CHAPTER 2
BASICS OF SCIENCE, ENGINEERING, and TECHNOLOGY

OVERVIEW

The major goal in science education is to create people who are scientifically literate and who can think critically. To do so, major components such as attitudes and process skills must be established.

Children interact with science daily, so preparation to live in a changing world as productive individuals should begin early in a child's life. Science instruction calls for hands-on experiences, which emphasize the process skills of science. Opportunities for language and literacy development are also created by the manipulation of science materials.

Children's perception of the world and concepts is not the same as adults' because they base their perceptions, as we all do, on their past experiences. Misconceptions arise because their experiences are limited.

Children should be taught to observe, classify, predict, and communicate their discoveries.

This chapter introduces the learning cycle as an application of Piaget's theory of cognitive development. Techniques other than the learning cycle are also presented, such as discrepant events and data collection and analysis. These methods emphasize science process skills.

This chapter presents multiple strategies for teaching science. Subject integration is introduced as a way to help children retain concepts. Webbing, lesson and unit planning, and assessment strategies are also considered necessary components to help the teacher plan the experiences that will aid in concept development.

OBJECTIVES

Upon completion of this chapter, students should be able to:

- Describe the importance of the science framework and standards, the relationship of science and literacy, science as inquiry and as engineering design, and the content areas of science.
- Explain how science concepts are developed and learned.
- Assess, plan, teach, and evaluate science instruction in line with national standards.

SUGGESTED ACTIVITY

1. Observing and Communicating: Peanuts
   MATERIALS NEEDED: Peanuts in shells, index cards.
   PROCEDURE: Distribute peanuts to the class and have them select their favorite peanut. Ask the students to observe the peanut and write a description on an index card. Then, have them describe their peanut to neighboring students. Place all the "favorite" peanuts in a fishbowl and challenge the students to find their peanut. Discuss what it means to observe with all of your senses.

   A variation of this activity is to place students in groups of four or five. Distribute peanuts to

the class and have them select their favorite peanut and write a description. When all descriptions are completed, have the students place their descriptions at the center of the table in one pile and their peanuts in another. Then students should trade tables with another group and match the peanuts to the correct descriptions. Allow each group to confirm whether the appropriate peanuts were matched with the correct description. Discuss with students what it means to observe with all of the senses and to communicate ideas clearly.

Note: Any materials having similar characteristics may be used for this activity. For younger children, use materials such as leaves, pieces of fabric, or buttons. The materials used should differ slightly in size, shape, or color.

2. Rockin' through the Learning Cycle
   MATERIALS NEEDED: An assortment of rocks and minerals, hand lenses, pans of water.
   PROCEDURE: Divide the students into small groups. Provide each group with an assortment of rocks, minerals, hand lenses, and water. Instruct the students to find out all they can about the rocks. Then ask the students to contribute the data that they have gathered about their rocks in a class discussion. Make a class chart with information about each rock. Reinforce the concept that the earth is made up of rocks and soil.

   Have students rub rocks together to make soil. Collect the bits of soil into a container and see whether bean seeds will sprout and grow in the newly made soil. Provide reference books and storybooks for students to read to find out how rocks become soil.

   Discuss the stages of the learning cycle represented in this activity. Have students suggest extensions and additional instructional strategies.

3. Discrepant Event: What Is This Paste?
   MATERIALS NEEDED: Cornstarch, water, food coloring, nonminty food flavoring, bags.
   PROCEDURE: Make a thick paste from cornstarch, water, and green food coloring. It should be the consistency of toothpaste and resemble it in color (not too dark—a nice, light green is preferable). Add a nonminty flavoring such as root beer. Place about one tablespoon of the scented paste into clear plastic bags. Distribute the bags to the students and ask them to attempt to determine what the substance is by using their sense of smell. Students will expect the substance to have a minty smell and be toothpaste. After hearing all ideas, reveal the scent and substance. Discuss how this discrepant event caused them to respond to an experience on the basis of their prior experiences. Discuss how discrepant events can affect science instruction and student learning.

4. Planning with a Curriculum Guide
   MATERIALS NEEDED: Curriculum guide from the local school district.
   PROCEDURE: Examine a curriculum guide from a local school district. Lead the class in developing a teaching unit from one of the resource units found in the guide.

5. Webbing a Science Concept
   MATERIALS NEEDED: Copies of the Concept Web Template provided in this text, science textbooks, and science resource books.

PROCEDURE: Distribute copies of the Concept Web Template (see p.3) to groups of three or four students. Ask them to work together to come up with ideas for activities in each subject area that would reinforce the science concept listed in the center. Allow students access to a variety of science texts and resource books. After about 30–45 minutes, ask students to share their ideas with the rest of the class. *Note:* It works well to make transparency copies of the science concept web for each student group. Provide overhead markers to each group and allow students to work directly on the transparency. In this manner, each group can present from the overhead, making it possible for all class members to see the group's work.

6. Identifying Local, State, and National Standards
   MATERIALS NEEDED: Copies of local, state, and national content standards in the areas of literacy, mathematics, social sciences, art, music, drama, movement.
   PROCEDURE: Distribute copies of the local, state, and national content area standards to groups of three or four students. Ask them to work together using the science concept web developed in the previous activity to identify local, state, and national content area standards reinforced by their web activities. After about 30 minutes, ask the students to share their ideas with the rest of the class.