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Math 5270

Class Final - Lesson Plan

Grade Level: 7th grade

Utah Core Standards:

- 7.G.1 – Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- 7.RP.2 – Recognize and represent proportional relationships between quantities.
  - 7.RP.2a – Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
- MPS.5 – Use appropriate tools strategically.
- MPS.6 – Attend to precision.

Note about standards:
7th grade students will not develop a formal definition of similarity until Secondary II (G.SRT.1-3). In 8th grade, they will informally look at the effects of dilations and other transformations of two-dimensional figures using coordinates (8.G.2-4). Rather than using the term "similar", for this 7th grade lesson the concept will be referred to as "being the same shape".

Duration: at least 2 Class Periods

Materials: Document Camera, Traditional Pattern Blocks (triangle, square, 2 sizes of rhombuses, trapezoid, and hexagon), Fraction Pattern Blocks (half a triangle, half a trapezoid), centimeter graph paper, centimeter rulers, protractors, basic calculators (for Co-taught students), large chart paper, markers, sticky notes

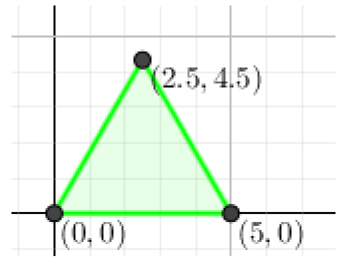
Student Objectives: I can determine what conditions are necessary to grow patterns that look the same as the original shape. I can recognize patterns with side lengths, angles, perimeters, and areas of polygons.

Prior to this lesson, students will have been exposed to Patterns Blocks by tracing the blocks, identifying the shapes, measuring the side lengths in centimeters and the angles in degrees, and calculating approximate perimeter and area for each shape.

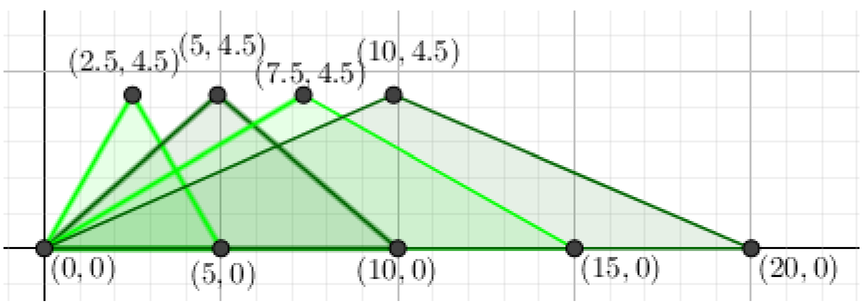
<u>Day 1</u>
Desks should be arranged into either pairs or groups of 4 for easy collaboration throughout the lesson. Students should come into class, pick up prepared materials, and prepare to start when the bell rings. Students will need a one of each of the 8 pattern blocks, protractors, and centimeter rulers.

When class begins, remind students of how we have worked with pattern blocks before by tracing them, finding the measurements of the blocks' sides and angles, and calculating the blocks' perimeters and areas. Today we are going to look for patterns when we make the blocks "grow".

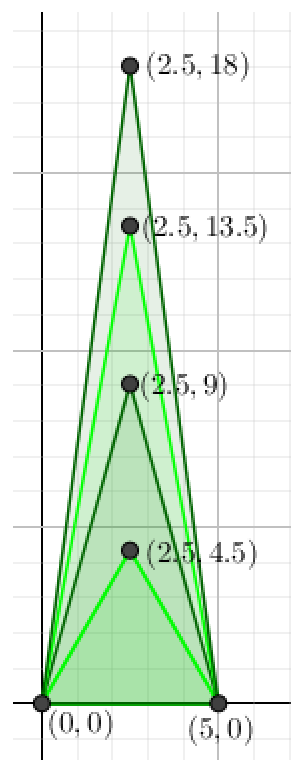
Pass out the **Pattern Block Growth Patterns Activity** worksheet and have students trace the green equilateral triangle in the corner of the coordinate graph (on page 1 of the worksheet) so one vertex is at the origin and one side length is on the *x*-axis. Because 7th graders have not used trigonometry yet, we'll approximate the third vertex. Students should round their approximations to the nearest ½ centimeter. Demonstrate how to do this under the document camera before moving on.

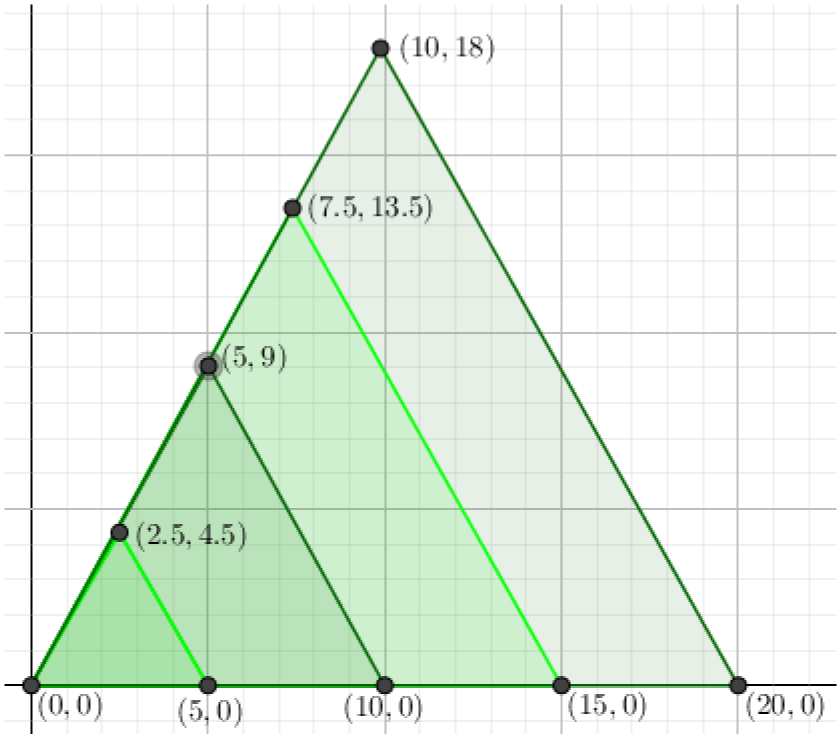


What would happen to the shape if we multiplied the *x*-coordinates of our triangle by 2? Show that the origin point stays the same, (5, 0) goes to (10, 0), and (2.5, 4.5) goes to (5, 4.5). Draw the new vertices, connect the vertices. Check that students have drawn the correct triangle (especially with a co-taught class). Ask the question "What do you see?" without giving an answer. The intent here is for students to see that a horizontal stretch has occurred. Students have not been exposed to transformation vocabulary, so they may use words like "pull", "stretched", or "moved" to describe what happened. Repeat the process by drawing two additional triangles, this time by multiplying each *x*-coordinate by 3 and then 4. Ask for students to help with calculating the coordinates of each vertex. Give 1-2 minutes for students to write down what they see has "stayed the same" in the pictures and what has changed. For 1 minute, have students share within their group of 4 what they wrote. Then ask for 3-4 groups to share with the class what their groups saw. Help the class answer any remaining questions on the first page of the worksheet.



Hopefully, a student will ask, or bring it up yourself, why we are only multiplying the *x*- coordinates. What would happen if we multiplied just the *y*-coordinates? Ask for some predictions and record them on the board. Have students turn to the second page of the worksheet and work with their groups to determine what happens when they multiply the *y*-coordinates by 2, 3, and then 4. Be sure to walk around the classroom to check on multiplication and ask/answer questions. Students should work on the questions at the bottom of page 2 when they have completed the drawing. Give students 5-10 minutes to complete the task before coming back together as a class to check their understanding. The intent here is for students to see that a vertical stretch has occurred.

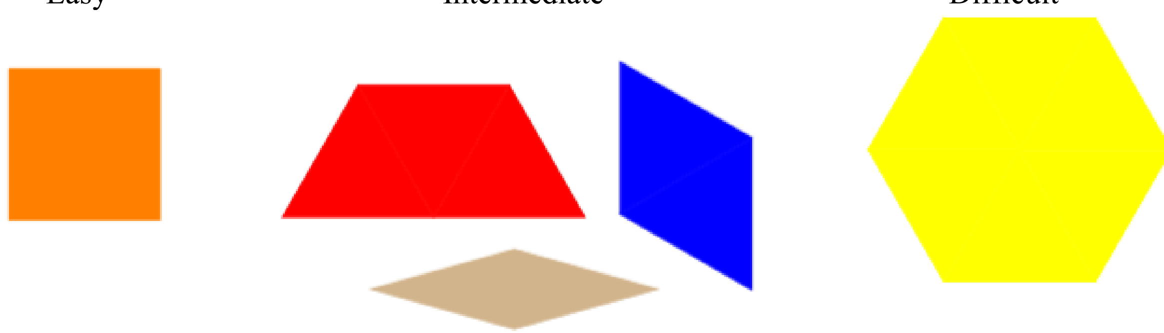




When students are ready to move on, ask why students think we didn't get equilateral triangles. Hopefully, someone will suggest that we should try multiplying both the *x*- and *y*-coordinates. Give students 5-10 minutes to complete the task before coming back together as a class to check their understanding. This time students should see that each time a dilation occurred. They should comment on the angles being the same. Some students may notice that coordinates line up to create a proportional relationship. Maybe they will use their protractor to measure the angles and see that they are all the same. Other students may notice the parallel lines formed by the similar triangles (although, this is not part of the 7th Grade Core.)

If time permits, have students complete the activity with a different pattern block. Students should pick something that is appropriate for their level of understanding.

Easy Intermediate Difficult



For homework, students should pick another pattern block and repeat the same process. At the end of the homework assignment students should fill in the blanks for the following statement:

In order to maintain the same shape (but not necessarily the same size), we must <u>multiply both the x-axis and y-axis by the same number</u> because it keeps the <u>angles</u> and the <u>ratio of the side lengths</u> the same.

For Honors students, allow for independent practice with the "Extra for Experts" activity for homework. Students will explore what happens if one vertex and one side of the polygon is NOT fixed to the origin and *x*-axis, respectively. They also have the choice to explore what happens if they multiply by a fraction (horizontal and/or vertical shrink), multiply by a negative number (reflection), add instead of multiply (horizontal and/or vertical translation), or another idea that they choose themselves.

Day 2

Desks should be arranged into either pairs or groups of 4 for easy collaboration throughout the lesson. Students should come into class, pull their homework out from the previous night, and prepare to start when the bell rings.

When class begins, post the summarizing statement from the homework the included the blanks.

In order to maintain the same shape (but not necessarily the same size), we must multiply both the x-axis and y-axis by the same number because it keeps the angles and the ratio of the side lengths the same.

Ask for suggestions for how to fill in the missing answers. Write (or have a student scribe) on the whiteboard the suggestions for all to see. Point out patterns in student answers. If students are not arriving at the correct conclusion, another drawing example may need to be completed as a class. If, however, everyone seems to understand, then it's time to move on.

Divide the class up into 8 different groups. Each group should be assigned one of the eight pattern blocks including the fraction pattern blocks. (Consider dividing these groups up by ability—giving easier pattern blocks like the triangle and square to the students who struggle and harder blocks like the fractions blocks and the hexagon to the more advanced groups.) The task is for students to compare the perimeters of their drawings from yesterday. Each group should be giving a large piece of chart paper and a couple of markers. Each group should create a poster that summarizes their findings about the perimeters of the polygon stretches and dilations. The goal is to for students to see that only the perimeters of the dilations are proportional (at the same rate as the side lengths!) Students should have 20-30 minutes to create the posters. Honors students, and those ready for a challenge or completed early, should also look at the relationship between the areas of stretches and the areas of dilations compared to the original pattern block. The goal is for these students to see that the each area of the dilations is multiplied by the square of the growth factor.

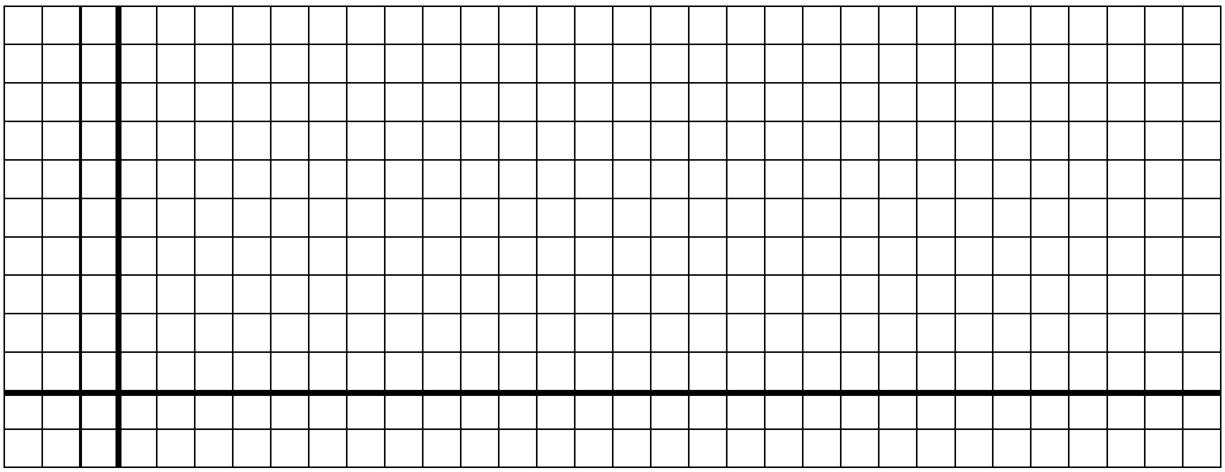
Once groups are finished creating their posters, display them around the classroom. When the time is completed, allow students to perform a "gallery walk" to view others' posters. They should be looking for similarities between their poster and the work from the other groups. Allow the class about 5 minutes for the gallery walk. Once students have finished, or the time is up, allow students to journal in their notes about what similarities they saw. Then have them share their similarities with their group. Finally, choose students to share with the class about their observations. Summarize the class findings on the board.

Before class ends, have students write on a sticky note about where—outside of math class—they might find someone needing to use polygons that are the same shape but not necessarily the same size. (Bring these ideas up again when discussing scale factor and blue prints later.) Students should hand in their sticky note as they exit the door.

Name: ________________________________
Period: ___________

Pattern Block Growth Patterns
Activity

Activity One:
Trace a green triangle on the coordinate plane below. One vertex should be at the origin, and one side should be on the *x*-axis. Label the coordinates of each vertex. (Approximate to the nearest ½ unit, if necessary.)



Multiply the *x*-coordinate of each vertex of the original triangle by 2. Draw the new triangle on the same coordinate plane above. Repeat with multiplying the *x*-coordinate of each vertex of the original triangle by 3 and then 4. Draw each of the new triangles on the same coordinate plane above.

What type of triangle did we begin with on each graph? (Classify by side length and angles.)

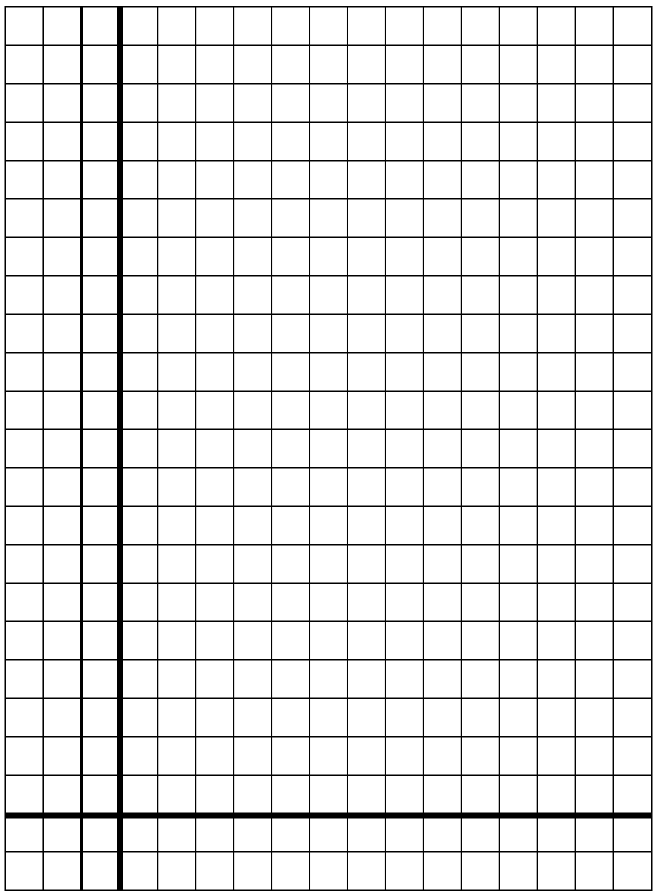
What stayed the same in each of the triangles?

What changed in each triangle?

After we changed the *x*-coordinates by multiplying by 4, what type of triangle did we end up with? (Classify by side length and angles.)

Do we have the same shape that we started with? Why or why not.

Trace the same equilateral triangle in the corner of the coordinate graph. This time multiply the y-coordinate of each vertex of the original triangle by 2, 3, and then 4. Draw each of the new triangles on the same coordinate plane below.



What type of triangle did we begin with on each graph? (Classify by side length and angles.)

What stayed the same in each of the triangles?

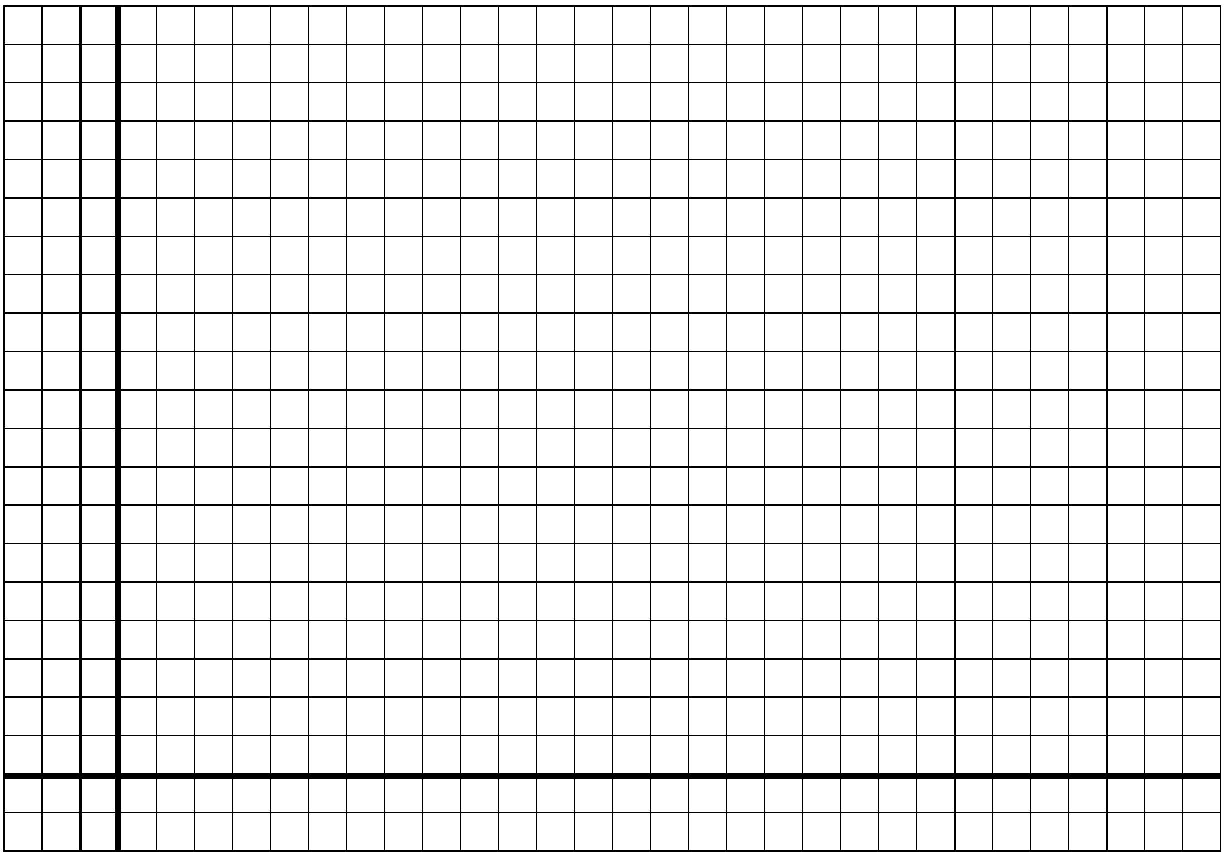
What changed in each triangle?

After we changed the y-coordinates by multiplying by 4, what type of triangle did we end up with? (Classify by side length and angles.)

Why don't we have the same shape that we started with?

Predict what you would need to do in order to keep the same shape of triangle.

Trace the same equilateral triangle in the corner of the coordinate graph. This time multiply both the x-coordinate and the y-coordinate of each vertex of the original triangle by 2, 3, and then 4. Draw each of the new triangles on the same coordinate plane below.



What stayed the same in each of the triangles?

What changed in each triangle?

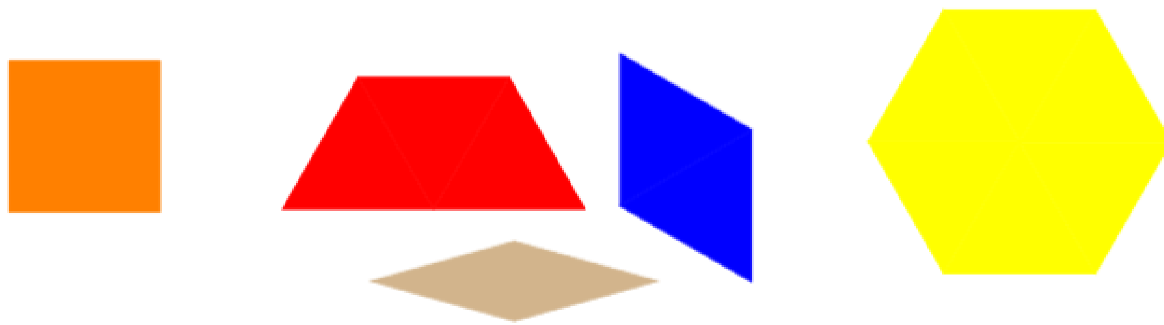
After we changed both the x-coordinates and y-coordinates by multiplying by 4, what type of triangle did we end up with? (Classify by side length and angles.)

Do we have the same shape that we started with? Why or why not.

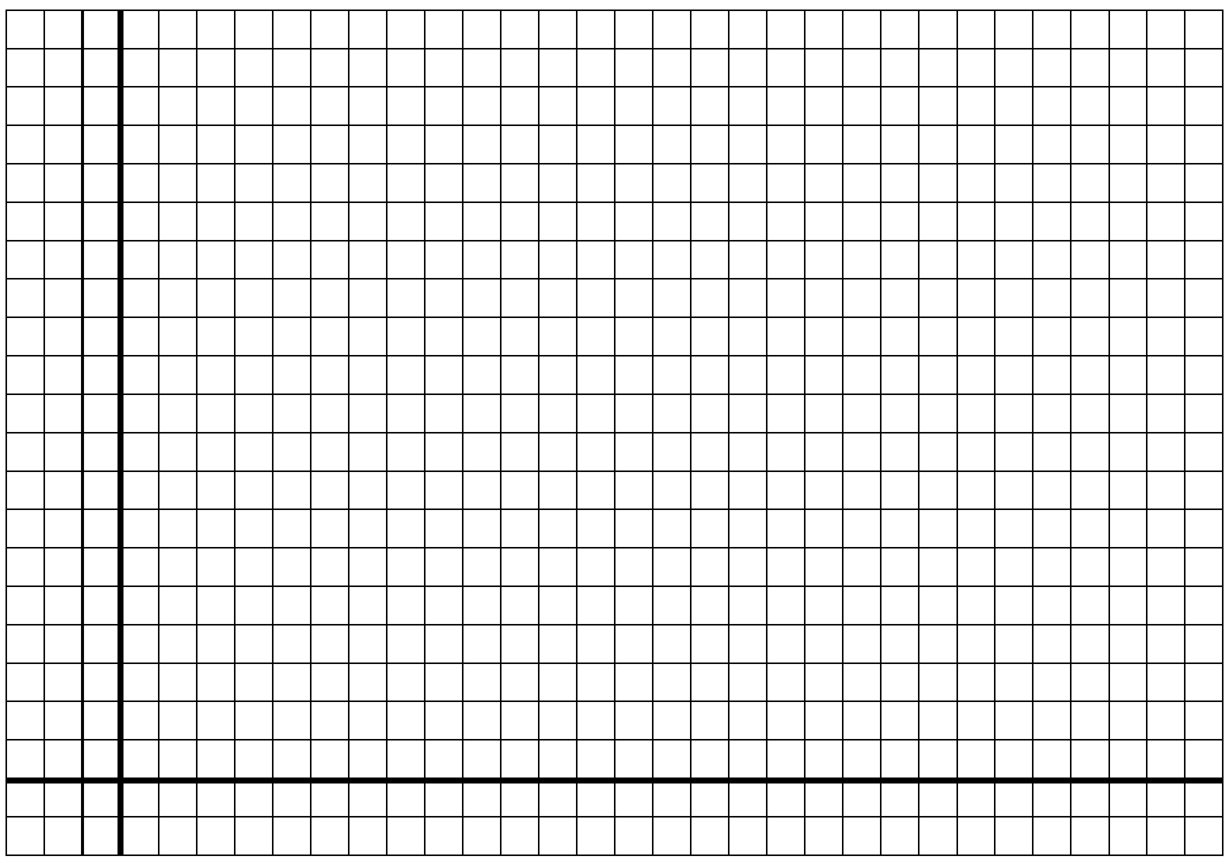
Activity Two:

Repeat the steps from Activity One with a different shape. Choose one of the pattern blocks from below.

Basic | Intermediate | Advanced



Trace your pattern block on the coordinate plane below. One vertex should be at the origin, and one side should be on the *x*-axis. Label the coordinates of each vertex. (Approximate to the nearest ½ unit, if necessary.)



Multiply the *x*-coordinate of each vertex of the original pattern block by 2, 3, and then 4. Draw the new shapes on the same coordinate plane above.

Repeat by multiplying the *y*-coordinate of each vertex of the original by 2, 3, and then 4. Draw each of the new shapes on the same coordinate plane above.

What type of pattern block did you begin with for activity two?

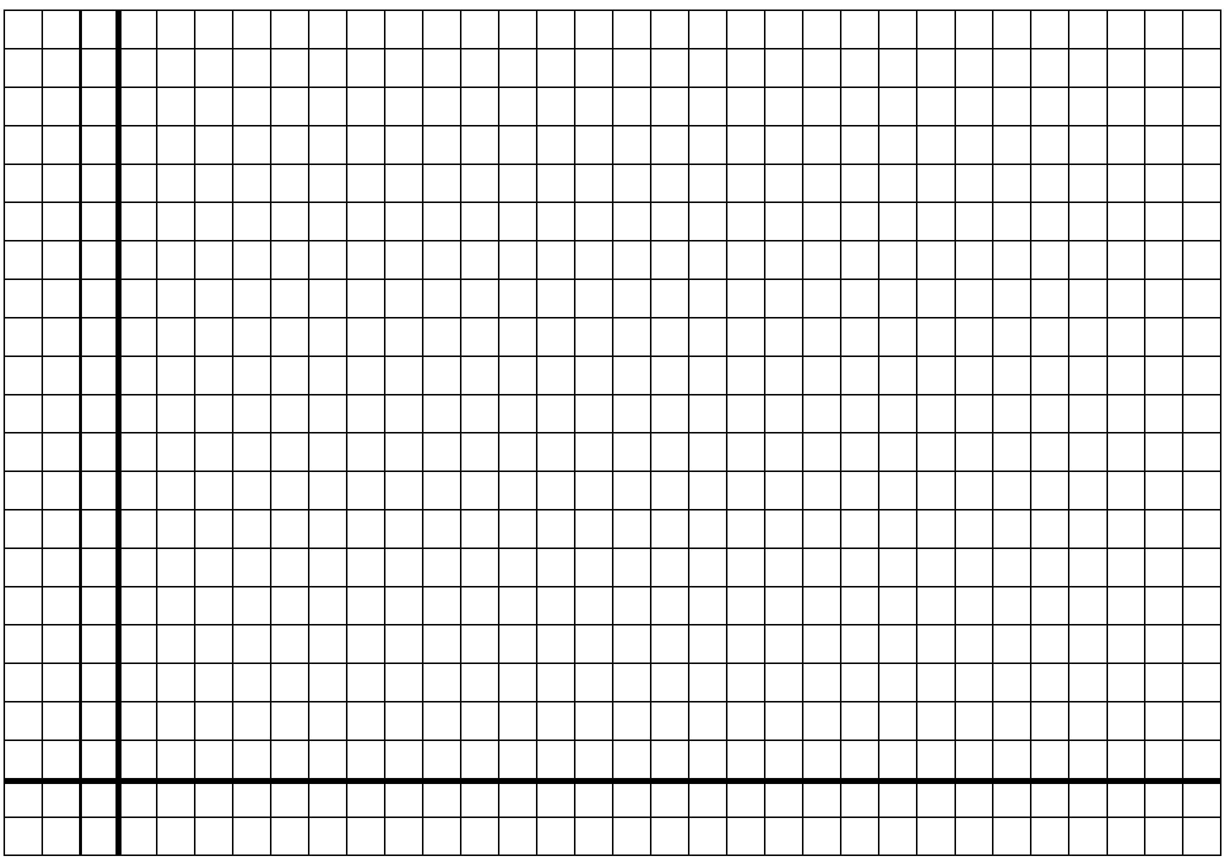
What stayed the same with each drawing?

What changed in each drawing?

After you changed the x-coordinates by multiplying by 4, what type of shape did you end up with? What about after you changed the y-coordinates by multiplying by 4?

Do you have the same shape that we started with? Why or why not.

Trace the same pattern block in the corner of the coordinate graph. This time multiply both the x-coordinate and the y-coordinate of each vertex of the original pattern block by 2, 3, and then 4. Draw each of the new shapes on the same coordinate plane below.



Do we have the same shape that we started with? How do you know?

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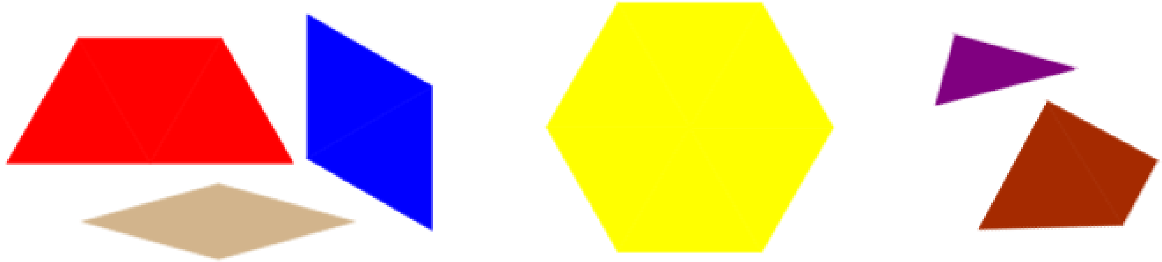
Pattern Block Growth Patterns

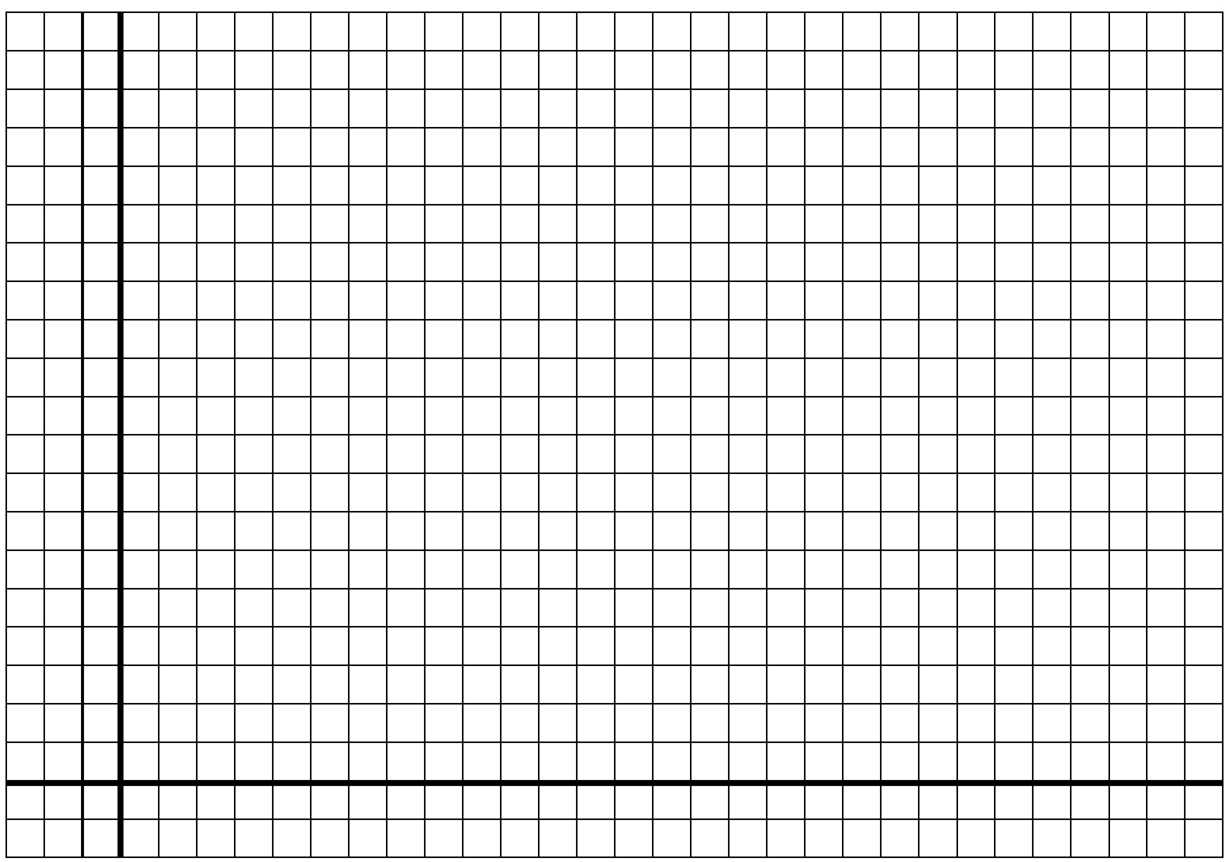
Homework

Repeat the steps today's activity with a different shape. Choose one of the pattern blocks from below that is harder than what you did in class.

Intermediate Advanced Challenging!



Trace your pattern block on the coordinate plane below. One vertex should be at the origin, and one side should be on the *x*-axis. Label the coordinates of each vertex. (Approximate to the nearest ½ unit, if necessary.)



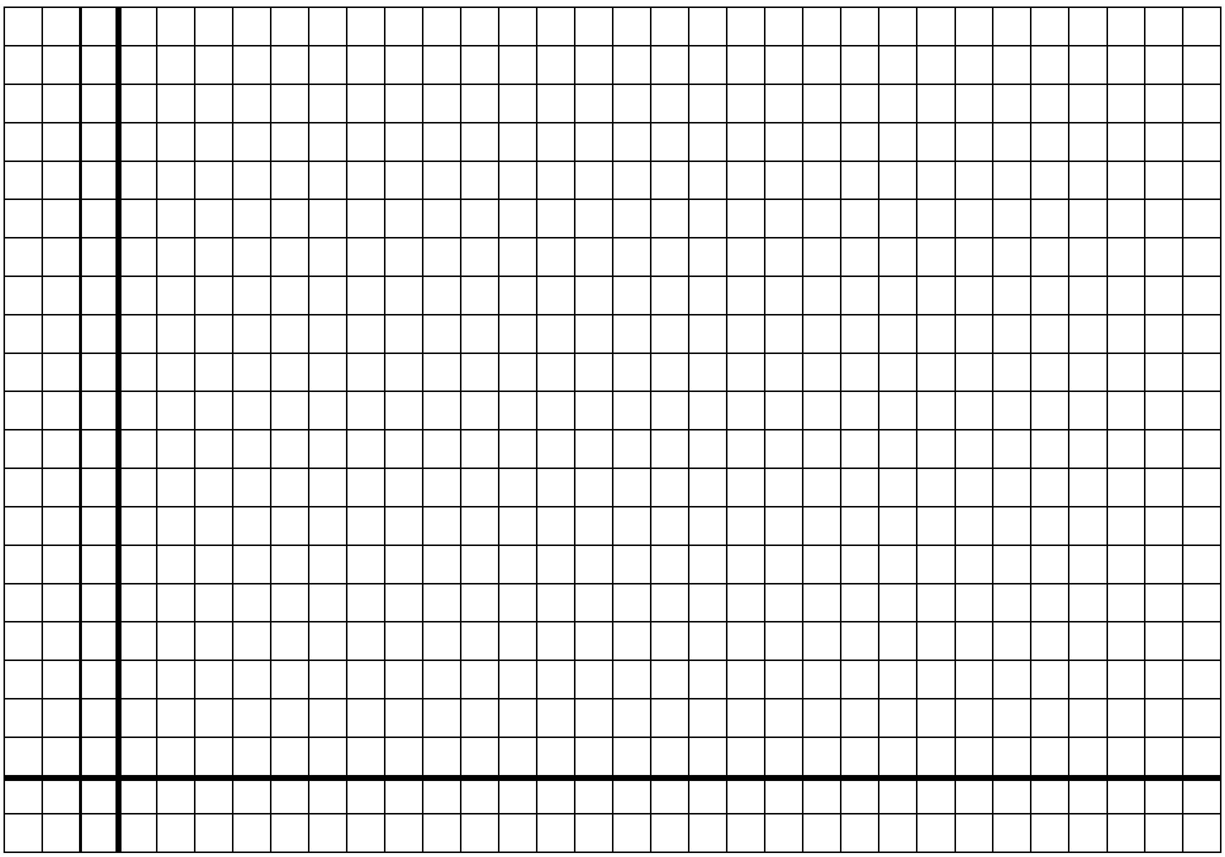
Multiply the *x*-coordinate of each vertex of the original pattern block by 2, 3, and then 4. Draw the new shapes on the same coordinate plane above.

Repeat by multiplying the *y*-coordinate of each vertex of the original by 2, 3, and then 4. Draw each of the new shapes on the same coordinate plane from the previous page.

What type of pattern block did you begin with for the homework?

Do you have the same shape that we started with? Why or why not.

Trace the same pattern block in the corner of the coordinate graph. This time multiply both the *x*-coordinate and the *y*-coordinate of each vertex of the original pattern block by 2, 3, and then 4. Draw each of the new shapes on the same coordinate plane below.



Complete the following sentence based off what you learned with today's activity and your homework.

In order to maintain the same shape
(but not necessarily the same size), we must

____

because it keeps the ____________________ and the
________________________ the same.

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Pattern Block Growth Patterns

Extra for Experts

In our pattern growth activity, we have always had one vertex of our pattern block on the origin and one side on the x-axis. But what would happen if we placed the pattern block ANYWHERE on the coordinate plane? Pick a pattern block, trace it, and multiply the coordinates by 2, 3, and/or 4 to see what happens.

What happened to the polygon and its growth when you didn't have a vertex and a side stuck in place?

There are other types of “growth” patterns that we haven’t looked at yet. What would happen if you multiplied by a fraction? Or a negative number? What about adding instead of multiplying? What else would cause a pattern to change? Pick a pattern block, trace it, and draw a couple of copies of your pattern block to see what happens with your idea.

What change did you try?

What happened to the polygon and its growth with your change?