Congruence

Congruence is the concept used in geometry to describe two geometric figures that are equal or the same. Informally, two figures *F* and *G* drawn on a piece of paper are *congruent* if they have:

Exactly the *same size*

and

Exactly the *same shape*

Congruent figures might be triangles, quadrilaterals, circles, or any other kind of figure.

In order to make this idea more apparent, it helps to imagine that figure *F* and figure *G* are physical shapes cut out of cardboard. If they have the same size and shape, it must be possible to move figure *F* physically so that it exactly coincideswith figure *G*. *Transformation* is the concept used in geometry to formally express this informal idea of moving a figure *F* to coincide with a figure *G*.

Transformations

The formal, mathematical way to describe the movement of a figure is through a *geometric transformation*. The type of geometric transformation called a *rigid motion* moves a figure as a whole without any distortion.

In other words, a *rigid motion transformation* does not change the size or the shape of a figure. As such, a transformed figure is always *congruent* to the original figure. In fact, the mathematical definition of *congruency* for two figures states that there is a sequence of rigid motion transformations that move one figure to coincide with the other.

The relationship of a figure in one location in the plane to an identical figure in any other location in the plane can be described in terms of three simple transformations: **Translations**, **Reflections**, and **Rotations**.

Translations

A *translation* is a type of transformation that moves every point in the plane a fixed distance in a fixed direction.

If you think of a figure as being a shape cut out of cardboard, a translation slides the whole figure without rotating it and without turning it over.
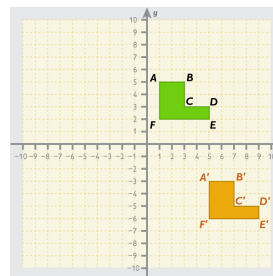
Reflections

A *reflection* is a type of transformation that reflects every point in the plane across a fixed line ℓ in the plane. This line is called the *line of reflection*. In this figure, the line of reflection is the y-axis.

If you think of a figure as being a shape cut out of cardboard, a reflection flips the whole figure over with respect to the line of reflection. The line of reflection may pass through the figure or it may lie completely outside the figure.
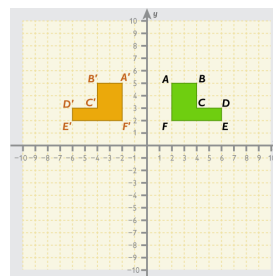
Rotations

A *rotation* is a type of transformation that rotates every point in the plane through a fixed angle with respect to a fixed center point. In this figure, the center of rotation is the origin, (0, 0). The original figure has been rotated counterclockwise 90°.

If you think of a figure as being a shape cut out of cardboard, a rotation turns the whole figure around the center point. The center point may be inside the figure or outside the figure.