D=R*T

from the Esri GeoInquiries™ collection for Mathematics

MATH

Target audience – Algebra/Geometry learners **Time required – 15 minutes**

Activity	Use an aerial photograph to determine the distance around a track, and then calculate rate and time for each lap and the race as a whole.
Math Standards	**CCSS: MATH.CONTENT.HSG.C.B.5**. Find arc lengths and areas of sectors of circles. **CCSS: MATH.CONTENT.HSG.MG.A.1**. Use geometric shapes, their measures, and their properties to describe objects.
Learning Outcomes	• Students will find the distance around an irregular surface. • Students will make related calculations involving motion.

Map URL: http://esriurl.com/mathGeoInquiry2

Engage

How big is the Indy 500 track?

→ Click the URL above to launch the map.
? Why is it called the Indianapolis 500? *[The race as a whole is 500 miles long, involving multiple laps.]*
? How might you find a way to estimate the length of the track? *[Possible answers include: Compare to other known objects visible in the map; use the scale bar; and so on.]*
? How long do you estimate the track to be? *[Allow students to estimate without providing an exact answer.]*

Explore

How long are the straightaways on the track?

→ Using the Measure tool, use the Distance tool in feet to measure the track. *[See the* Use the Measure Tool *tip on page 2 for details.]*
→ Measure the straightaways of the track.
? How long are all straightaways together? *[Two ⅝-mile-long (1,000 m) long straightaways plus two ⅛-mile-long (200 m) short (chute) straightaways = 1⅜ or 1.5 miles.]*

Explain

How are the curves in the oval track measured?

→ Measure the distance of the four curved areas by approximating the center of one curve, and use the Measure tool to determine the radius.
– The curves are not quarter circles, so the calculation will be approximate.
→ Calculate the distance for each arc length with a circumference formula for circles (2 x pi x radius).
– The sum of all distance measures from the curves and straight segments will be the distance around one lap of the Indy 500.
? How long is the track at Indianapolis? *[Total of measures will approximate 2.5 miles.]*
? How many laps are necessary to complete the Indy 500? *[200 laps]*

more ▶

Elaborate

How does track length vary between inside and outside lanes?

→ Read aloud: "Compare distances for the inside and outside lanes of the track. The track is 50 feet wide in the straight sections and 60 feet wide in the curves."

? How much farther does a car travel on the outside compared to the inside of the track? *[Straight sections make no difference; curves have a radius 60 ft longer, so each lap would be 2pi x 60, or 120pi (~377) ft longer.]*

? How long would it take an average car going 60 miles per hour to travel around the track? *[2.5 minutes]*

? How long would it take that same car to complete the full Indy 500? *[2.5 minutes per lap * 200 laps = 500 mins (or a little over 8 hours); current winners complete the course in about 3 hours.]*

Evaluate

How does radius change between ovals and circles?

? If the track was totally circular but the same distance, what would the radius be? *[c = 2 * pi * r; approximate radius is 2,100 feet]*

? How do early estimates of the track length compare to the measured track lengths? *[Answers will vary.]*

TURN A MAP LAYER ON AND OFF

- Make sure that the Details pane is selected, and click Show Contents Of Map.
- To show individual map layers, select the check boxes next to the layer names.
- Hint: If a map layer name is light gray, zoom in or out on the map until the layer name is black. The layer can now be turned on.

USE THE MEASURE 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.

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...

- With an ArcGIS Online organizational account for schools, use the Analysis tools to calculate a drive time. Use the model analysis to get to school. How does the average speed compare with the record speed for the Indianapolis 500 race? *[Record was in 2013: 187.433 mph]*
- Explore another mapped race with story maps at: http://esriurl.com/GEO041701.

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 14*
- *Geometry by Houghton Mifflin — Chapter 9*

Version Q1 2018. Send feedback: http://esriurl.com/GeoInquiryFeedback