

P A T H W A Y S



Introduction

The Geometry Playground Pathways will help support your students' hands-on and immersive learning experiences during their upcoming visit to the Exploratorium's Geometry Playground exhibition.

You'll find activities here designed for use before, during, and after the field trip. They employ simple materials, step-by-step instructions, and a range of possible outcomes to improve each student's spatial reasoning skills, and to build on the geometry topics covered by the exhibits.

EDUCATIONAL PHILOSOPHY:

These activities are designed to:

- Encourage creative and critical thinking skills.
- Meet the needs of students with multiple learning styles by using hands-on activities that involve visual, spatial, and logical thinking skills.
- Engage students at varying levels and at their own paces.
- Allow students to explore and experiment with their ideas by offering a multiplicity of learning experiences.

This packet includes:

- Activities to do before, during and after your visit to the museum
- Resource pages needed for the activities
- California State Mathematics Content Standards



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BEFORE THE VISIT

GRADES
K - 2

STRING SHAPES

Make many-sided shapes with string.

Time: 45 minutes

Goal: To make a variety of three-sided and four-sided polygons, and to understand how the same shape can look different depending on your point of view.

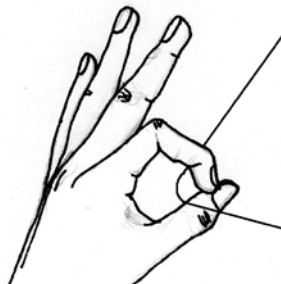
Materials:

- *String, about 2.5 meters (8 feet) long, tied at the ends to form a loop*
- *Masking tape*
- *Floor space*
- *Three people (more can join later)*

Try This:

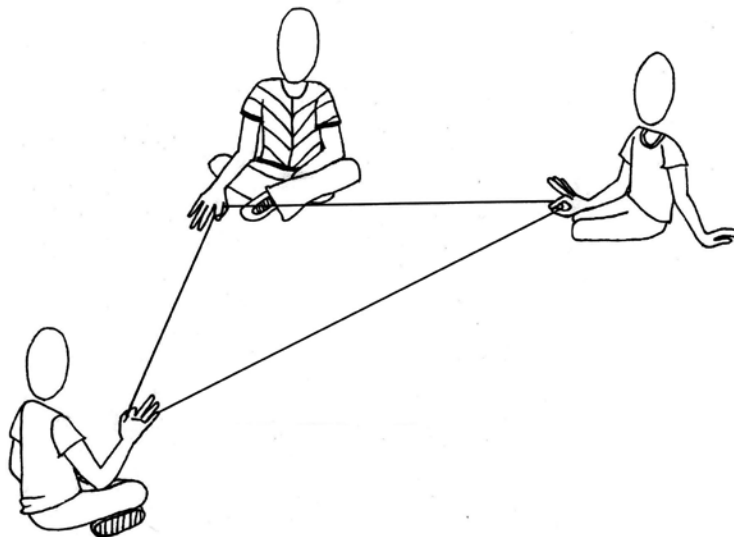
1. Sit on the floor with your friends, facing one another. Start with three people.

2. Each person should take one hand and close the thumb and a finger around the string. The string should slide through easily. (If you have only two people, one person should use both hands.)



3. Pull the string taut. What shapes can you make with three people, each using one hand? How many sides does the shape have? How many points?

4. By changing your hand positions while allowing the string to slide through your fingers, you can make different kinds of triangles. How are they different? What happens to the lengths of the sides of the triangle?

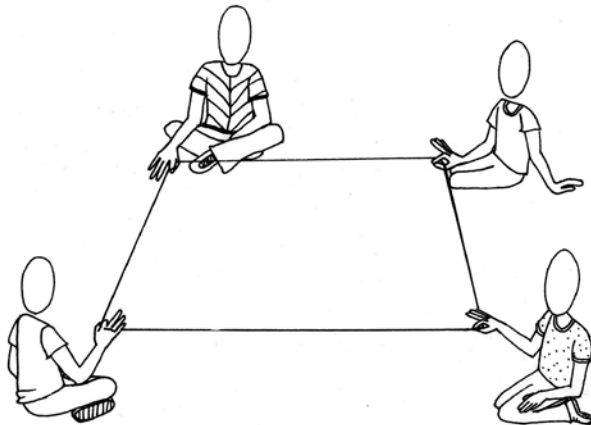




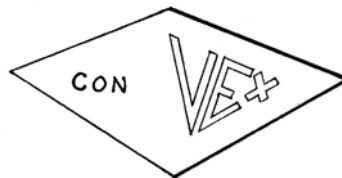
BEFORE THE VISIT

GRADES
K - 2

- When the group finds an interesting triangle, take turns describing the triangle from your point of view. Does it remind you of anything?
- How can you make a shape with four sides? Have a fourth person join your group and hold the string with one hand.



- What interesting shapes can you make with four people? Four-sided shapes are called **quadrilaterals**. Notice that you can make convex as well as concave shapes. Keep your hands close to the floor as you make shapes.



- When one group has found an interesting shape, work with the teacher to lower that shape down, and carefully tape each point of the shape to the floor.
- Stand in a circle around the shape.
- Take turns describing the quadrilateral from different points of view. Move around the circle to the right and describe the shape again. Keep doing this until you're back where you started.
- How can you make a shape with five sides?

Make up your own question!

Try to make up an interesting question that you can answer with this activity. The question should begin with the phrase:

How can I make a _____?

You'll be asked to do a similar exercise when you visit Geometry Playground at the Exploratorium.



BEFORE THE VISIT

GRADES
K - 2

What's Going On?

When three or more people hold the string taut, it creates a **polygon**. A polygon is any flat shape whose sides are straight lines. There are many kinds of polygons, such as triangles, quadrilaterals, rectangles, and squares.

The number of hands holding the string determines how many sides and how many points, or **vertices**, the polygon will have. Three hands create **triangles**, which have three sides and three points. Four hands create **quadrilaterals**—four sides and four points. By adding hands, one at a time, you can make **pentagons** (5), **hexagons** (6), **heptagons** (7), and **octagons** (8).

Depending on position of the hands holding the string, your polygon may be a **convex** polygon, or a **concave** polygon. Concave polygons have at least one point that goes in like a cave. In convex polygons all the points go outward.

Describing the shapes from different points of view is similar to turning—or **rotating**—the shape. Instead of rotating the shape itself, you are moving around the shape. The shape itself never changes, yet each view of it looks a little different.



BEFORE THE VISIT

GRADES
K - 2

CALIFORNIA STATE MATHEMATICS CONTENT STANDARDS

Kindergarten: Measurement and Geometry

1.1 Compare the length, weight, and capacity of objects by making direct comparisons with reference objects (e.g., note which object is shorter, longer, taller, lighter, heavier, or holds more).

2.0 Students identify common objects in their environment and describe the geometric features:

2.1 Identify and describe common geometric objects (e.g., circle, triangle, square, rectangle, cube, sphere, cone).

2.2 Compare familiar plane and solid objects by common attributes (e.g., position, shape, size, roundness, number of corners).

Kindergarten: Mathematical Reasoning

1.2 Use tools and strategies, such as manipulatives or sketches, to model problems.

1st Grade: Measurement and Geometry

2.0 Students identify common geometric figures, classify them by common attributes, and describe their relative position or their location in space:

2.4 Arrange and describe objects in space by proximity, position, and direction (e.g., near, far, below, above, up, down, behind, in front of, next to, left or right of).

2nd Grade: Measurement and Geometry

2.1 Describe and classify plane and solid geometric shapes (e.g., circle, triangle, square, rectangle, sphere, pyramid, cube, rectangular prism) according to the number and shape of faces, edges, and vertices.

2nd Grade: Mathematical Reasoning

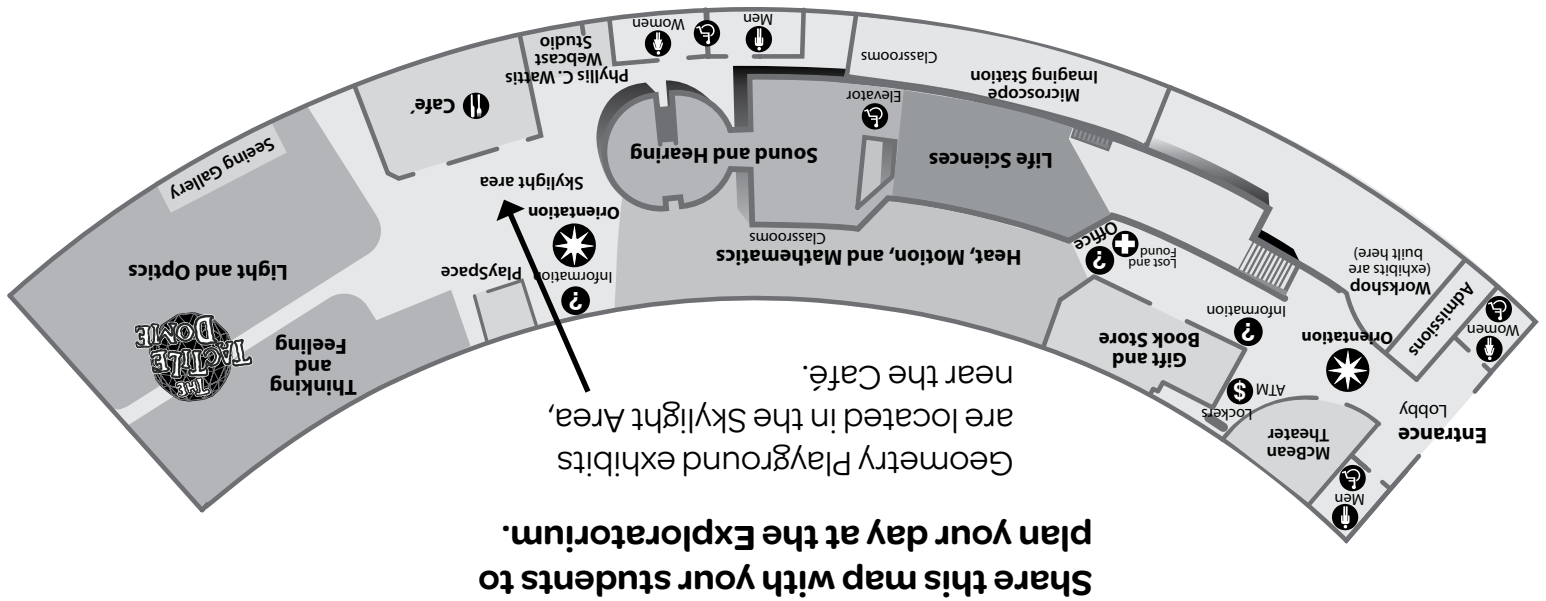
1.2 Use tools and strategies, such as manipulatives or sketches, to model problems.



DURING THE VISIT
GRADES
K-2

Teachers:

In preparation for your field trip to the Exploratorium, please make photocopies of the next page—the one with the upside-down map—to hand out to each of your field trip chaperones.



FOLD HERE

At the Geometry Playground Exhibition:

Background for Field Trip Chaperones

The Exploratorium is a place that nurtures curiosity, encouraging visitors to ask their own questions, and answer them by experimenting.

After your group has played for a while with the Geometry Playground exhibits, read through the following section with your group. **Each student should make up a question that can be answered by experimenting** with one of these three exhibits:

Spin a Shape in Light – room with black light and fluorescent toys

Distorted Drawing – table with cylindrical mirror and touch screen

Boundary Functions – large floor area with projected lines on it

The question should begin with the phrase:

How can I make a _____?

Examples:

At Spin a Shape in Light: How can I make a cylinder—a shape like a can?

At Distorted Drawing: How can I make a straight line going across in the mirror?

At Boundary Functions: How can I make a triangle?

The more interesting the question, the better. Have fun!



AFTER THE VISIT

GRADES
K - 2

THE FOUR-SQUARE QUILT

Put triangles together to make patterns.

Time: 45 minutes

Goal: In this activity, students investigate the patterns that can be made by combining triangles in patterns, and practice shape rotation and reflection.

Materials:

- *Four-Square Quilt template (attached)*
- *Triangle template (attached)*
- *Two different colors of paper*
- *Glue*
- *Set of Shape Finders for each group*

Advance Preparation:

Make one copy of the Four Square Quilt template for each student.

Copy the Triangle template onto the colored papers. Each student will need four triangles in each of the two colors, for a total of eight triangles. Younger students will need to have the triangles cut for them. Cut out the Shape Finder pieces.

Try This:

1. How would you orient a triangle so that it fits inside one of the four squares on the Four-Square Quilt template? You may need to turn the triangle, or rotate it, to get it to fit.
2. Arrange the eight triangles inside the four squares. Do not let any of the triangles cover part of another triangle. Make sure you do not cover any lines of the squares. To use all of the triangles, you will need to put two triangles in each square.
3. Play around with different patterns until you find one you like.
4. Glue the triangles onto the Four-Square Quilt template to complete your final pattern.
5. Look at other people's patterns. How are they different from yours? How many different arrangements you see?
6. Look at your pattern again. Do you see any larger shapes that are made of more than one triangle? Pick one of the Shape Finder pieces and place it on top of your quilt pattern. Does it match any part of your pattern? You may have to turn the Shape Finder piece sideways, or upside down, or flip it over, to match your pattern. Turning a shape sideways or upside down is called **rotation**. Flipping a shape over is called **reflection**. If the Shape Finder piece doesn't fit, try another.

Can you find Shape Finder shapes on another quilt pattern? Try to identify similar shapes in different quilt patterns.



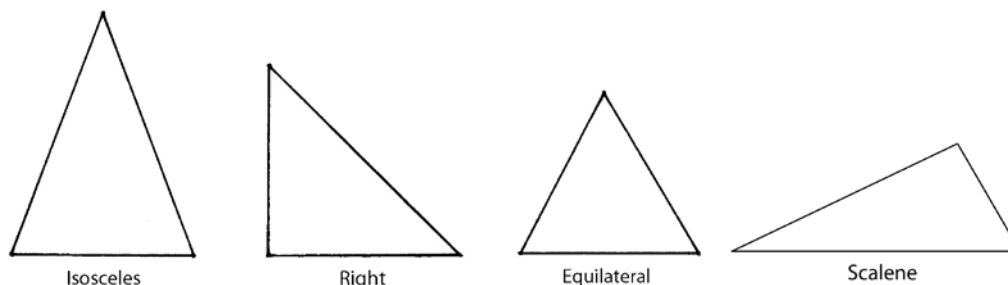
AFTER THE VISIT
GRADES
K - 2

What's Going On?

Triangles can be combined to make other shapes. Two triangles put together can make a square, a larger triangle, or a four-sided shape called a **parallelogram**.

With four triangles you can make an even larger triangle, a larger square, a rectangle, and other shapes as well.

When you flipped over the shape finder, you were creating a **reflection** of it. It's the same thing that happens to a shape when you see its reflection in a mirror. You can confirm this with a mirror if you have one. If you reflect a shape twice, you will be back to your original shape.



The triangles you used here are called **isosceles triangles**. That means that two of the triangle's sides are the same length.

They are also **right triangles**. Right triangles have one angle that measures 90 degrees, like the corner of a square.

There are other kinds of triangles, too. When a triangle has three sides all the same length, it's called an **equilateral triangle**.

If all three sides of a triangle are different lengths, it's called a **scalene triangle**.



AFTER THE VISIT
GRADES
K - 2

CALIFORNIA STATE MATHEMATICS CONTENT STANDARDS

Kindergarten: Algebra and Functions

1.0 Students sort and classify objects: Identify, sort, and classify objects by attribute and identify objects that do not belong to a particular group (e.g., all these balls are green, those are red).

Kindergarten: Measurement and Geometry

2.0 Students identify common objects in their environment and describe the geometric features:

2.1 Identify and describe common geometric objects (e.g., circle, triangle, square, rectangle, cube, sphere, cone).

2.2 Compare familiar plane and solid objects by common attributes (e.g., position, shape, size, roundness, number of corners).

1st Grade: Measurement and Geometry

2.0 Students identify common geometric figures, classify them by common attributes, and describe their relative position or their location in space:

2.4 Arrange and describe objects in space by proximity, position, and direction (e.g., near, far, below, above, up, down, behind, in front of, next to, left or right of).

2nd Grade: Measurement and Geometry

2.1 Describe and classify plane and solid geometric shapes (e.g., circle, triangle, square, rectangle, sphere, pyramid, cube, rectangular prism) according to the number and shape of faces, edges, and vertices.

2.2 Put shapes together and take them apart to form other shapes (e.g., two congruent right triangles can be arranged to form a rectangle).

Four-Square Quilt

