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? *[Multiple the length by the width: A = l x 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 x 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 = (½)(b x 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 x 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 x 100 = 31.9% error.

USE THE MEASUREMENT TOOL	ADD MAP NOTES
• 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.	• 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 Moise & Downs — Chapter 11*
- *Geometry by Houghton Mifflin — Chapter 11*