon.
   D. Heat the air in the balloon.

6. Which statement best describes what makes a gas balloon rise into the air?
   A. The gas inside the balloon decreases in volume as the balloon rises into the air.
   B. The temperature of the air increases as the balloon rises into the air.
   C. The mass of the balloon material is greater than the mass of the gas inside the balloon.
   D. The density of the air surrounding the balloon is greater than the density of the gas inside the balloon.

7. What will likely happen to a rubber balloon filled with gas as it rises into the air?
   A. It will remain the same size.
   B. It will shrink in size until it collapses.
   C. It will expand in size until it bursts.
   D. It will expand and then shrink.

8. Scientists interested in studying weather would most likely send a weather balloon into which part of the atmosphere?
   A. Mesosphere
   B. Stratosphere
   C. Thermosphere
   D. Troposphere

9. Scientists currently use gas balloons to collect information on which of the following?
   A. Condition of the ozone layer
   B. Effects of gravity on humans
   C. Contents of craters on the Moon
   D. Patterns of airplane traffic

10. One problem with using hydrogen gas in scientific balloons is that hydrogen gas
    A. gives less lift than most other gases
    B. is a rare and expensive gas
    C. is highly explosive
    D. turns to liquid as the balloon rises

Background Questions Used in the Search and Simulation Scenarios

Questions 1–8. To what extent do you do the following on a computer? Include things you do in school and things you do outside of school.

1. Play computer games

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

2. Write using a word processing program

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

3. Make drawings or art projects on the computer

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

4. Make tables, charts, and graphs on the computer

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

5. Look up information on a CD

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

6. Find information on the Internet for a project or report for school

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

7. Use e-mail to communicate with others

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

8. Talk in chat groups or with other people who are logged on at the same time

A. Not at all
B. Small extent
C. Moderate extent
D. Large extent

9. Who taught you the most about how to use a computer?

A. I learned the most on my own.
B. I learned the most from my friends.
C. I learned the most from my teachers.
D. I learned the most from my family.
E. I don't really know how to use a computer.

10. How often do you use a computer at school? Include use anywhere in the school and at any time of day.

A. Every day
B. Two or three times a week
C. About once a week
D. Once every few weeks
E. Never or hardly ever

11. How often do you use a computer outside of school?

A. Every day
B. Two or three times a week
C. About once a week
D. Once every few weeks
E. Never or hardly ever

12. Is there a computer at home that you use?

A. Yes
B. No

Questions 13–15. Please indicate the extent to which you AGREE or DISAGREE with the following statements.

13. I am more motivated to get started doing my schoolwork when I use a computer

A. Strongly agree
B. Agree
C. Disagree
D. Strongly disagree
E. I never use a computer.

14. I have more fun learning when I use a computer

A. Strongly agree
B. Agree
C. Disagree
D. Strongly disagree
E. I never use a computer.

15. I get more done when I use a computer for schoolwork

A. Strongly agree
B. Agree
C. Disagree
D. Strongly disagree
E. I never use a computer.

16. Which best describes you?

A. White (not Hispanic)
B. Black (not Hispanic)
C. Hispanic ("Hispanic" means someone who is from a Mexicano, Mexican America, Chicano, Puerto Rican, Cuban, or other Spanish or Hispanic background
D. Asian ("Asian" means someone who is from a Chinese, Japanese, Vietnamese, or other Asian background)
E. Pacific Islander ("Pacific Islander" means someone who is from a Filipino, Hawaiian, or other Pacific Islander background)
F. American Indian or Alaskan Native ("American Indian or Alaskan Native" means someone who is from one of the American Indian tribes, or one of the original people of Alaska)
G. Other

17. If you are Hispanic, what is your Hispanic background?

A. I am not Hispanic.
B. Mexican, Mexican America, or Chicano
C. Puerto Rican
D. Cuban
E. Other Spanish or Hispanic background

18. How far in school did your mother go?

A. She did not finish high school.
B. She graduated from high school.
C. She had some education after high school.
D. She graduated from college.
E. I don't know.

19. How far in school did your father go?

A. He did not finish high school.
B. He graduated from high school.
C. He had some education after high school.
D. He graduated from college.
E. I don't know.

20. About how many books are there in your home?

A. Few (0–10)
B. Enough to fill one shelf (11–25)
C. Enough to fill one bookcase (26–100)
D. Enough to fill several bookcases (more than 100)

21. Does your family get a newspaper at least four times a week?

A. Yes
B. No
C. I don't know.

22. Does your family get any magazines regularly?

A. Yes
B. No
C. I don't know.

23. Is there an encyclopedia in your home? It could be a set of books, or it could be on the computer.

A. Yes
B. No
C. I don't know.

24. On a school day, about how many hours do you usually watch TV or videotapes outside of school?

A. None
B. I hour or less
C. 2 or 3 hours
D. 4 or 5 hours
E. 6 hours or more

25. Which best describes the science course you are taking this year?

A. I am not taking a science course this year.
B. Life science (for example, biology)
C. Physical science (for example, physics or chemistry)
D. Earth science (for example, geology or astronomy)
E. General science (several content areas of science taught separately)
F. Integrated science (several content areas of science combined and taught throughout the year)

Questions 26–29. About how often do you do each of the following in your science class?

26. Design your own science experiment or investigation

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

27. Carry out the science experiment or investigation you designed

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

28. Write up results of the experiment or investigation you designed

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

29. Talk to class about the results of your experiment or investigation

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

Questions 30–34. If you are taking a science class this year, about how often do you use a computer to do the following?

30. Collect data using lab equipment that interfaces with computers (for example, probes)

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

31. Download data and related information from the Internet

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

32. Analyze data using the computer

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

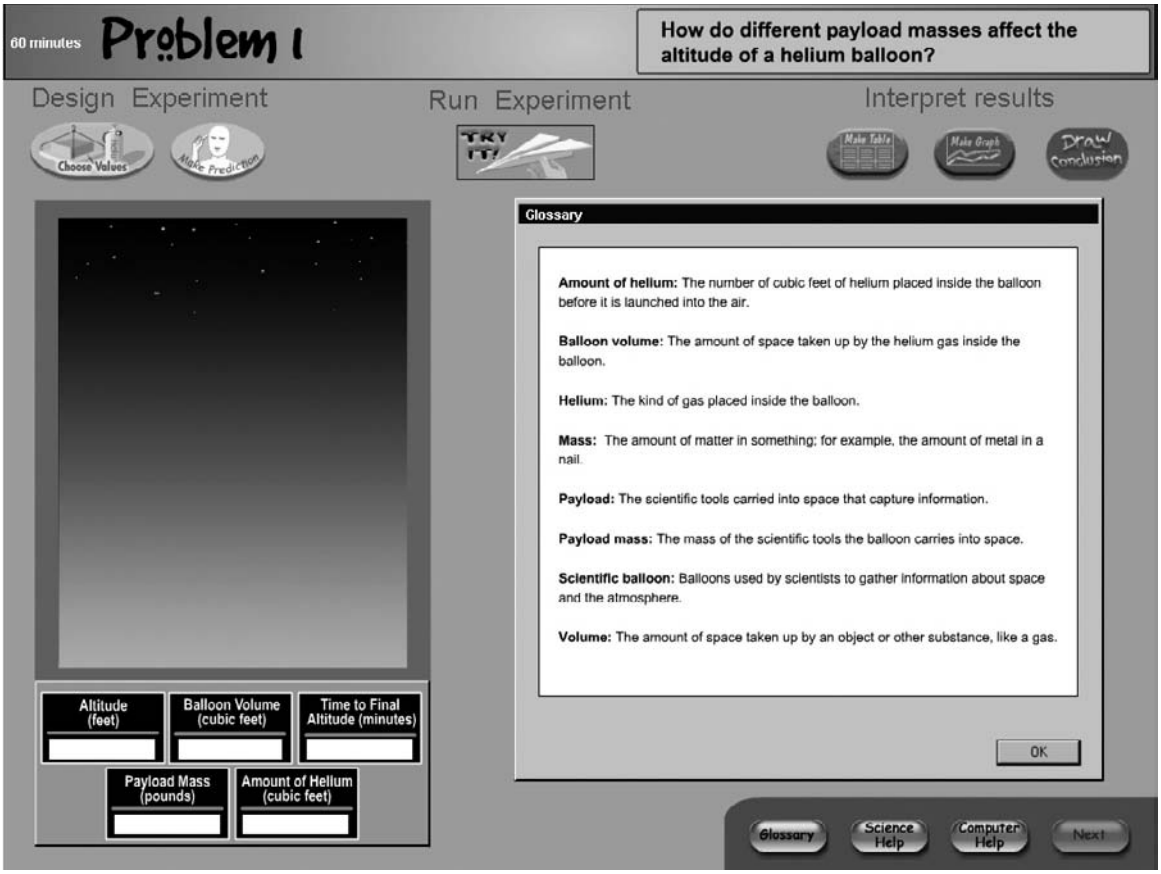
33. Use the Internet to exchange information with other students or scientists about science experiments or investigations

A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

34. Use computer simulations to perform experiments or explore science topics

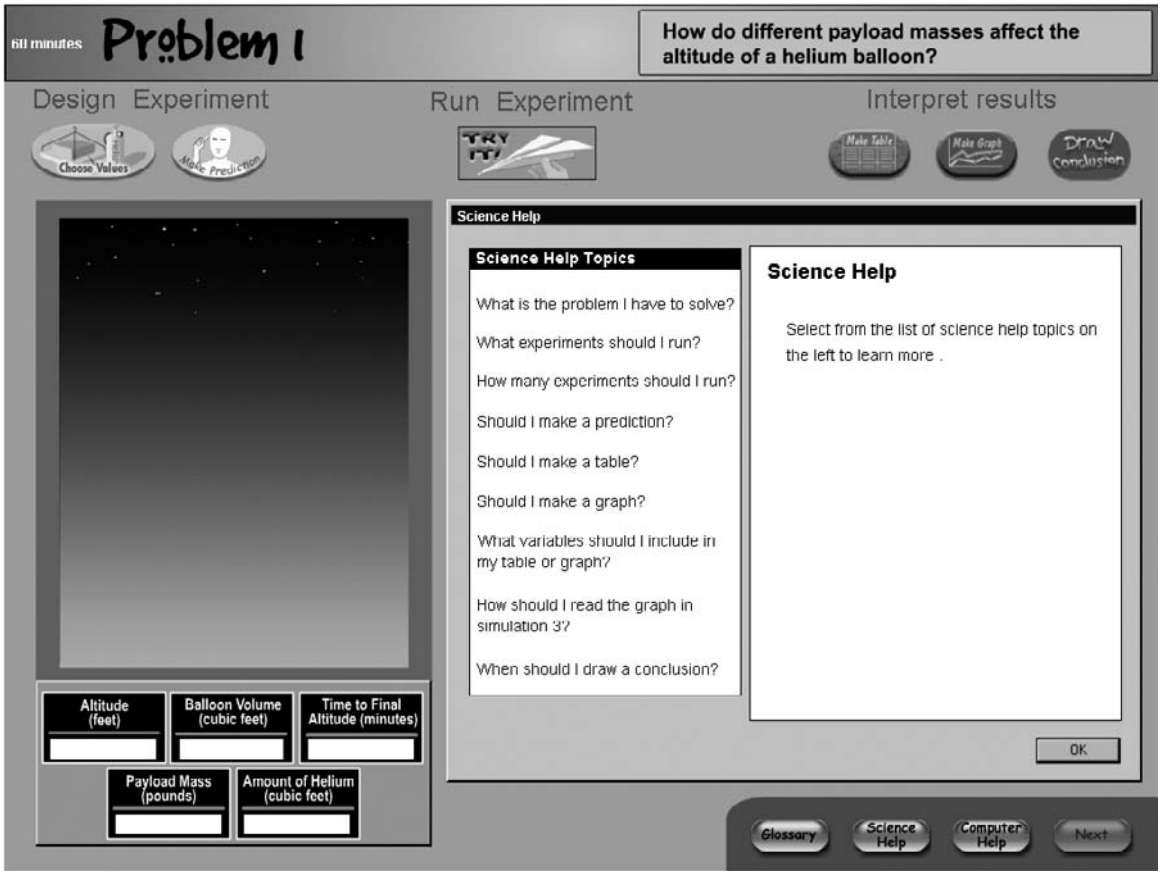
A. I am not taking science.
B. Once a month or more
C. Sometimes, but less than once a month
D. Never

Figure E-1. Computer screen showing the TRE Simulation glossary, grade 8: 2003



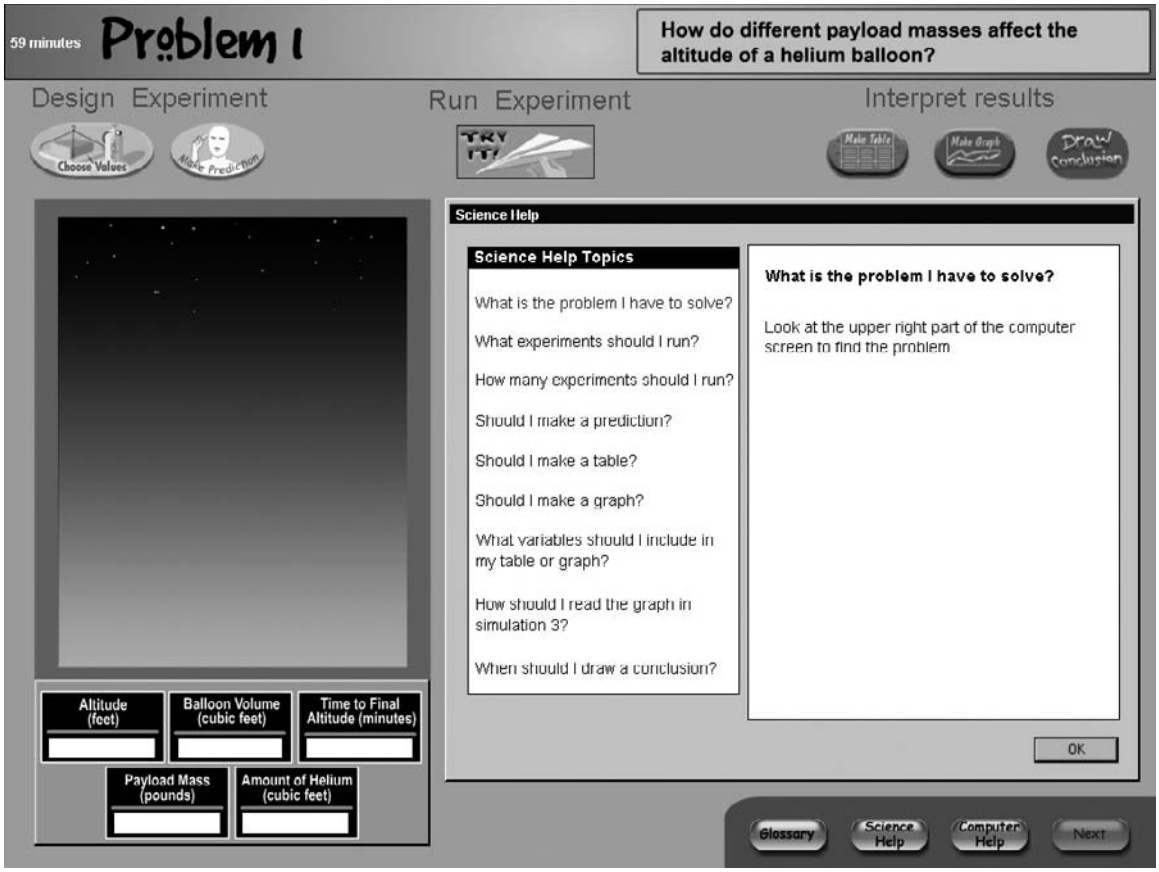
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-2. Computer screen showing the TRE Simulation Science Help topics menu, grade 8: 2003



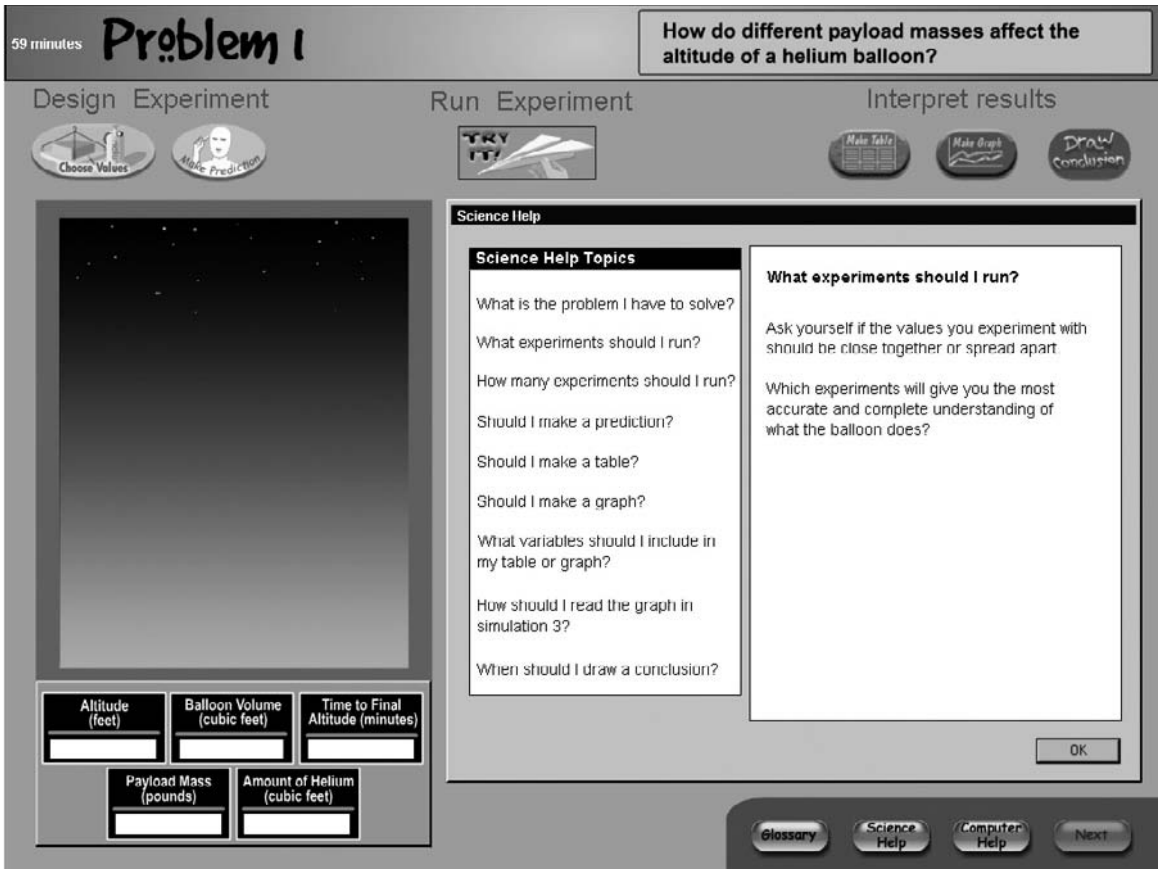
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-3. Computer screen showing help for the first TRE Simulation Science Help topic, grade 8: 2003



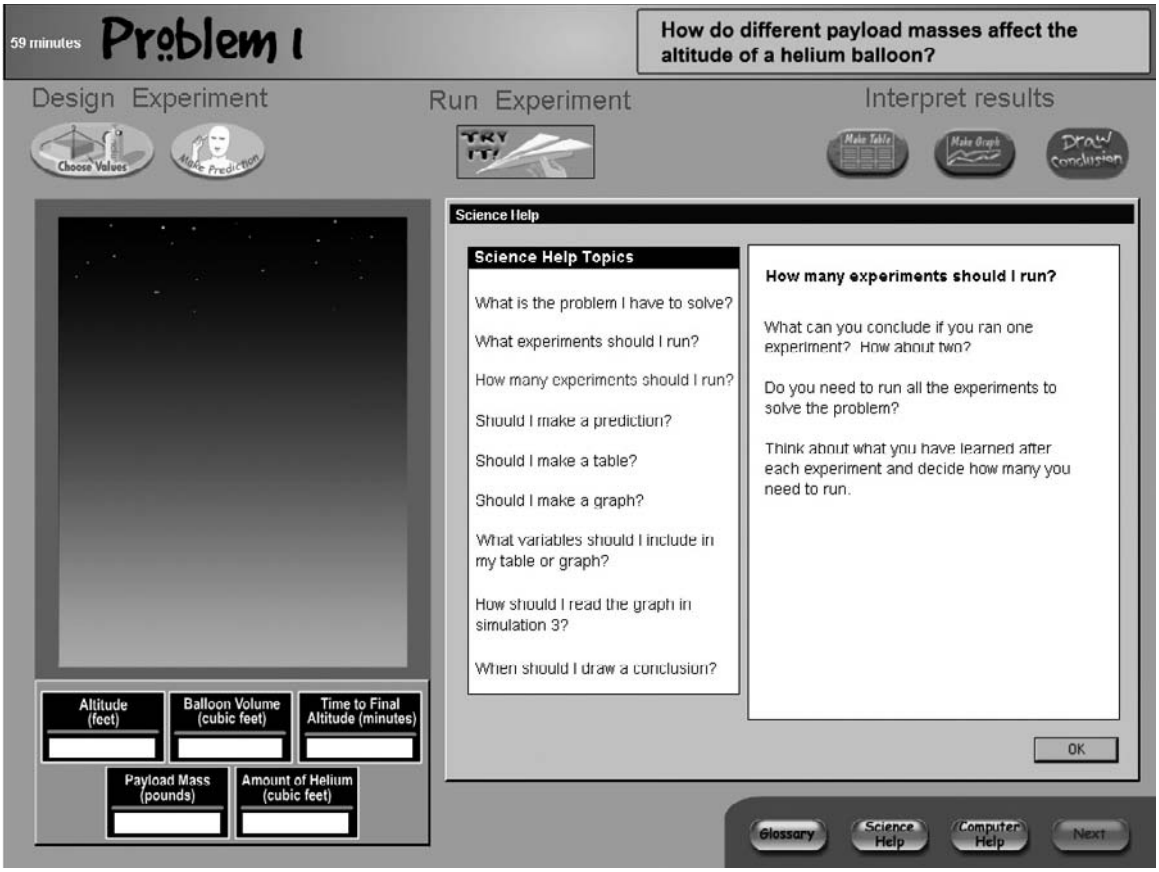
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-4. Computer screen showing help for the second TRE Simulation Science Help topic, grade 8: 2003



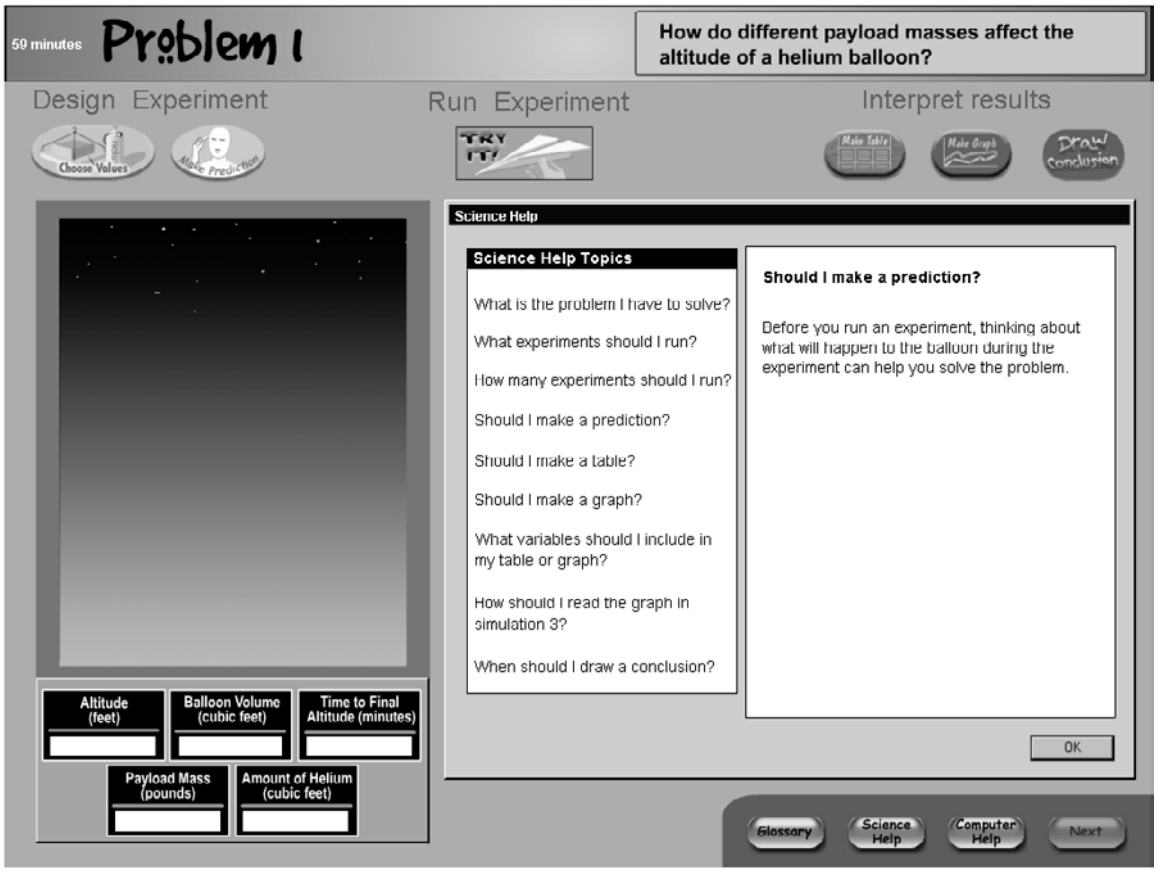
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-5. Computer screen showing help for the third TRE Simulation Science Help topic, grade 8: 2003



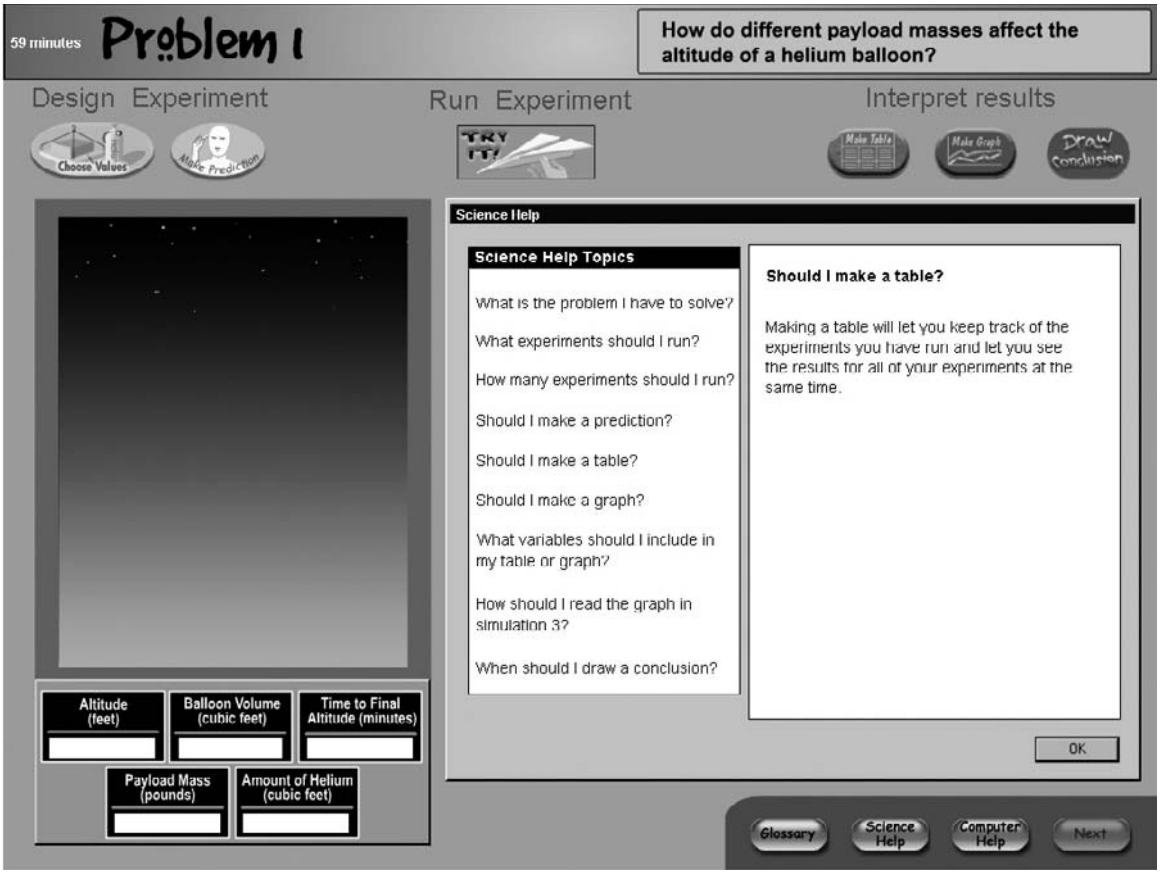
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-6. Computer screen showing help for the fourth TRE Simulation Science Help topic, grade 8: 2003



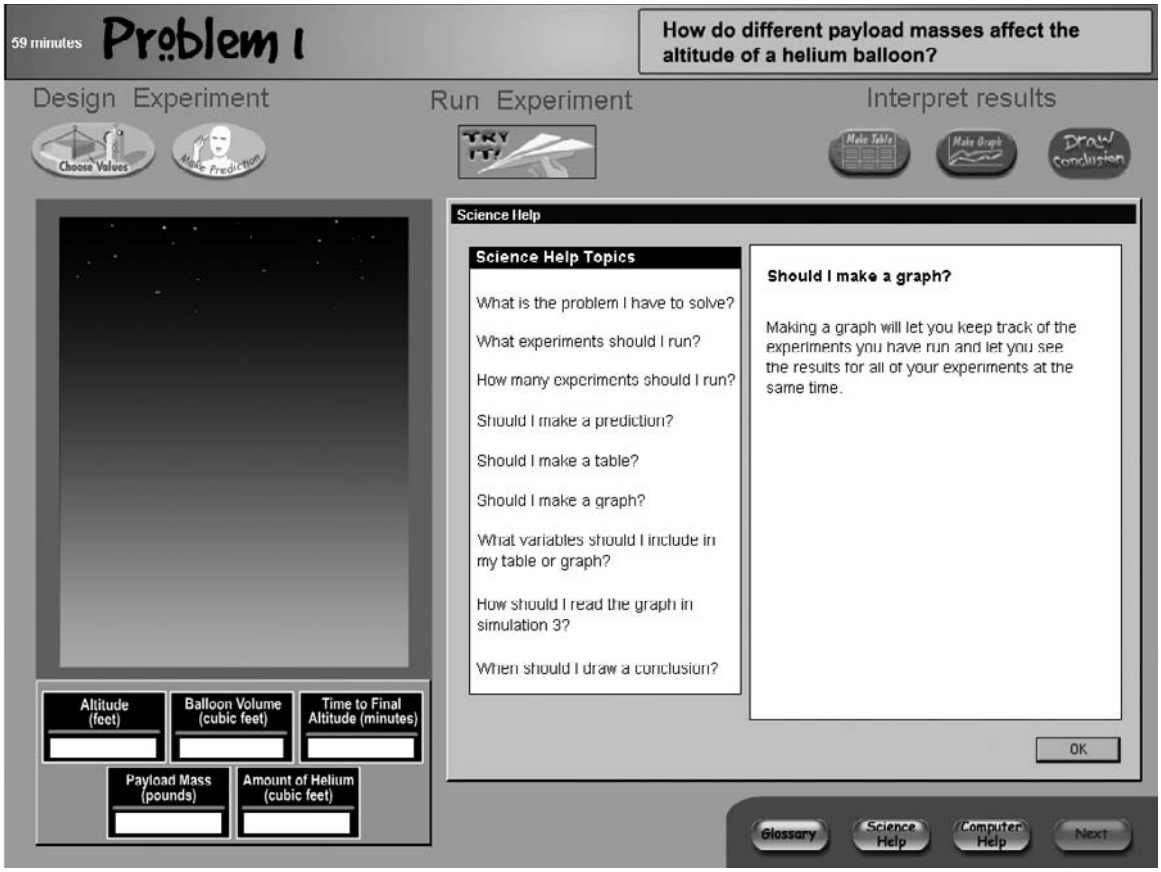
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-7. Computer screen showing help for the fifth TRE Simulation Science Help topic, grade 8: 2003



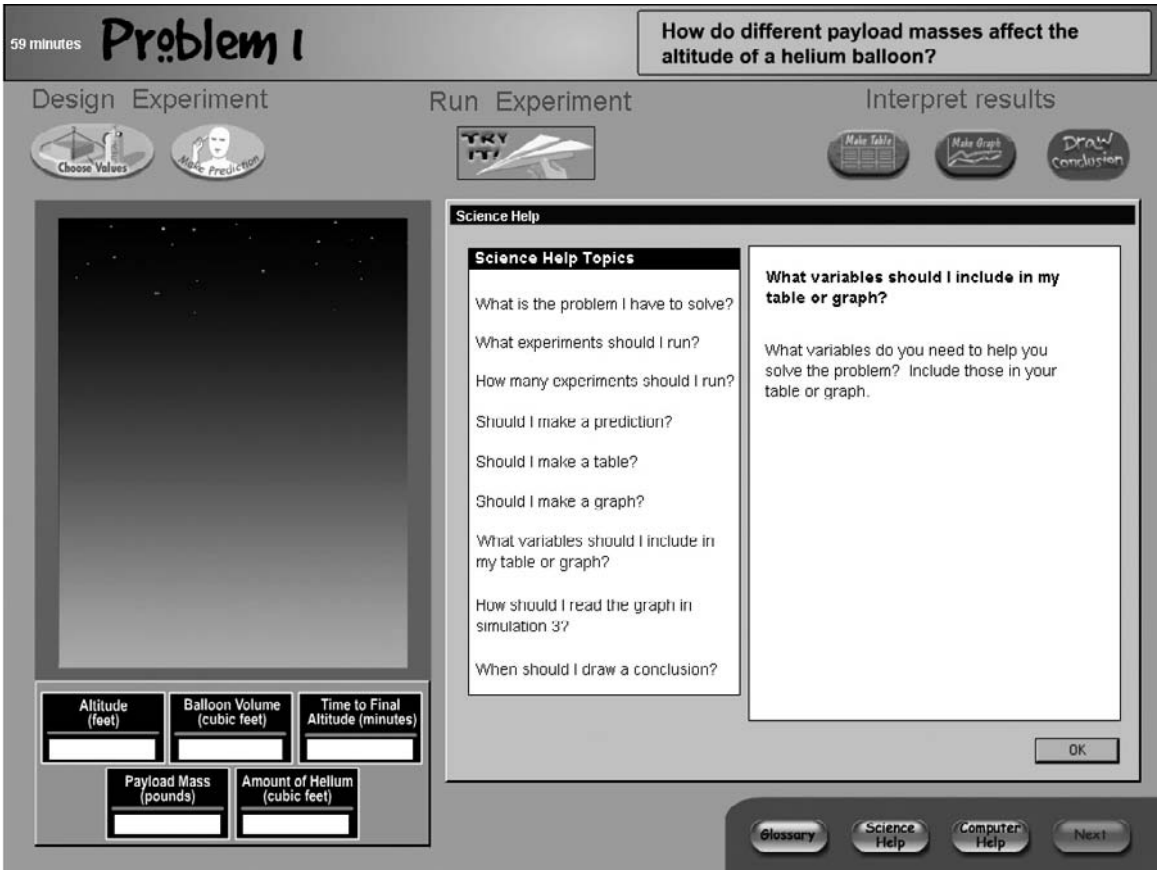
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-8. Computer screen showing help for the sixth TRE Simulation Science Help topic, grade 8: 2003



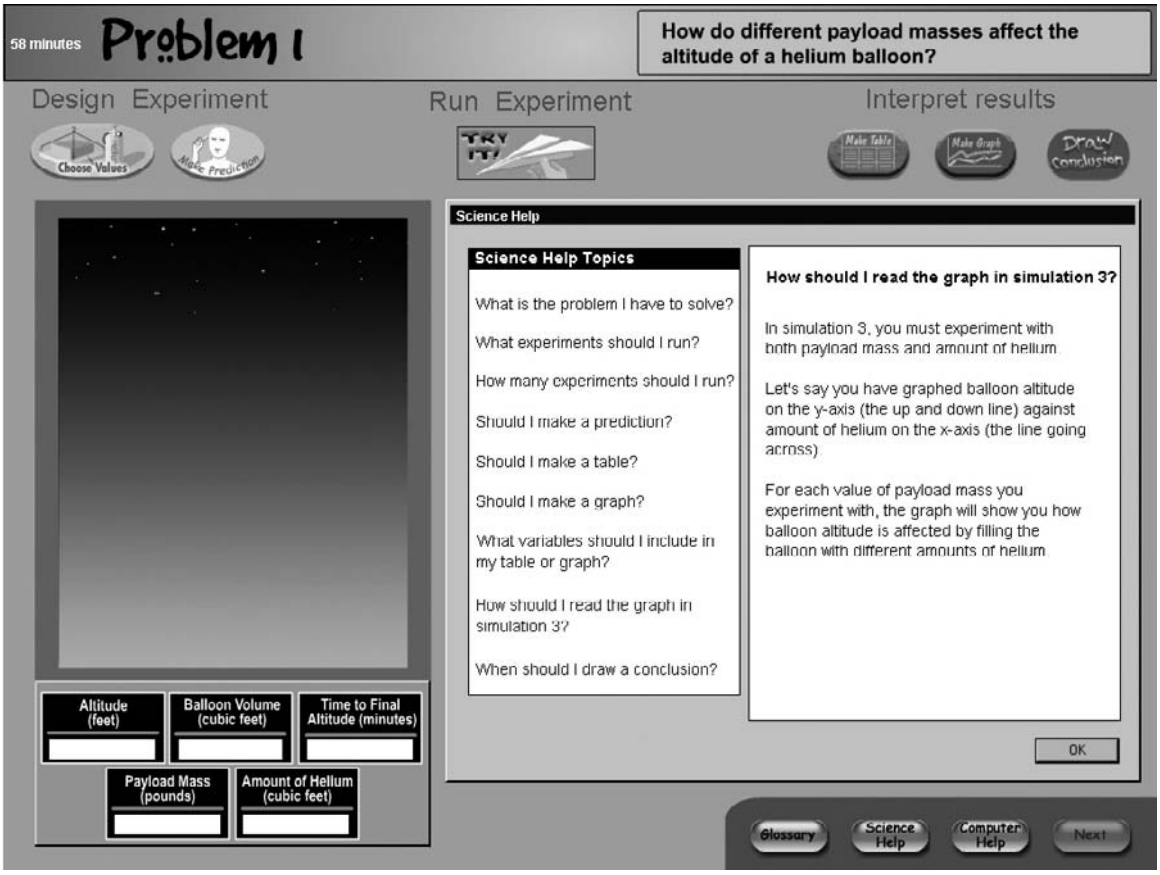
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-9. Computer screen showing help for the seventh TRE Simulation Science Help topic, grade 8: 2003



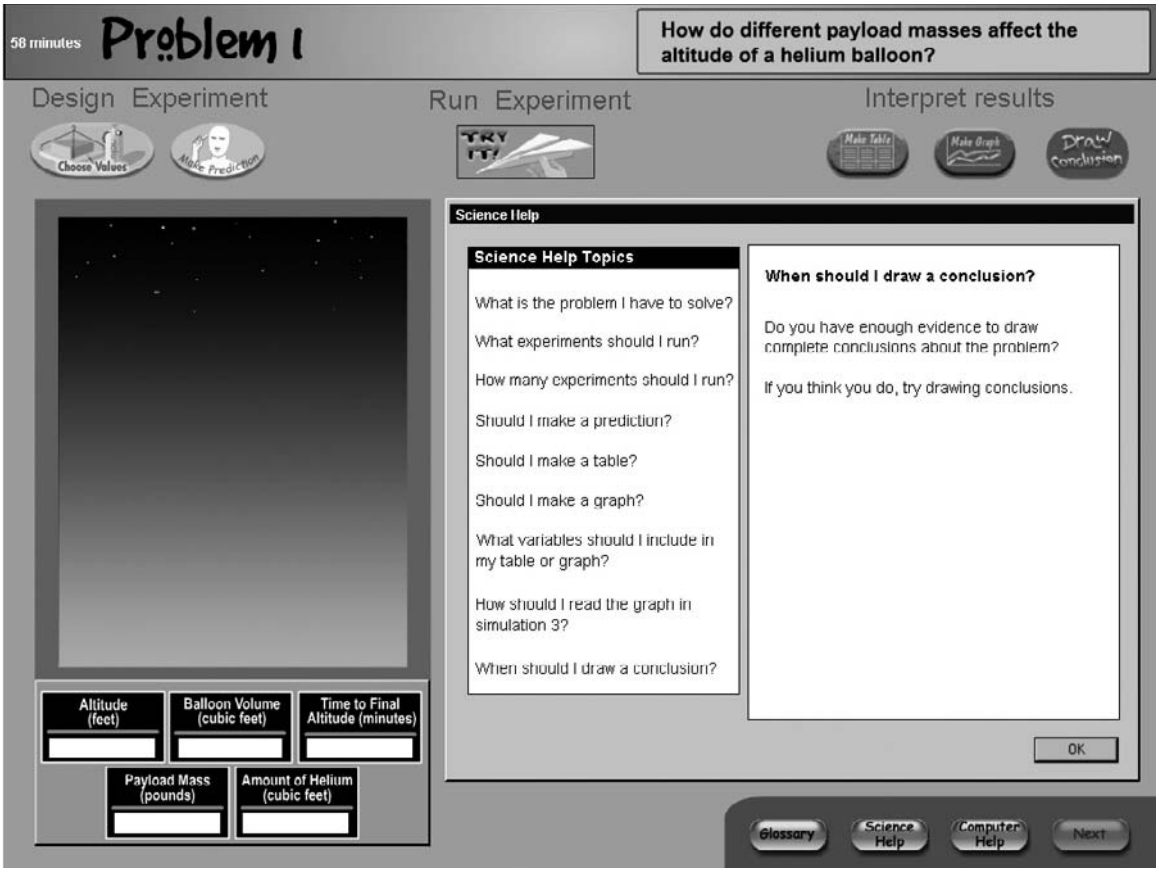
NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-10. Computer screen showing help for the eighth TRE Simulation Science Help topic, grade 8: 2003



NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.

Figure E-11. Computer screen showing help for the ninth TRE Simulation Science Help topic, grade 8: 2003



NOTE: TRE = Technology-Rich Environments.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2003 Problem Solving in Technology-Rich Environments Study.