Op Art and Parallel Lines

Your Challenge

➤ **Learn about op art and then create your own op art design with parallel lines.**

Op art is a style of abstract art in which lines, shapes, and space are organized to produce optical illusions. Optical illusions trick your eyes and brain. Op art pictures are abstract and usually black-and-white. They often give the viewer the impression of movement or three dimensions.

Search for "op art" on the internet. Look for examples of designs that use parallel lines in black and white.

Create your own piece of op art inspired by examples you find online. Use sets of parallel lines in your design. A set may consist of any number of parallel lines, and sets of parallel lines can intersect other sets of parallel lines. Use only black marker or pencil. Be sure to use a ruler or straightedge to draw your lines. When you are finished, explain whether or not your design includes any transversals and any congruent angles.

Name:

Op Art and Parallel Lines

RECORDING SHEET

Midpoint Investigation

Your Challenge

What are the properties of triangles formed by connecting the midpoints of the sides of a triangle?

➤ **The exact center of a line segment is called the *midpoint*. Use a geometry software program to explore the results of connecting the midpoints of the sides of a triangle.***

a. Open the geometry software program.

b. Use the *Polygon* tool to draw an acute triangle *ABC*.

1. In the Measure menu, select the *Angle* tool and use it to find the measure of each angle. What are the measures?

2. Select the *Distance* or *Length* tool and use it to find the length of each side. What are the lengths?

c. Use the *Midpoint* tool and either click on points *A* and *B* or on $\overline{AB}$ to create its midpoint *D*. Repeat to create the midpoint *E* of $\overline{BC}$.

d. Use the *Polygon* tool to create triangle *DBE*. Use the *Angle* tool and the *Distance* or *Length* tool to find the measures of the angles and the lengths of the sides of triangle *DBE*.

3. What is the relationship of the corresponding angles of triangles *DBE* and *ABC*?

4. What is the relationship of the corresponding sides of triangles *DBE* and *ABC*?

5. Are triangles *DBE* and *ABC* similar? Why or why not?

*** You may need to adjust the steps depending on which graphing program you use. If needed, use Help or Support menus or online tutorials.**

Midpoint Investigation

6 Is $\overline{DE} \parallel \overline{AC}$? Why or why not?

7 What is the relationship between $\overline{DE}$ and $\overline{AC}$?

8 Use what you have learned to complete this statement:
The segment that joins the midpoints of two sides of a triangle _____.

e. Use the *Midpoint* tool to create midpoint *F* of $\overline{CA}$. Use the *Polygon* tool to create triangle *EFD*. The diagram now has five triangles: $\triangle ABC$, $\triangle EFD$, $\triangle DBE$, $\triangle ADF$, and $\triangle FEC$. Use the geometry tools to find the measures of the angles and the lengths of the sides of each triangle.

9 Which segments are parallel?

10 Which triangles are similar? Explain.

11 Which triangles are congruent? Explain.

f. Select the *Move* tool to move point *B* to form right triangles and to form obtuse triangles. Observe side lengths and angle measures for all the triangles.

12 What are the observed properties of triangles formed by connecting the midpoints of the sides of a triangle?

Spiral of Theodorus

Your Challenge

The Spiral of Theodorus is created by placing right triangles edge-to-edge so that the hypotenuse of one triangle becomes the longer leg of the next triangle (with the shorter leg always having a length of 1). Both legs of the first triangle have a length of $\sqrt{1}$, or 1. The hypotenuse of the first triangle, which is a leg of the next triangle, has a length of $\sqrt{2}$. The hypotenuse of second triangle, which is a leg of the third triangle, has a length of $\sqrt{3}$, and so on, up to the point where the final triangle has a hypotenuse with a length of $\sqrt{17}$. Do a search for the Spiral of Theodorus on the internet to see what it looks like.

➤ **Use graphing technology to construct the Spiral of Theodorus.***

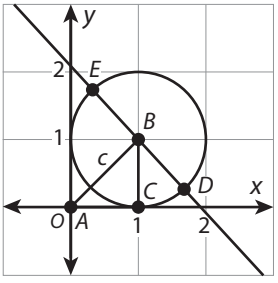
a. Open the graphing technology program.

b. From the Polygon menu, select the *Polygon* tool to create triangle *ABC* with vertices at *A*(0, 0), *B*(1, 1), and *C*(1, 0).

1 What kind of triangle is triangle *ABC*? What is the length of the hypotenuse?

c. Follow these steps to create the next triangle in the spiral with side lengths 1, $\sqrt{2}$, $\sqrt{3}$.

- From the top vertex of the triangle, create a segment of length 1 perpendicular to the hypotenuse. To do this, select the *Perpendicular Line* tool. Select the top point *B* and then select the hypotenuse of the triangle. A line perpendicular to the hypotenuse through the top point is created.
- From the Circle menu, use the tool that allows you to draw a circle by giving the center and radius to create a circle with center at point *B* with radius 1.
- Select the *Intersect* tool. Click on the perpendicular line and the circle to find the points of intersection. Point *E* in the diagram is a vertex of the next triangle.

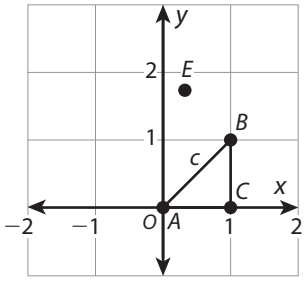


*** You may need to adjust the steps depending on which graphing program you use. If needed, use Help or Support menus or online tutorials.**

Name:

Spiral of Theodorus

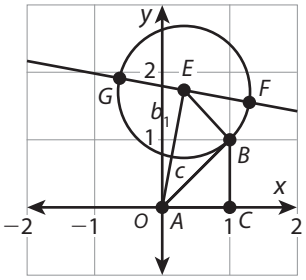
d. Find the tool for hiding objects. Use it to hide the circle, the perpendicular line, and point *D*, so as not to clutter the construction. The result should look like the figure on the right.

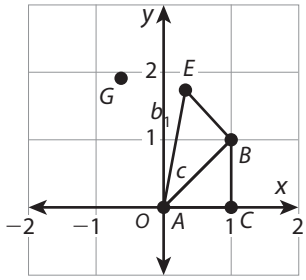


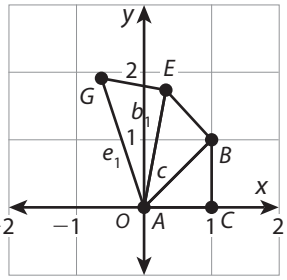
Use the *Polygon* tool to create right triangle *AEB*.

2 What are the lengths of the sides of triangle *AEB*? Give irrational lengths in the form of square roots, not rounded decimals.

e. Repeat the process described in step c to complete the spiral. The diagrams below show the steps for drawing the third triangle.







3 What are the lengths of the sides of the third triangle?

4 What are the lengths of the sides of the 16th triangle?

f. Save a copy of your completed Spiral of Theodorus.