



$$D=R*T$$

from the Esri GeoInquiries™ collection for Mathematics

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 5/8-mile-long (1,000 m) long straightaways plus two 1/8-mile-long (200 m) short (chute) straightaways = 1 2/8 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 ($2 \times \pi \times \text{radius}$).
- 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*]

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 $2\pi \times 60$, or 120π (~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 Houghton Mifflin — Chapter 9*
- *Geometry by Moise & Downs — Chapter 14*