

# HANDS-ON WHOLE SCIENCE

of thousands of models piled up, this requirement was discontinued. Except for formulas, such as a recipe for a new soft drink, all applications must, however, be accompanied by detailed drawings.

Patents remain in effect for 17 years, but having one doesn't guarantee that an invention will be used by millions of people or make its creator a lot of money. For example, you've probably never heard of a

*used-gum receptacle* (Reva Harris Keston) or a *wind-powered plow* (John Cook), although both were patented inventions. Some inventors never patent their creations because they prefer to keep them secret. For example, the formula for Coca-Cola has never been patented. Instead it's kept locked away in bank vaults, revealed only to trusted company officials and family members.

## LEARNING OBJECTIVES

- Students will practice a five-step approach to creative problem solving.
- Students will recognize that inventions may be new ideas or improvements, or new applications of devices or procedures previously invented.
- Students will be aware of the importance of inventions and inventiveness in problem-solving situations.

## EXPERIMENT

### BOATS AFLOAT

Introduce this activity with a warm-up exercise in making predictions. Make a foil boat by folding or molding a 12-inch square of foil. Show your students a dried pinto bean and let them handle it. How many beans could the boat hold without sinking? Record each student's prediction before putting the boat in water to test it out. Place beans in the boat one at a time until the boat sinks. Record the number of beans the boat supported without sinking. Now challenge your students to design foil boats that will support the weight of even more beans. Share with students the following process approach to inventive problem solving before giving them directions for designing and testing their own boats.

#### Step One: Observe

Prepare by collecting as much information about the problem as possible through observation.

#### Step Two: Brainstorm

Make a list of as many possible solutions to the problem as you can think of. Think about the problem overnight and add additional ideas to your list in the morning.

#### Step Three: Infer and Predict

Use what you've learned in other situations to help select the solution most likely to solve the problem. Research the topic at the library to add to what you already know.

#### Step Four: Experiment

Test the solution you chose. Observe and record the results.

#### Step Five: Evaluate

Analyze the results of the experiment and decide if the solution you tested was successful. If it wasn't, why not? What other solution might be worth testing?

#### Each student or small group will need:

- a 12-inch square of aluminum foil
- scissors
- a tape measure
- dried pinto beans
- test area—such as a bucket, wading pool, sink, or aquarium

#### Directions to Students

1. Copy the Boats Afloat chart.
2. Design an aluminum boat. First, design the boat's shape on paper. Use the foil to create this shape. Measure the boat's height, width, and length, and record this information on your Boats Afloat data sheet.
3. Set the boat afloat. Begin adding beans one at a time until the boat sinks. Record the number of beans the boat held before sinking. Dry the beans and the boat, repeat the test two more times, and record new information.
4. Compute the average number of beans the boat held without sinking. Record this number on the chart.

#### Follow-up Activity

Have students share their designs and results. Compare these re-

sults to the performance of the boat in the preliminary exercise. Discuss which designs worked well and which didn't. Have students incorporate this information into a new design, repeat the testing procedure, and compare designs and results again. Finally, as a class, use all of this information to design a boat that will surpass all of the others. Test it and discuss how the changes you made affected the boat's ability to support weight.

#### Evaluation

The average number of beans supported by the boats will vary depending on designs. Design changes should reflect that students observed and responded to the performances of their original designs.

Teachers: Copy this chart on the board.

### BOATS AFLOAT DATA

	Boat 1	Boat 2	Class Boat
Height			
Width			
Length			
Test 1 # of beans			
Test 2 # of beans			
Test 3 # of beans			
Average			