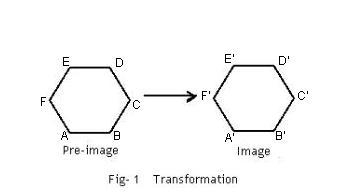
Lesson 9.2: Translations

**Transformation:**  An operation that moves or changes a geometric figure to produce a new figure, called the **image**.

* The original figure is called the **pre-image**.

**Types of Transformations:**

1. Translations (9.2)
2. Reflections (9.1)
3. Rotations (9.3)
4. Dilations (later)

**Translation:** Shifting a figure left/right and up/down

**Ex1)** Triangle ABC has A(0,0), B(0, 4), and C(5, 0). Translate the figure 2 units to the right and 1 unit down. Draw the figure and image and give a general rule for each point on the figure.

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If the image is **congruent** to the preimage, the transformation is an \_\_\_\_\_\_\_\_\_\_\_\_. The transformation preserves distance, angle measure, betweenness of points, and collinnearity.

Ex2) Quadilateral HJLK has H(1, 0), J(0, 4), L( 3, 1), K(2, 5)

If HJLK is translated (x, y) 🡪 (x +3, y – 5), What are the coordinates of point K’? What are the coordinates of point J’?

Ex3) State the rule for the given translations:

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|  |  |  |  | A |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | B’ |  |  |  | C’ |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | C |  |  |
|  | B |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

A’

**a.**

H

S

I

F

T

S’

H’

I’

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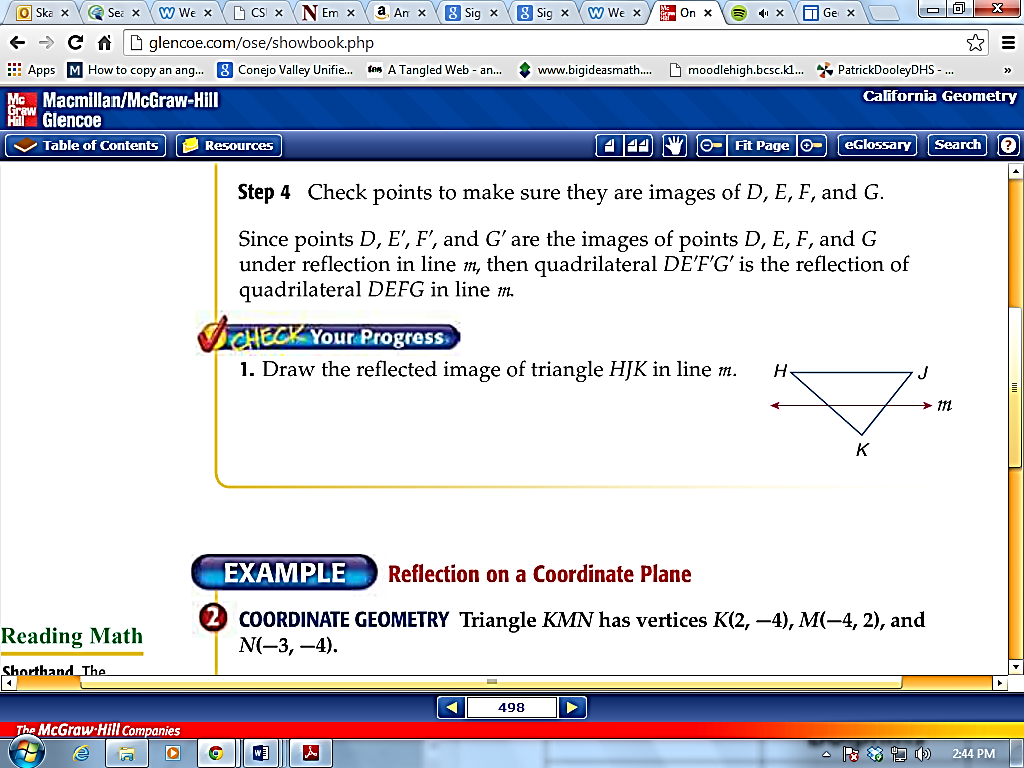
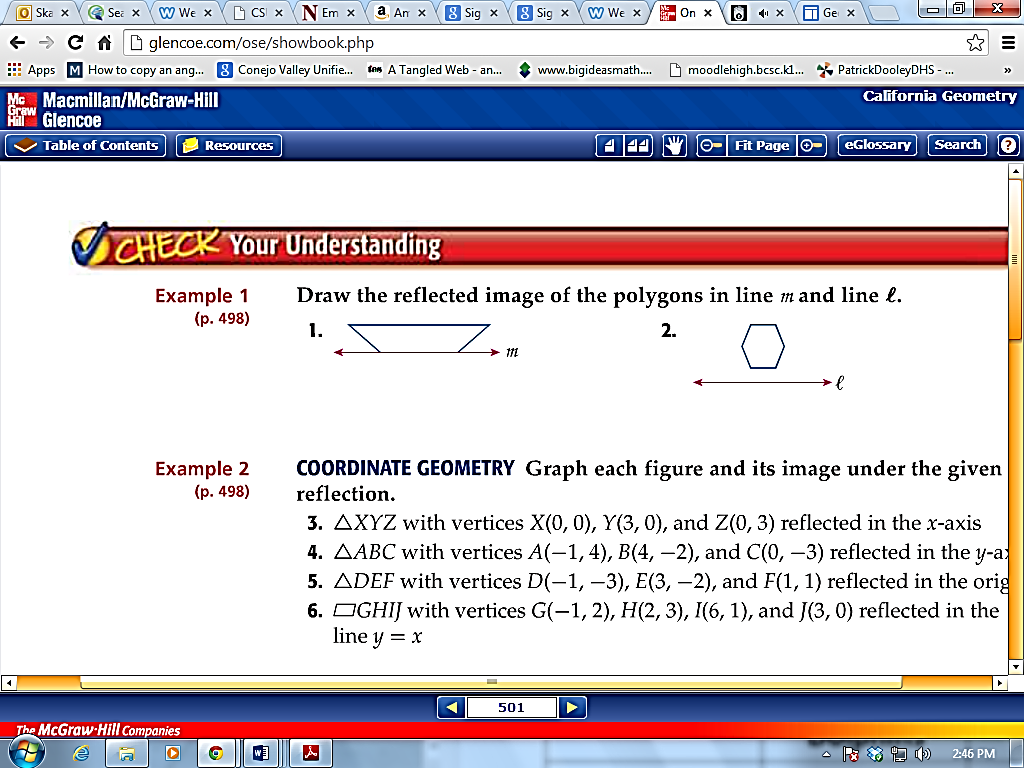
T’

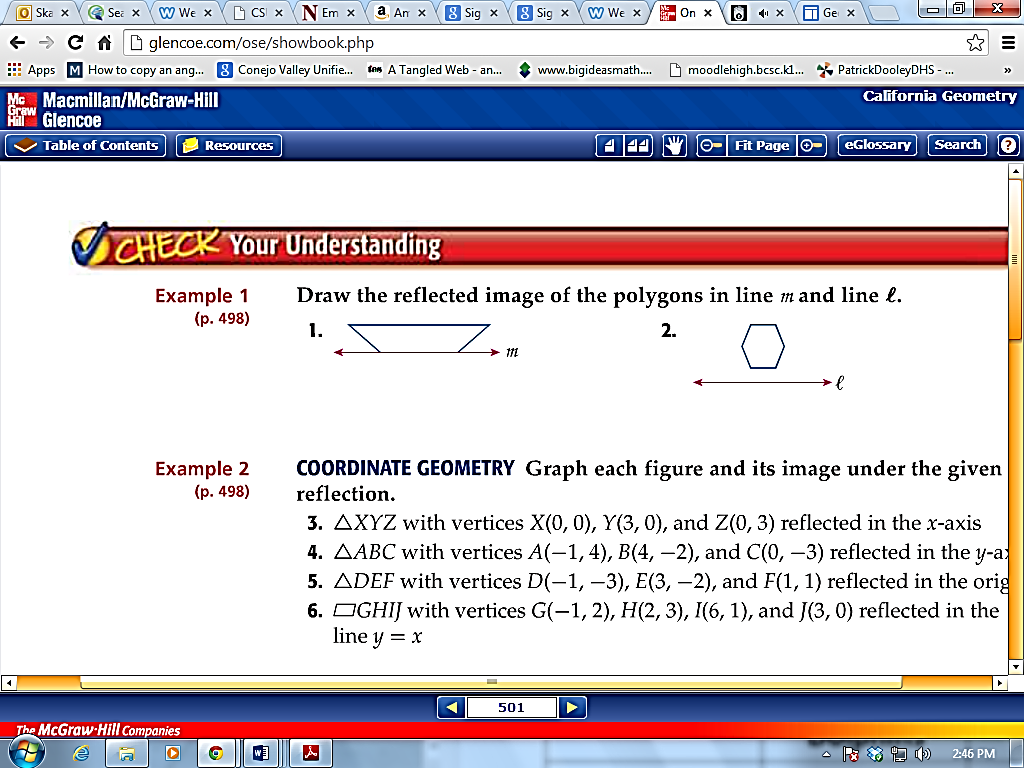
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**b.**

**Reflections (Section 9-1)**

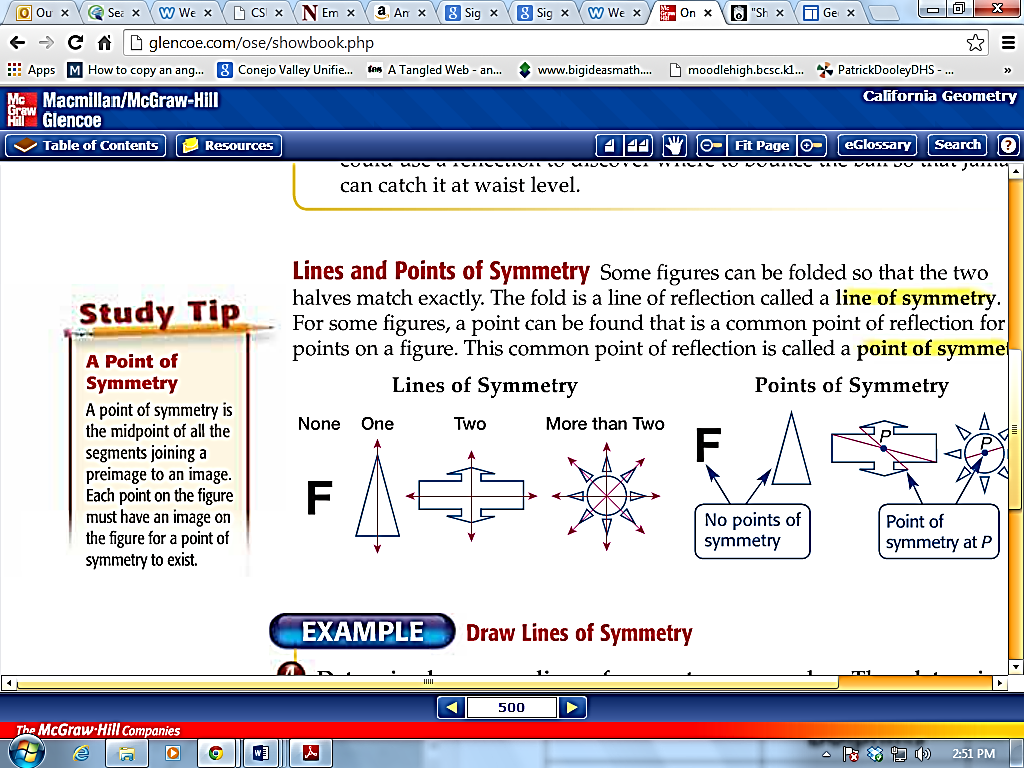
A **reflection** is a transformation representing a flip of a figure. Figures may be reflected in a point, a line, or a plane.

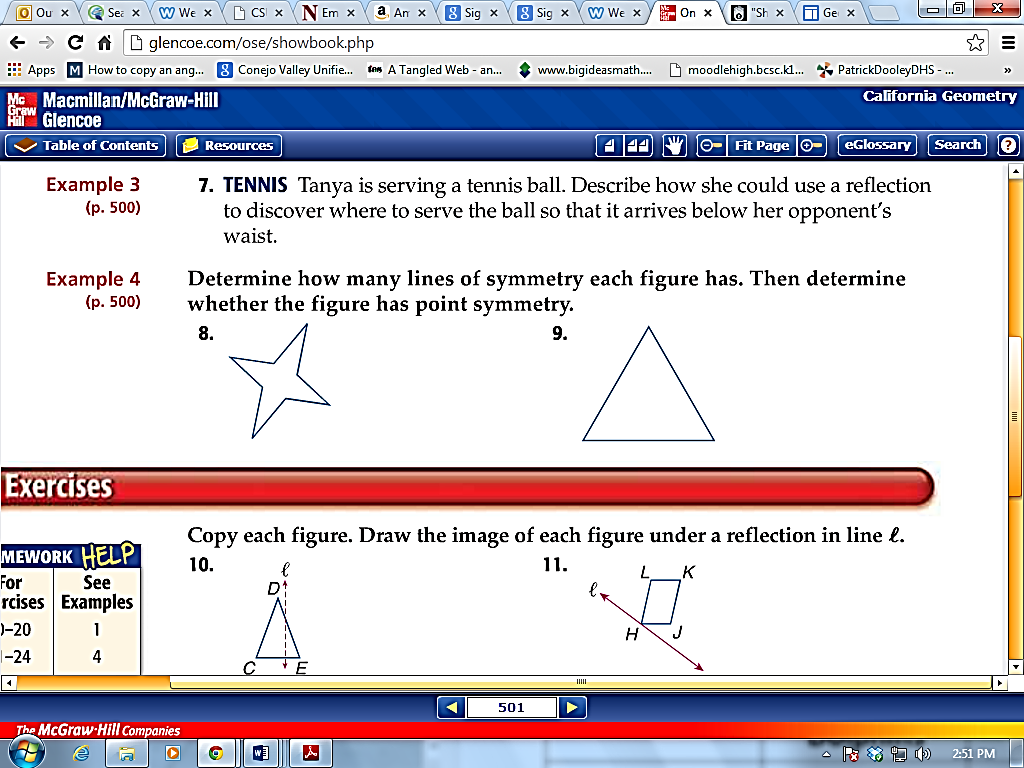
**Example 1:** 



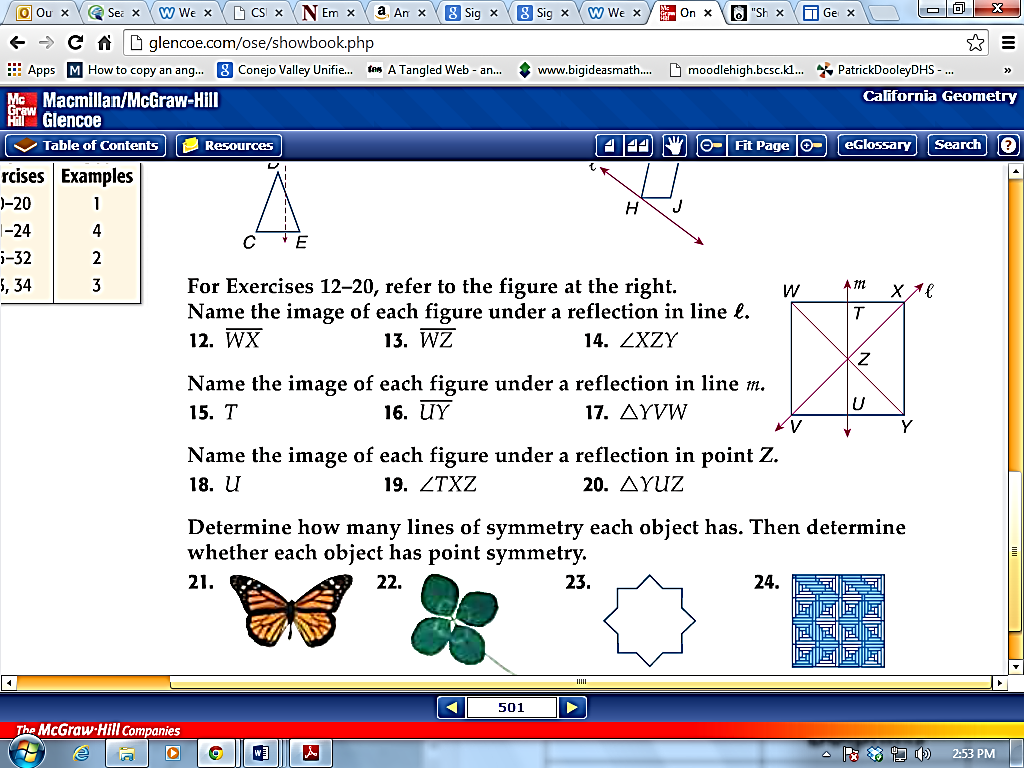
a. b.

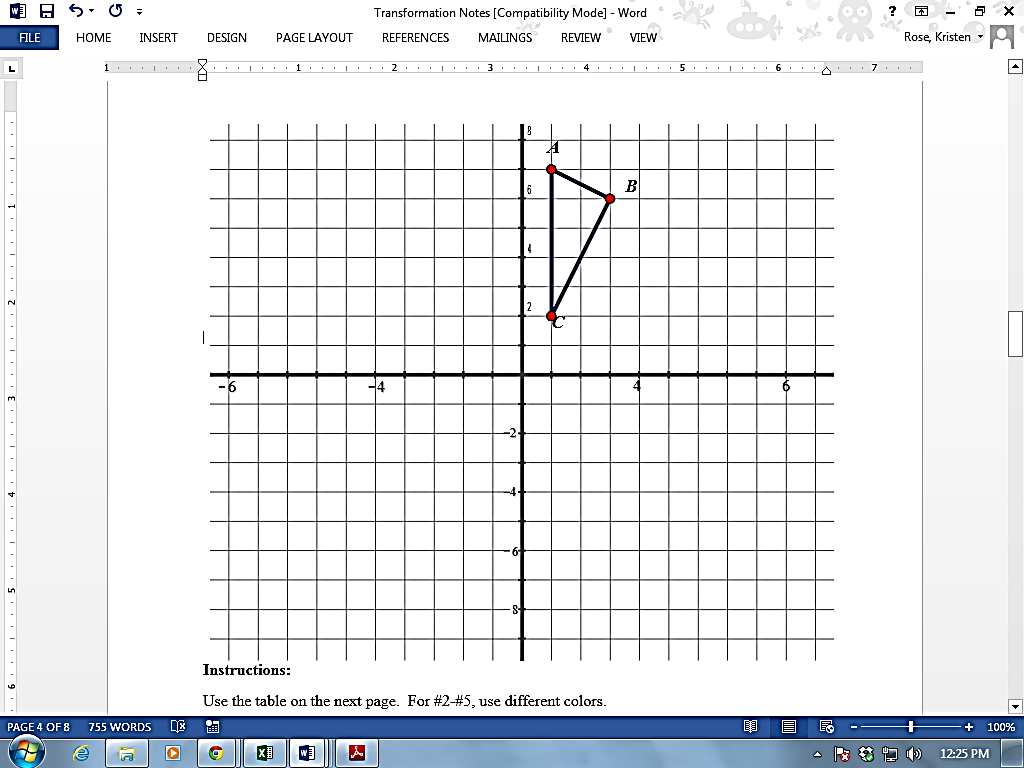
Some figures can be folded so that the two halves match exactly. A fold is aline of reflection called a **line of symmetry**. If all the lines of symmetry intersect at the same point, the figure has **point symmetry.**



**Example 2:**

**Example 3:**



**Instructions:**

For #2-#5, use different colors.

1. Write down the coordinates of A, B, C in column 1
2. **Reflect triangle ABC over x axis**. Label the new coordinates: A’, B’ C’ and write them in column 2.
3. **Reflect triangle ABC over y axis.** Label the new coordinates: A’’, B’’, C’’ and write them in column 3.
4. **Reflect triangle ABC over the line y = x.** Label the new coordinates: A’’’, B’’’, C’’’ and write them in column 4.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Original | Reflected over | Reflected over | Reflected over | Reflected over | |
| Coordinates | the x axis | the y axis | the line y=x | the origin | |
|  |  |  |  |  |  |
| A ( | A’ ( | A’’ ( | A’’’ ( | A’’’’ ( | |
|  |  |  |  |  |  |
| B ( | B’ ( | B’’ ( | B’’’ ( | B’’’’ ( | |
|  |  |  |  |  |  |
| C ( | C’ ( | C’’ ( | C’’’ ( | C’’’’ ( | |
|  |  |  |  |  |  |
|  | Write down | Write down | Write down | Write down | |
|  | observations | observations | observations | observations | |
|  | between points: | between points: | between points: | between points: | |
|  | A & A’ | A & A’’ | A & A’’’ | A & A’’’’ | |
|  | B & B’ | B & B’’ | B & B’’’ | B & B’’’’ | |
|  | C & C’ | C & C’’ | C & C’’’ | C & C’’’’ | |
|  |  |  |  |  |  |

1. **Reflect triangle ABC over the origin.** Label the new coordinates: A’’’’, B’’’’, C’’’’ and write them in column 5.

9.3: Rotations

**Rotation:** A transformation that turns every point of a preimage through a specified angle (angle of rotation) and direction about a fixed point (center of rotation)

Ex1A) Rotate quadrilateral ABCD 60° counterclockwise about point R.

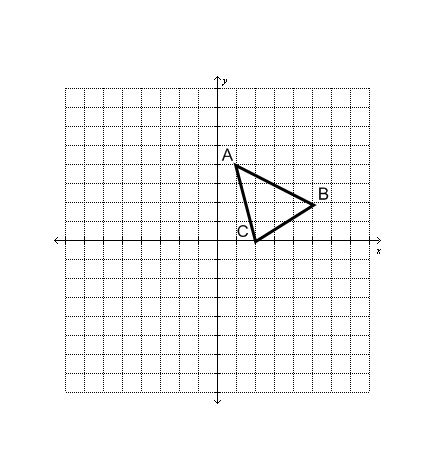
R

Ex1B) Rotate quadrilateral ABCD 40° clockwise about point R.

R

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Ex2) Triangle ABC has vertices A(-2, -3), B(-6, -3) and C(-5, -5). Draw the image of ΔABC under a rotation 120° counterclockwise about the origin.

**Rotating by a multiple of 90 degrees:**

**1.**

a) Rotate Triangle *ABC*, 90o counterclockwise.

Label the triangle *A****′*** *B****′*** *C***′**.

b) Rotate Triangle *ABC*, 180o counterclockwise.

Label the triangle *A″ B″ C″*.

c) Rotate Triangle *ABC*, 270o counterclockwise.

Label the triangle *A****′′′*** *B****′′′*** *C****′′′***.

**2.** Organize your results from #1 in the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Starting Point** | **90°**  **Rotation**  **CC** | **180°**  **Rotation**  **CC** | **270°**  **Rotation**  **CC** | **360°**  **Rotation**  **CC** |
| ***A* (1, 4)** |  |  |  |  |
| ***B* (5, 2)** |  |  |  |  |
| ***C* (2, 0)** |  |  |  |  |

**3.** Complete each rule for finding the image of any point (*x, y*) under the given rotation.

a) 90**°** rotation about the origin: (*x, y*) → ( , )

b) 180**°** rotation about the origin: (*x, y*) → ( , )

c) 270**°** rotation about the origin: (*x, y*) → ( , )

d) 360**°**  rotation about the origin: (*x, y*) → ( , )

**4.** What are the coordinates of (3, - 2) under a 90**°** counterclockwise rotation about the origin?

**5.** What are the coordinates of (- 5, 4) under a 180**°** counterclockwise rotation about the origin?

**6.** What are the coordinates of ( 3, 2) under a 90**°** **clockwise** rotation about the origin?