



# Area of a complex figure

from the Esri GeoInquiries™ collection for Mathematics

Target audience – Geometry learners

Time required – 15 minutes

## Activity

Find the area of a complex figure by dividing it into simpler shapes, such as rectangles, squares, triangles, and trapezoids.

## Standards

**CCSS: MATH.CONTENT.HSG.GPE.B.7** – Compute perimeters of polygons and areas of triangles and rectangles.

**CCSS: MATH.CONTENT.6.G.A.1** – Solve real-world and mathematical problems involving area, surface area, and volume.

**CCSS: MATH.CONTENT.7.G.B.6** – Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

## Learning Outcomes

- Students will find the area of a complex figure.
- Students will find the areas of rectangles, squares, triangles, and trapezoids.

Map URL: <http://esriurl.com/mathGeoInquiry11>



## Engage

### How do you find the area of a complex figure?

- Click the URL above to launch the map.
- Click Bookmark, and then select Lake Ontario.
- ? What simple shapes could be used to cover the surface area of Lake Ontario? [*Rectangles, squares, triangles, and trapezoids.*]



## Explore

### How do you find an approximate area of a complex figure?

- To the left of the map, click Details and then the Show Contents Of Map button.
- Select the Rectangle layer check box to turn on the layer.
- ? How do you find the area of a rectangle? [*Multiply the length by the width:  $A = l \times w$* ]
- Click Measure, select the Distance button, and from the drop-down list, choose Miles.
- Measure the length and width of this rectangle.
- Calculate the area of the given rectangle.
- Turn on the Square layer.
- ? How do you find the area of a square? [*Multiply the side of the square by itself:  $A = s \times s$* ]
- Measure a side of this square, and calculate the area of the given square.



## Explain

### What other shapes could help cover this complex figure (Lake Ontario)?

- Turn on the Triangle layer.
- ? How do you find the area of a triangle? [*Multiply the base by the height of the triangle and cut it in half:  $A = (\frac{1}{2})(b \times h)$* ]
- Measure the base and height of the triangle, and calculate the area of the given triangle.
- Turn on the Trapezoid layer.
- ? How do you find the area of a trapezoid? [*Multiply the average of the two bases by the height of the trapezoid:  $A = (b1 + b2) / 2 \times h$* ]
- Measure the two bases and height of the trapezoid, and calculate the area of the given trapezoid.
- Add the areas of the smaller shapes.
- The sum will be an approximation for the area of the complex figure.
- ? What is your area of Lake Ontario? [*Accept reasonable answers based on class/student work.*]

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## Elaborate/Extend

### How could you find an even more accurate approximation of the area of Lake Ontario?

- Zoom in to find areas that were overlooked.
- ? If these areas were added to your previous estimate, would it make the estimate more or less accurate? *[More accurate]*
- ? How many small areas added to your estimate would produce the best estimate? *[As many as possible.]*
- ? Why would you limit the number of small areas added to your estimate? *[Time and resource cost to calculate the areas; improvement of estimate may be too small to matter; and so on.]*

## Evaluate

### How accurate was your area for Lake Ontario?

- Calculate the percent error between the areas calculated and the known area (7,340 square miles).  
*[% Error = (Known - Calculated) / Known x 100]*
- Sample calculation: If you added the areas of the smaller shapes and found a total area of 5,000 square miles, the percent error calculation would be: % Error =  $(7,340 - 5,000) / 7,340 \times 100 = 31.9\%$  error.

### USE THE MEASUREMENT TOOL

- Click Measure, select the Distance button, and from the drop-down list, choose a unit of measurement.
- On the map, click once to start the measurement, click again to change direction, and double-click to stop measuring.
- Hint: Position the area of interest on the map so that it is not obscured by the Measure window.

### ADD MAP NOTES

- Click Add and from the drop-down list, choose Add Map Note.
- Type a name, select a template from the drop-down list, and click Create.
- In the Add Features pane, choose a symbol and click in the map to place it.
- In the pop-up window, add your desired information.

## Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://www.esri.com/schools>.

THEN TRY THIS...

- Find a more accurate approximation of the area of Lake Ontario. Use the Zoom tool to find areas that might have been overlooked. Draw in additional simple shapes and find their areas.
- Use the Measure tool to click along the shore of Lake Ontario. Compare this area to your approximate area from this activity. Which is more accurate and why?

## TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these high school texts.

- *Geometry by Holt, Rinehart & Winston — Chapter 9*
- *Geometry by Houghton Mifflin — Chapter 11*
- *Geometry by Moise & Downs — Chapter 11*