Teacher Guide: Pattern Finder

Learning Objectives

Students will …

- Observe frogs jumping on colored lily pads in certain patterns.
- Practice finding more and more complex patterns.
- Use an experiment to test a hypothesis.
- Adjust hypotheses to account for new information.
- Draw conclusions based on repeated tests of hypotheses.

Vocabulary

experiment, hypothesis, observe, prediction, theory

Lesson Overview

The *Pattern Finder* Gizmo™ shows frogs jumping between red, green, and blue lily pads. Each frog's jumping follows a particular set of rules—some simple, some more complex. "Beginner" and "advanced" sets of frogs are available.

Watch those leaping frogs!

The Student Exploration sheet contains three activities:

- Activity A – Students learn how to determine the jumping patterns for the "beginner" set of frogs.
- Activity B – Students use hypotheses to make predictions, then test predictions with experiments.
- Activity C – Students practice higher-order thinking skills by analyzing three frogs in the "advanced" set.

Suggested Lesson Sequence

1. **Pre-Gizmo activity** (15 – 30 minutes)
   Ask each student to create a pattern with tiles, crayons, or other colored objects. Each pattern should contain enough information to tell what the pattern is, but should also have a few missing colors that need to be filled in. When the patterns are ready, students can challenge their classmates to determine the missing colors in the sequence.

   Find examples of patterns in real life. These might include the sequence of colors of a traffic light, the dots and dashes of Morse code, or the pattern a wide receiver follows in football. Ask your students how each of these patterns is useful.

2. **Prior to using the Gizmo** (10 – 15 minutes)
   Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations.

3. **Gizmo activities** (15 – 20 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (15 – 30 minutes)
   As students are working or just after they are done, discuss the following questions:
   - Which patterns depended on where you placed the frog?
   - Which pattern was the hardest to determine? Why?
   - Can you detect patterns when all the frogs are all hopping at once? (Try it!)
   - Can a hypothesis ever be proven true?

5. **Follow-up activity: Stock predictions** (2 days)
   Humans are very good at finding patterns, but not all patterns are reliable. A good illustration of this concept is the stock market.

   Save up the stock market pages from the newspaper for a week. Bring them in one day, and ask your students to find several examples of stocks that show a distinctive pattern such as rising in value each day or falling in value each day. (Encourage students to look for other kinds of patterns as well.) Students can draw graphs to show the trend for each stock that they choose. Based on these patterns, ask students to predict what the stock will do the *next* day. You can also ask students which stocks they would buy or sell based on the patterns they have seen.

   The next day, bring in the stock market page again to see if student predictions were correct. How many of the stocks continued to follow the pattern? How many did not? In general, how easy is it to use patterns to make money on stocks?

   Many news analysts offer explanations for the stock market *after* something has happened. Students may find that it's much harder to predict what *will* happen!

Scientific Background
Recognizing patterns is an essential skill to develop in the elementary years. Patterns are important in learning music, dance, language, and mathematics. The *Pattern Finder* Gizmo introduces many key aspects of patterns:

- Something that looks chaotic and complex (like six frogs jumping) can often be reduced to simple patterns when you focus on one thing at a time.
- Complicated patterns can be determined if you collect enough data.
- Once a hypothesis is formed, it is important to make predictions and test these predictions with multiple experiments. For example, some of the patterns in the Gizmo change depending on the color of the first lily pad.

The second and third points are major emphases of the *Pattern Finder* Student Exploration sheet. Patterns are an excellent way to introduce investigative methods such as forming hypotheses, making predictions, and analyzing the results of experiments.

For example, if you place the pink frog from the "beginner" set on a red lily pad, it will only jump on red pads. This might lead to the hypothesis: "The pink frog only jumps on red pads." Based on this hypothesis, you might predict that placing the frog on a green pad would result in a leap to a red pad. If you try this, however, you would find that its rule is actually "the frog always jumps to another pad of the same color it started on." Testing and modifying hypotheses based on experimental results is an essential component of many scientific investigations.

It is important to remember that, while hypotheses can be supported by confirmed predictions, no hypothesis can ever be conclusively proven to be true. No matter how many times the blue frog jumps to a red lily pad, there is always a chance that it will jump to a green or blue lily pad next.

In mathematics, many patterns can be found in sequences of numbers. Consider the sequence of the "perfect squares": 0, 1, 4, 9, 16, 25, 36, and so on. (Each number in the sequence is a perfect square: 0 is 0^2, 1 is 1^2, 4 is 2^2, 9 is 3^2, etc.) Another interesting pattern develops when you find the difference between each pair of terms in the sequence:

$1 - 0 = 1$ $4 - 1 = 3$ $9 - 4 = 5$ $16 - 9 = 7$ $25 - 16 = 9$ $36 - 25 = 11$

You get the sequence of odd numbers! Many other fascinating patterns can be found in sequences such as Fibonacci numbers and Pascal's triangle. (See **Selected Web Resources**.)

Biology Connection: Hopping Frogs!

While the situation depicted in the *Pattern Finder* Gizmo is not meant to represent reality, frogs have shown distinctive preferences for jumping toward one color rather than another. In a 1964 research paper in the Journal of Experimental Biology (see **Selected Web Resources**), Drs. Boycott, Mrosovsky, and Muntz reported on a series of experiments in which frogs were placed on a specially-designed platform and given the choice of hopping towards one of two colors.

Which way will he go?

In one experiment, the researchers gave the frogs a choice of jumping toward a green or a blue screen. In the majority of cases, the frogs preferred to jump toward the blue screen rather than the green screen. The exact reason for this blue preference is not certain, although it has been suggested that frogs escaping from predators tend to hop into the water, which reflects blue light. Other theories propose that the blue preference is an artifact of a preference for certain light intensities.

Selected Web Resources

Patterns activities: http://www.proteacher.com/100026.shtml
Patterns lessons: http://edcommunity.apple.com/ali/story.php?itemID=462&version=232&pageID=688
Number patterns: http://www.mathsisfun.com/numberpatterns.html
Number pattern game: http://www.funbrain.com/cracker/index.html
Fibonacci numbers: http://www.world-mysteries.com/sci_17.htm
Group juggle: http://wilderdom.com/games/descriptions/GroupJuggle.html
Frog jumping preferences: http://jeb.biologists.org/cgi/reprint/41/4/865.pdf