

What am I?

A Game Connecting Mathematics and the Environment

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Teacher's Guide: Primary level

Lesson 1: Classification in Geometry

Introduction

Mathematicians and biologists study very different things. Mathematicians study numbers, patterns, and shapes, while biologists study plants and animals. However, mathematicians and biologists both need to know how to sort and classify things, because it helps them understand how the things they study are related and how they work and are put together. And numbers, patterns, and shapes are present everywhere in nature, even in living things. So when you study the natural world, you end up using and discovering a great deal of mathematics.

Tell your students that in the next three lessons they will play a game called “What am I?”. In this game, they must act like detectives and try to find answers to various problems by asking the least number of questions possible. By playing the game, students will see how sorting and classifying things in a clever way can help them ask useful questions when they are trying to solve a puzzle or a mystery. They will also see how mathematics is present everywhere in nature, and they will learn (in Lesson 3) how they can use their knowledge to help protect the environment.

Warm-up Game



Cut out shapes A, B, C, D, G, H, I, and J on Blackline Master (BLM) 1: Introductory Shape Game (Primary) and post them on the board using sticky-tack or tape. Tell your students that you are thinking about one of the shapes. They must find out what shape you are thinking of by asking you questions, to which you will only answer “Yes” or “No.” The goal of the game is to identify the shape by asking the least number of questions. (You might let one student at a time ask questions until they have found the answer, or you might allow students to take turns asking questions.) Students are not allowed to say the letter printed on the shape: they must identify the shape using descriptions.

Play the game several times, keeping track of how many questions your students have to ask each time. Students should see that if they ask questions that are very specific, such as “Are you thinking of a small shaded square?”, they may have to ask many questions before they learn the answer. (As there are eight shapes, they might need to ask as many as seven questions this way).

Ask your students whether they have a strategy for playing the game. Can they always find the answer by asking a certain number of questions? Students should see that they only need to ask three questions. The first question, for instance, might tell them the shape (“Is the shape a square?”), the second the size (“Is the shape small?”), and the third the shading (“Is the shape grey?” or “Is the shape shaded?”). Ask your students whether it makes any difference in what order they ask the questions, and whether they would be certain to get the answer in three questions if they just guessed the shape at random. (No, it might take seven questions).

As students eliminate possibilities by asking questions, you might remove the shapes that have been eliminated from the board, to make it easier for students to focus on the remaining shapes. You might also ask students to help you identify the shapes that have been eliminated by a particular question.

Research in psychology has shown that students' brains work far more efficiently if they are confident and engaged. One way to build confidence is to "raise the bar" incrementally by asking students a series of questions that appear to be harder and harder but that do not require any new skills or knowledge to answer. If some of your students are lacking confidence, you might give them a chance to show off by playing the game with all sixteen shapes (from A to L) on BLM 1. Make a big deal of the fact that they can play the game with so many shapes. The sorting categories for all sixteen shapes are shaded/unshaded, large/small, and square/circle/triangle.

The Shape Game

Place a selection of the shape cards from BLM 2: Shape Sorting Game (Primary) on the board and ask students to discuss what properties they might use to sort the shapes. You might have students work in groups, each with a set of shape cards. You might also give them rulers (to measure the sides of the shapes).

When students think about how they would sort the shapes, they might consider the following sorts of questions:

- Is the shape shaded or unshaded?
- How many corners (or vertices) does the shape have?
- How many sides does the shape have?
- Are the sides all straight or are some sides curved?
- Does the shape have any square corners (right angles)? If so, how many?
- Is the shape equilateral (that is, are all sides of the same length)?

If your students are not able to describe the shapes using geometric terms, you might review the following terms:

The **sides** of a shape are the lines that form the boundary of the shape.

A **vertex** is a point where two sides of a figure meet.

A **square corner** or **right angle** is an angle of the type found at the corner of a square.

A shape is **equilateral** if all of its sides are of the same length.

A shape with three straight sides is a **triangle**, four sides a **quadrilateral**, five sides a **pentagon**, and six sides a **hexagon**.

Some quadrilaterals have special names. A **square** has four equal sides and four right angles.

A **rectangle** has opposite sides that are equal and four right angles. A **rhombus** has four equal sides but not necessarily any right angles. Shape R is a rhombus, and so is shape F (a square).

Below is a series of games of increasing difficulty that can be played with the geometric shapes on BLM 2. You should pick the games that suit your students. Post the shapes in each game on the board and play the game exactly as you played the warm-up game. You might allow students to come to the board and lead the game by picking a selection of shapes and asking their fellow students to guess the shape they are thinking of. Students might sort the shapes in many different ways, but in each game it is possible to identify any shape by asking just two or three questions. For each game there are some suggested sorting attributes that students might use to sort the shapes.

Game 1

Shapes: B, F, J, N



Sorting Attributes: Students might sort the shapes using the following attributes: shaded/unshaded; 3 sides/4 sides or 3 vertices (or corners)/4 vertices (or corners) or triangle/square.

Game 2

Shapes: B, C, J, K

Sorting Attributes: shaded/unshaded; straight sides/curved sides

Game 3

Shapes: F, H, N, P

Sorting Attributes: shaded/unshaded; square/rectangle or equilateral/not equilateral

Game 4

Shapes: A, B, F, H

Sorting Attributes: 3 sides/4 sides or square/triangle; equilateral/not equilateral

Game 5

Shapes: A, B, F, H, I, J, N, P

Sorting Attributes: shaded/unshaded; 3 sides/4 sides; equilateral/not equilateral

Game 6

Shapes: E, F, G, H, M, N, O, P



Sorting Attributes: shaded/unshaded; straight sides/curved sides; square/rectangle for one set of shapes and 1 curved side/2 curved sides for the other set

Game 7

Shapes: All 16 shapes from A to P

Sorting Attributes: shaded/unshaded; straight sides/curved sides; 3 sides (or vertices)/4 sides (or vertices); equilateral/not equilateral for one set of shapes and 1 curved side/2 curved sides for the other set

Game 8

Shapes: F, H, T, U

Sorting Attributes: quadrilateral/pentagon or 4 sides/5 sides or 4 vertices/5 vertices; equilateral/not equilateral

Game 9

Shapes: A, B, F, H, W, X

Sorting Attributes: triangle/quadrilateral/hexagon or 3 sides/4 sides/6 sides or 3 vertices/4 vertices/6 vertices; equilateral/not equilateral

Game 10

Shapes: A, B, F, R, T, V

Sorting Attributes: triangle/quadrilateral/hexagon or 3 sides/4 sides/6 sides or 3 vertices/4 vertices/6 vertices; at least one square corner/no square corners