

Size Transformation Investigation

Course: Geometry

Goals: To enable students to:

- Determine the effects of a size transformation on lengths and areas of a shape

Prerequisite Skills:

- Knowledge of rigid transformations (and associated vocabulary),
- Length and area calculations

Materials Required:

Each student will need:

- One investigation packet
- Ruler
- Calculator

An Approach:

- Briefly review knowledge of rigid transformations as a whole class
- Have the students work through the investigation at their own pace in pairs or small groups (with each student completing their work in their own packet) while you circulate through the room answering questions and clarifying any issues
- Summarize as a class as necessary throughout the class period(s)
- Summarize as a class at the end of the investigation

Alternate/Further Ideas:

- This can be extended to investigate the effect of size transformations on volumes

Investigating Size Transformations¹

By the end of this short investigation you should be able to:

1. Use coordinates to create a size transformation of a given magnitude centered at the origin.
 2. State the effect of a size transformation of a given magnitude on the length and area of the pre-image.
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Quick review:

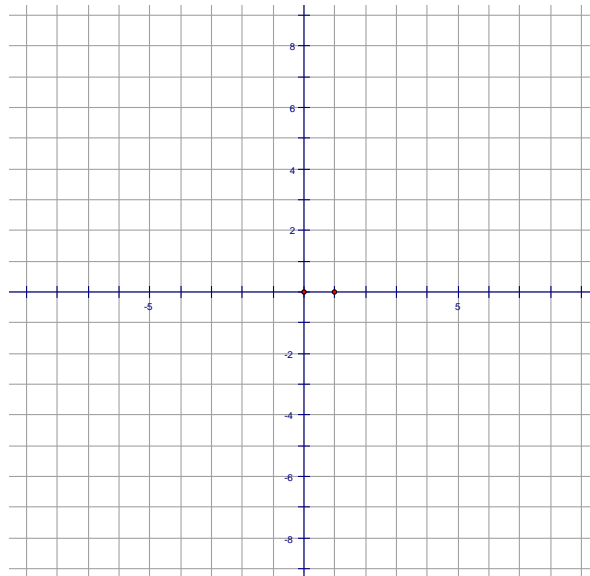
- We recently studied *rigid transformations*.
 - The 3 types of rigid transformations are _____, _____ and _____.
 - They are called *rigid* because _____.

Now we're going to change the size of our pre-image – but we're going to preserve the shape.

1. A **size transformation** (or **dilation**) of magnitude 3 centered at the origin is defined by the following rule:

$$(x, y) \rightarrow (3x, 3y)$$

- a. Draw Rectangle ABCD given the following vertex coordinates: A(1, 2), B(3, 1), C(1, -3), D(-1, -2).
- b. Using the rule above, calculate and then graph the image coordinates: A' (), B' (), C' (), D' ().



- c. How do you think the lengths of the sides of ABCD changed (by what *factor*)?

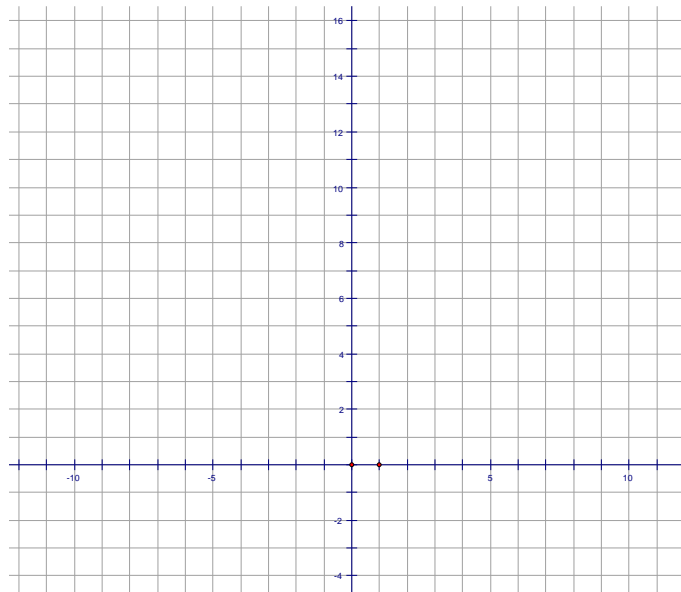
¹ Taken from *Core-Plus Mathematics, Contemporary Mathematics in Context: Course 2*, 2nd edition (McGraw Hill, New York, New York), 2008, pp 206 - 210

- d. How do you think the area of ABCD changed (by what *factor*)?
- e. Calculate the length of AB and BC.
- f. Calculate the length of A'B' and B'C'.
- g. Did the lengths change the way you expected?
- h. Calculate the area of ABCD.
- i. Calculate the area of A'B'C'D'.
- j. How did the area change (by what *factor*)?

2. A **size transformation** of magnitude 4 centered at the origin is defined by the rule:

$$(x, y) \rightarrow (4x, 4y)$$

- a. Draw triangle PQR given the following vertex coordinates: P(3, 4), Q(-3, 2), R(-2, -1)
- b. Using the above rule, calculate and then graph the image coordinates if PQR undergoes a size transformation of magnitude 4: P' (), Q' (), R' ().



- c. Calculate the lengths of sides PQ and QR.

 - d. Calculate the lengths of sides P'Q' and Q'R'. What do you notice?

 - e. Calculate the area of PQR.

 - f. Calculate the area of P'Q'R'. What do you notice about the areas?
3. Suppose a quadrilateral undergoes a size transformation of magnitude 6.
- a. Write the rule that would give you the image coordinates from the pre-image coordinates.

 - b. How would the lengths of the sides of the image compare to the pre-image side lengths?

 - c. How would the two areas compare?
4. Suppose a shape undergoes a size transformation of magnitude 0.5.
- a. Write the rule that would give you the image coordinates from the pre-image coordinates.

 - b. How would the lengths of the sides of the image compare to the pre-image side lengths?

 - c. How would the two areas compare?

5. A size transformation with magnitude 3.5 is applied to a right triangle with legs of length 4 and 5 units.
- Write the rule that would give you the image coordinates from the pre-image coordinates.
 - What are the lengths of the three sides of the image triangle?
 - What is the area of the pre-image?
 - What is the area of the image? How do you know?
6. A shape has an area of 10 cm^2 . What is the area of the image if the shape undergoes
- A size transformation of magnitude 8? (show work)
 - A size transformation of magnitude 1.5?
 - A size transformation of magnitude $\frac{1}{4}$?
 - A reflection across the x-axis?
7. How do you think the volume of a shape would change if it underwent a size transformation of magnitude 3? Explain your reasoning.