# Pre-Algebra Notes – Unit 11: Transformations & Congruence

NVACS 8.G.A.2   *Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.*

NVACS 8.G.A.3   *Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.*

Geometry not only looks at figures, it also studies the movement of figures. If you move all the points of one figure to create a new geometric figure, you call the new figure the *image*. Each point of the image matches exactly with a corresponding point of the original figure; in other words, the image is congruent to the original figure. This changing of position is called a *transformation.*

There are 4 types of transformations we are going to study: *translation, rotation*, *reflection, and dilation.* You may be more familiar with these as being called s*lide*, *turn*, *flip, and stretch/shrink.*
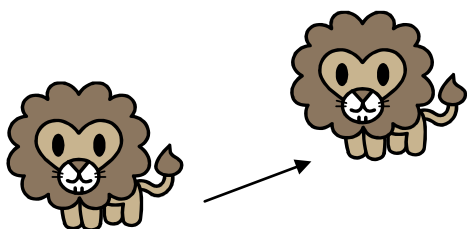
A *translation* is the simplest. If you copy a figure onto a piece of paper, than slide the paper along a straight path without turning it, your slide motion represents a translation.

A *rotation* is a turning motion. Points of the original figure rotate an identical number of degrees around a fixed center point.
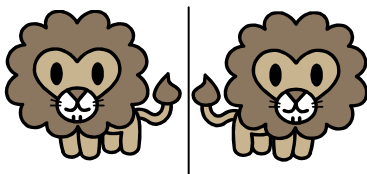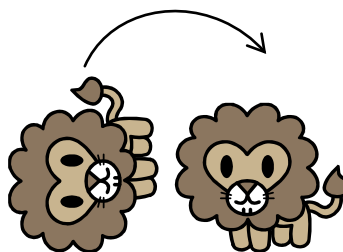
A *reflection* flips the figure across a line of reflection, creating a mirror image.

A *dilation* stretches or shrinks a figure, with respect to a fixed point.
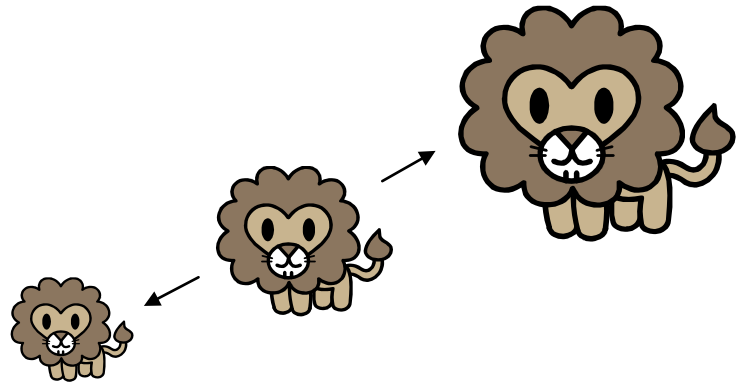
Review with students how they may relate the terms to ones they already know:

_sl_ide $\longrightarrow$ tran_sl_ation

_t_urn $\longrightarrow$ ro_t_ation

_fl_ip $\longrightarrow$ re_fl_ection

Transformations can also be shown on a coordinate grid. A *translation* will move each point like an ordered pair. For example, the translation shown moved the triangle right 3 units and up 4 units, which we could also show as $(x+3, y+4)$ or $(x, y) \rightarrow (x+3, y+4)$.
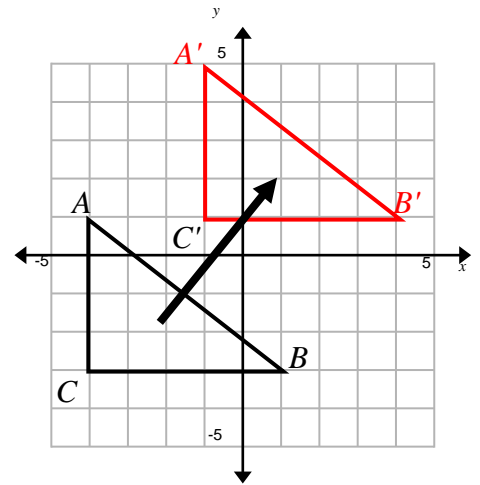
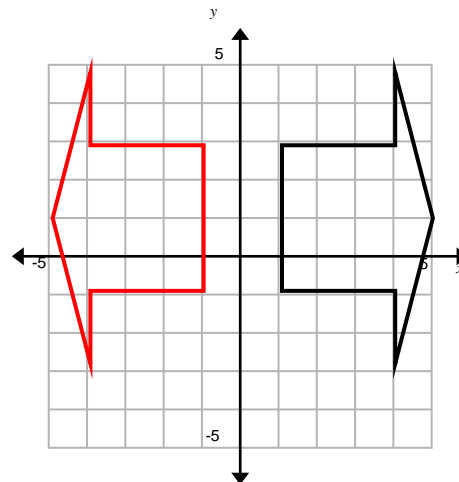A prime mark (') is used with the label of an image point. The image of point A is shown as point A' (read "A prime").

A *reflection* can be shown on a coordinate grid by reflecting the figure across an axis.
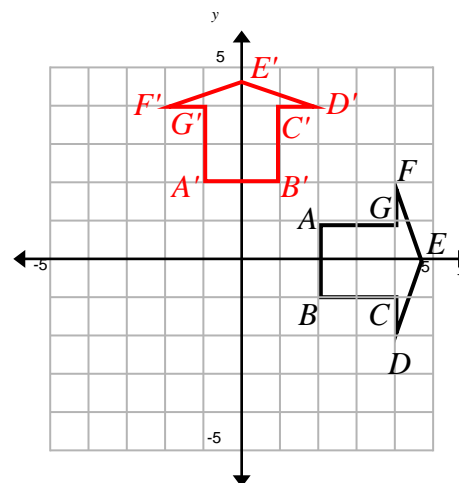
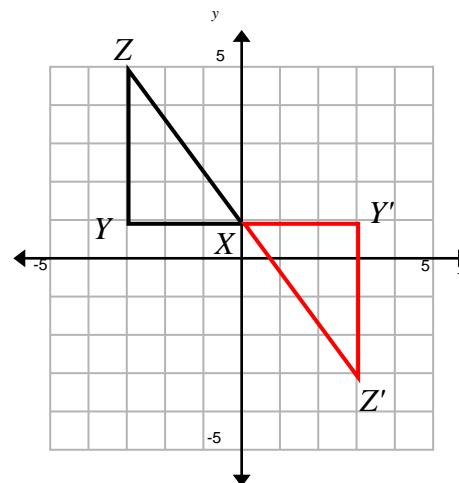Across the x-axis, the figure will follow the rule $(x, -y)$.
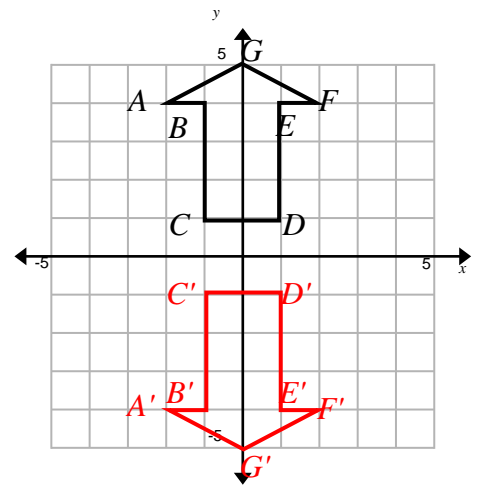
Across the *y*-axis, the figure will follow the rule $(-x, y)$.

A *rotation* can be shown on a coordinate grid by moving the figure about a point.   Unless it is indicated otherwise, rotation occurs around the origin. This example shows a rotation of 90° counterclockwise about the origin.

A rotation can also occur around a given point. This example rotated the triangle 180° about point *X*.

A *dilation* can be shown on a coordinate grid by stretching or shrinking the figure about a point. Unless it is indicated otherwise, the center of dilation is the origin. A scale factor is the ratio of a side length of the image to the corresponding side lenth of the original figure. This example shows a dilation about the origin, with a scale factor of 2.

In dilation, the figure will follow the rule $(kx,\ ky)$, where k is the scale factor.
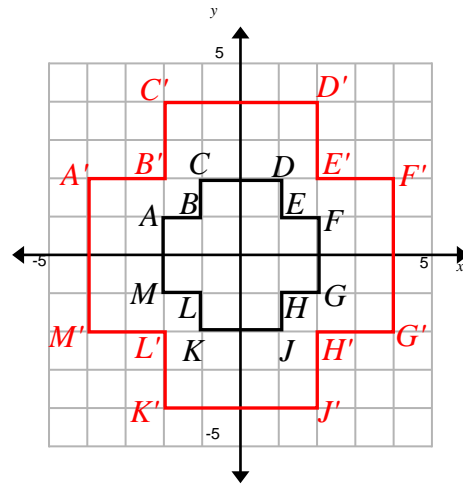
Transformations that can be used to show two figures are *congruent*: translations, reflections, and rotations.

Two figures are similar if the second figure can be obtained from the first by a sequence of transformations, including dilation. (Next unit of study)

Corresponding Parts of Congruent Figures

If two figures are congruent, their corresponding sides are congruent and their corresponding angles are congruent. For instance, in the figure to the right, triangle *ABC* is congruent to triangle *DEF* because ΔDEF is the image of ΔABC reflected over line *m*. So, $\Delta ABC \cong \Delta DEF$.
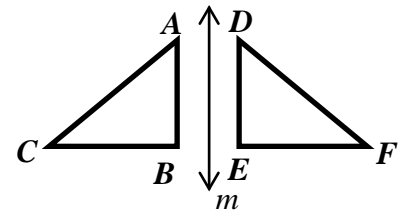
We now can list the corresponding (and congruent) parts of the triangles.

Congruent Sides:
$\overline{AB} \cong \overline{DE}$; $\overline{BC} \cong \overline{EF}$; $\overline{CA} \cong \overline{FD}$

Congruent Angles:
$\angle A \cong \angle D$; $\angle B \cong \angle E$; $\angle C \cong \angle F$