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Cache Code Math March Unit: Geometry in Mathematics and Programming

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Geometry in Mathematics and Programming

Fifth-Grade Mathematics Mini-Lessons

Table of Contents

Slide Deck to Support Instruction

#1 Math Routine: Which One Doesn't Belong?

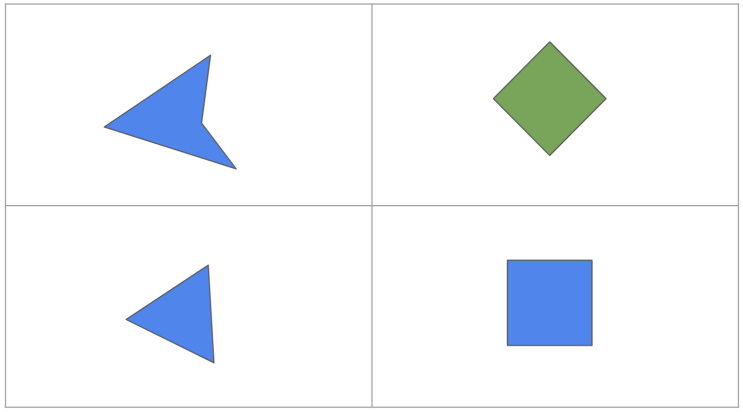
Go Math! Lesson: This math routine could fit with any Chapter 11 lesson or come before Chapter 11. This lesson plan provides two images, but you can also split them over two different days. It can be used to both access students' background knowledge and assess how they currently discuss the attributes of shapes in preparation for the math they will be using in the computer lab lessons.

Use a Think-Pair-Share format for each image: Think - silent individual think time; Pair - share their solution and why they think it is that solution with their partner; and Share - share solutions and mathematical thinking as a whole class.

This activity comes from Christopher Danielson's book, *Which One Doesn't Belong?* The activity involves showing an image of four shapes and asking "Which one doesn't belong?" There is no one right answer, and the task encourages reasoning about attributes of shapes. The purpose of this activity is to provide students opportunities to discuss shapes using precise language and practice argumentation. The first image contains an irregular polygon (Lesson 11.1), but it is a quadrilateral like the parallelogram and square (Lesson 11.3). The second image contains various kinds of triangles (Lesson 11.2).

A key goal for this routine is to help students reason about shapes according to their attributes and using precise language such as polygons, quadrilaterals, sides, vertices, acute/obtuse/right, congruent, perpendicular, parallel (see Front Matter for vocabulary).

I'm going to show a slide with four shapes and ask you "Which one doesn't belong?" First, I'll give you individual time to think. When you have an idea about which one doesn't belong with the other three and why, give me a silent thumbs up. Then, I'll have you share your solution and reasoning with a partner. Finally, we'll share our thinking with each other as a whole class. Ready?

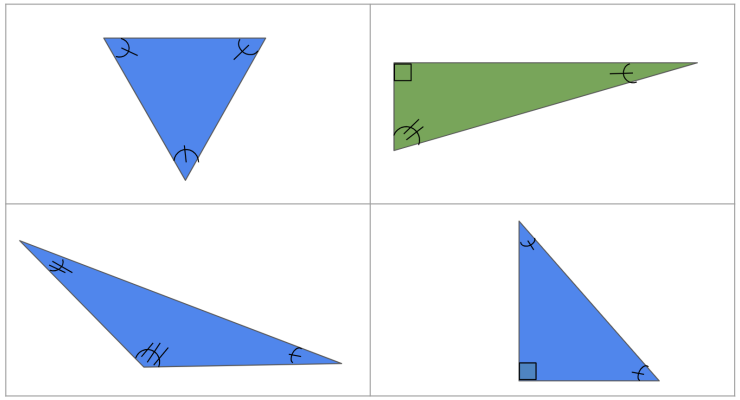


Show each slide and conduct a Think-Pair-Share. For each slide, ask *Which one doesn't belong?* and *Explain your reasoning*.

Think: *Which one doesn't belong?*

Pair and Share: *Explain your reasoning.*

(Possible responses: The one that doesn't belong is the green one because its color is different from the others. The bottom left because it is a triangle, and the others are quadrilaterals; it has 3 vertices while the others have 4 vertices. Other solutions that will come in Chapter 11 but students might not yet know: The top left because it is an irregular polygon, the others are regular polygons.)



Think: *Which one doesn't belong?*

Pair and Share: *Explain your reasoning.*

(Possible responses: The bottom left because it has one angle that is obtuse. The top left because it only has acute angles. Other solutions that will come in Chapter 11 but students might not yet know: The one that doesn't belong is the top left because it is equilateral, while the others have at least one side length that is not congruent to the others.)

If you'd like to try more or continue this routine on other days, see Danielson's book or websites such as https://wodb.ca/index.html

Discuss: *Look at all the ways you reasoned about these shapes using their attributes (traits or properties of a shape, like its sides, angles). What did you learn by comparing these shapes and reasoning about their attributes?*

Teacher statement after discussion: *"You will be reasoning about shapes' attributes in the computer lab. You'll be developing a game for each other using the names of the attributes you discussed today and during our Ch. 11 learning, like sides, angles, regular, congruent, not congruent, equilateral, symmetrical..."*

#2 Math Lesson: Visualizing -- What Shape Will It Be?
This mini-lesson extends students' learning from Lesson 9.2 on Ordered Pairs and applies it to the context of Chapter 11 and the Scratch coding activities. This activity is based on Enrich 9.2: Coordinate Grid Graphing Riddle in *Go Math!* The goal for this mini-lesson is for students to apply their understanding of reading and plotting ordered pairs to visualize shapes based on the plotted points.

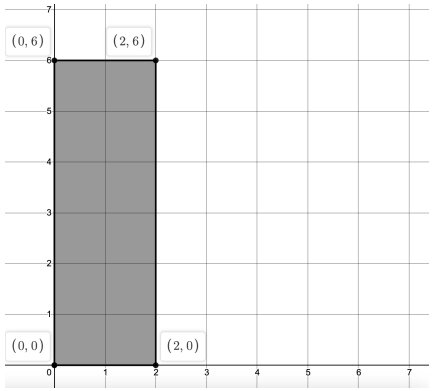
In Scratch programming in the computer lab, students will use a coordinate grid for the stage background and will need to plot points using ordered pairs.

Use a Think-Pair-Share format for each equation: Think - silent individual think time; Pair - share their solution and why they think it is that solution with their partner; and Share - share solutions and mathematical thinking as a whole class. Once students have shared ideas, show the image so they can see the shape. Continue further discussion if they notice new things or have new ideas about the ordered pairs and their relations to each other.

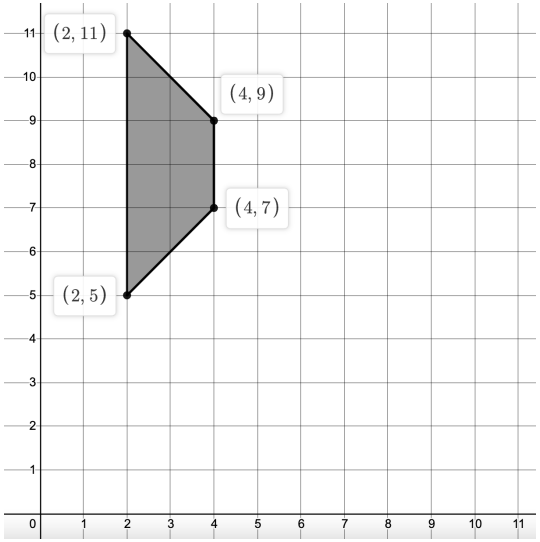
In this activity, I will show you Quadrant I of the coordinate grid and I will call out some ordered pairs. As I call out the ordered pairs, I want you to visualize where those points are on the coordinate grid, and then connect those points in your mind to create a polygon. You will see if you can guess my shape. Ready to try it?

- *Go Math!* grid: (0,0) (2,0) (2,6) (0,6) (0,0)
    - Think: *What shape did you visualize based on the ordered pairs? (Or, what shape can you imagine on the grid?)*
    - Pair and Share: *Explain your reasoning.*

  (Possible responses: It's a quadrilateral because there are 4 points. It is a rectangle because the distance between (0,0) and (2,0) and between (2,6) and (0,6) are shorter distances so two sides are 2 units long and the other two sides are 6 units long.)



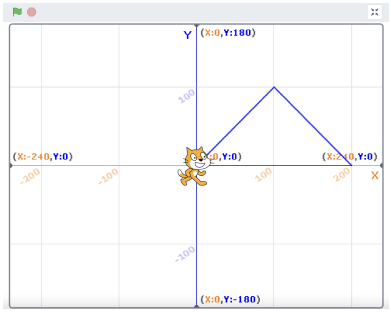
- *Go Math!* grid: (2,5) (2,11) (4,9) (4,7) (2,5)
  - Think: *What shape did you visualize based on the ordered pairs?*
  - Pair and Share: *Explain your reasoning.*
  - (Possible responses: It is a trapezoid because two sets of points fall vertically along the 2 and two sets fall vertically along the 4, so those lines are parallel, but the other lines would not be parallel. I can visualize a trapezoid when I connect the points.)



- Scratch grid (240x180): (0,0) (100,100) (200,0) (0,0)
    - Think: *What shape did you visualize based on the ordered pairs?*
    - Pair and Share: *Explain your reasoning.*

  (Possible responses: There are three vertices and three sides so I know it is a triangle.)
    - Scratch: *In order to tell the Scratch cat to draw a triangle, what ordered pairs would the cat need to glide to?*

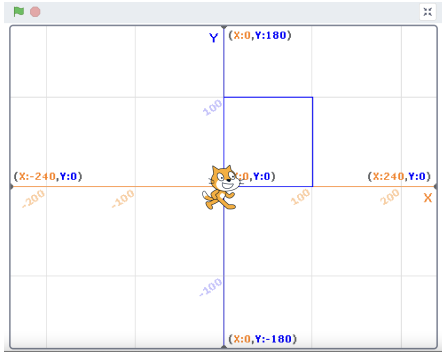
  (Possible responses: The cat must glide from the origin (0,0) to 100,100 to 200,0 and back to the origin at 0,0.)



- Scratch grid (240x180): (0,0) (0,100) (100,100) (100,0) (0,0)
    - Think: *What shape did you visualize based on the ordered pairs?*
    - Pair and Share: *Explain your reasoning.*

  (Possible responses: It's a quadrilateral because there are 4 points. It is a square because the distance between the points is 100 so every side is congruent.)
    - Scratch: *In order to tell the Scratch cat to draw a square, what ordered pairs would the cat need to glide to?*

  (Possible responses: The cat must glide from the origin (0,0) to 0,100 to 100,100 to 100,0 and back to the origin at 0,0.)



Discuss: *What did you learn by discussing your visualizing with each other about plotting ordered pairs on a grid to make shapes? How would you instruct the Scratch cat to draw those shapes?*

Teacher statement after discussion if before computer lab:

Say: *"You were able to visualize a shape using the ordered pairs as vertices of a shape. You will use what you know about ordered pairs and the attributes of shapes to create a shapes quiz in the computer lab using Scratch programming."*

#3 Math Lesson: Conditionals and Regular/Non-Regular Polygons
Go Math! Lesson: This mini-lesson could fit with any Chapter 11 lesson, but especially 11.1. See page 638 in *Go Math*.

Use a Think-Pair-Share format for each equation: Think - silent individual think time; Pair - share their solution and why they think it is that solution with their partner; and Share - share solutions and mathematical thinking as a whole class.

The goal for this mini-lesson is to help students identify and classify polygons, and understand the similarities and differences between regular and non-regular polygons.

I'm going to show a slide that shows a Venn diagram with several different shapes and ask you these questions:

- *What do the polygons in the left circle have in common with each other?*
- *What do the polygons in the right circle have in common with each other?*
- *What do the polygons in the center section have in common with both groups?*

First, I'll give you individual think time. When you have an idea for each, give me a silent thumbs up. Then, I'll have you share your solution and reasoning with a partner. Finally, we'll share our thinking with each other as a whole class. Ready?

(Show slide and conduct a Think-Pair-Share. This could be split into three separate Think-Pair-Shares, one for each question.)

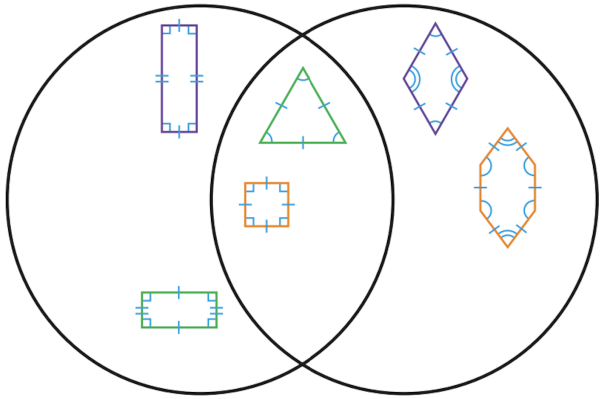


Image is from Go Math! page 638

(Possible responses: The left circle is rectangles. The left circle is quadrilaterals. The shapes in the left circle have congruent angles, but not all of the sides are congruent. The shapes in the right circle have congruent sides, but not all of the angles are congruent. The shapes in the middle have congruent sides and angles.)

Take a closer look at the green triangle and the orange square in the center of the Venn diagram. These are regular polygons. I'm going to show you some statements that will help you learn more about regular polygons and connect it with something called conditionals, which you will use in the computer lab. Conditional statements use the words "if" and "then." You'll make a game in the computer lab and will need to use conditional statements.

Show each statement on slides and conduct a think-pair-share for each statement. Remember, the "else" statement is a word that will be used with Scratch programming in the computer lab.

1. *If a triangle is regular, then it has three ____ sides, else it is not regular.* ***(congruent, equal, or same)***
2. *If a quadrilateral is regular, then it has four ____ angles, else it is _____.* ***(congruent, equal or same; not regular)***
3. *_____ a pentagon has congruent angles, _____ it is a regular pentagon, _____ it is not regular.* ***(If; then; else)***

Teacher statement after discussion: *You will see very similar statements (if, then, else) in the computer lab this week. In computer programming, these are called conditional statements, but as we've seen in class today, conditionals can also be used to classify shapes.*

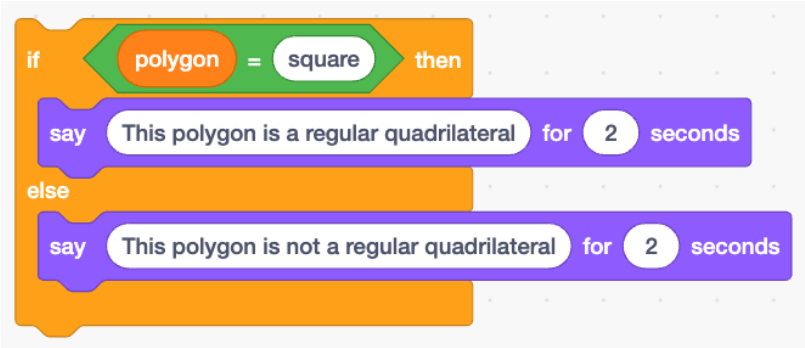
#4 Math Lesson: Conditionals and Quadrilaterals
This activity is based on problem solving question #8 *In Go Math!* Lesson 11.3. The goal for this is to help students identify and classify quadrilaterals and regular polygons using conditionals. Conditional statements will be used in the computer lab.

*In the computer lab you learned about conditional statements. Conditional statements use the words "if" and "then." For example, "**if** a polygon has 4 sides, **then** it is a quadrilateral." In Scratch programming, the program also needs an "else" statement. For example, "**if** a polygon has 4 sides, **then** it is a quadrilateral, **else** it is not a quadrilateral." We are going to use conditional statements to practice classifying quadrilaterals. I am going to show you some incomplete Scratch code and you will work in small groups to assemble it.*

Show incomplete Scratch codes, one at a time, and let students talk in pairs to fill in the blanks. Students could also complete this activity as a whole class on whiteboards or as a think-pair-share.

1. If the polygon is a square, then ____, else _____.

(If the polygon is a square, then the polygon is a regular quadrilateral, else the polygon is not a regular quadrilateral)



2. If the polygon has two pairs of congruent opposite sides, then ____, else _____.
   (If the polygon has two pairs of congruent opposite sides, then the polygon is a parallelogram, else the polygon is not a parallelogram)

3. If the polygon has four congruent sides, then ____, else _____.
   (If the polygon has four congruent sides, then the polygon is a rhombus, else the polygon is not a rhombus)

4. If the polygon has exactly one pair of parallel sides, then ____, else _____.
   (If the polygon has exactly one pair of parallel sides, then the polygon is a trapezoid, else the polygon is not a trapezoid)

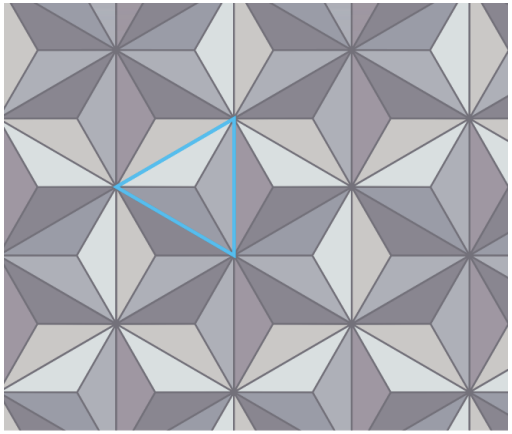
Discuss: *What did you learn about shapes while working on these Scratch codes?*

Teacher statement after discussion: *"Today you discussed quadrilaterals using Scratch codes. Conditionals in coding helped us make comparisons among the different quadrilaterals and how these quadrilaterals relate to each other. You will use it to make the code for the quiz questions."*

#5 Math Lesson: Interior/Exterior Angles of Acute, Obtuse, and Right Triangles
Go Math! Lesson: This mini-lesson could fit with any Chapter 1 lesson, but especially 11.2

This activity is adapted from Unlock the Problem on page 643 of *Go Math!* The goal of this lesson is to help students classify triangles by side length and angle measure. Their knowledge of angle measure will be extended to the difference between interior and exterior angles, which will help students understand that Scratch uses exterior angles when a rotation (turn) is programmed.

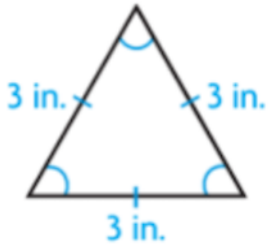
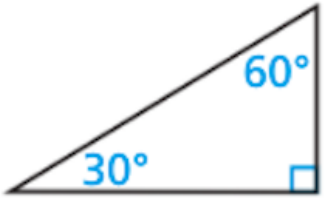
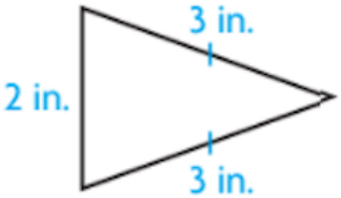
If you look closely at Epcot Center's Spaceship Earth building in Orlando, Florida, you may see a pattern of triangles. The triangle outlined in the pattern at the right has 3 congruent sides and 3 acute angles. What type of triangle is outlined? ***(Equilateral Triangle)***
What other types of triangles do you see in these pictures? ***(Isosceles and Scalene)***

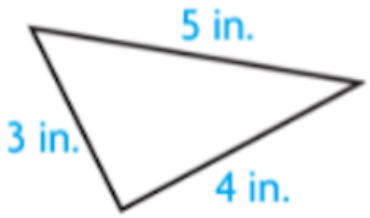


Triangles can be classified by both their side lengths and their angle measures. For example, the equilateral triangle on Epcot's Spaceship Earth has 3 congruent sides and 3 congruent 60° angles.
Triangles classified by their side lengths are called equilateral, isosceles, and scalene triangles.
Triangles classified by their angle measures are called right, acute, and obtuse triangles.

Use a Think-Pair-Share format for each slide: Think - silent individual think time; Pair - share their solution and why they think it is that solution with their partner; and Share - share solutions and mathematical thinking as a whole class.

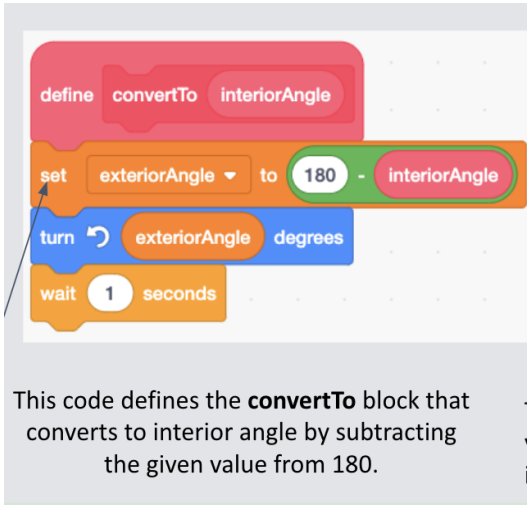
I'm going to show you some triangles and I want you to classify them as equilateral, isosceles, or scalene. First, I'll give you individual think time. When you have an idea for each, give me a silent thumbs up. Then, I'll have you share your solution and reasoning with a partner. Finally, we'll share our thinking with each other as a whole class. Ready?

Classify triangles by their side length	Classify triangles by their angle measures
 ***Equilateral (3 congruent sides and 3 congruent angles)***	 ***Right (one 90° angle)***
 ***Isosceles (2 congruent sides)***	 ***Acute (3 acute angles)***

 ***Scalene (0 congruent sides)***	 ***Obtuse (one obtuse angle)***

Let's look a little more closely at the angle measures in each triangle.
(Show triangles with angle measures on slides and point out each angle.)
These are called interior angles. Triangles and other shapes also have something called exterior angles.
Introduce exterior angles on slides. Have students guess what the exterior angle will be. Guide them to see that the measure of a line is 180 degrees.

Think back to Scratch programming you've been doing in the computer lab. Do you remember seeing this code? Take a look at it for a few minutes and think about what this code might do. What does the code say?



This code defines the **convertTo** block that converts to interior angle by subtracting the given value from 180.

Math uses the interior angle to measure the angle in a triangle. But in Scratch, sprites are rotated by exterior angles. To make Scratch work more like math, we use a variable to calculate the angle for Scratch. We subtract the amount in "degrees" of the interior angle from 180 and set that as our angle value for Scratch.
*The number used with the My Block is the interior angle we are used to using in math. What does the 180 - interiorAngle mean? What is that code saying? (*That is 180 – interior degrees = exterior angle degrees which tells Scratch how to rotate*)*

Discuss: *What did you learn about the math behind My Blocks when making shapes in Scratch?*

Teacher statement after discussion:
Say: *"You learned to define Triangle using My Blocks in the computer lab. Today you learned more about the math behind doing this in Scratch. To understand it, you need to know more than acute, obtuse, and right angles. You need to be more precise in Scratch. For example, you learned that you can't just give instructions to make a 60-degree angle for your equilateral triangles. You must program the angle by doing 180-120 to make 60. Now, you know the math behind these codes!"*

#6 Do the Scratch Quiz!

In this mini-lesson, you will need to access the students' Shape Quizzes from the Computer Lab Specialist. The CLS can provide you with guidance for which students' work to use (students who did not get to give their quiz to other students, a quiz that was challenging, a quiz for everyone's success, or other reasons). You can project the Scratch project on the screen and use the Think-Pair-Share format to take students' Scratch Quizzes as a whole class.