Activity: How Long is a Nautical Mile?

Objective: Students will be able to derive the equations for arc length and area of a sector through exploring how to calculate distances around the Earth.

Context: In the context of the Airplane Radar project, this lesson is motivated by a need to know the length of a nautical mile in order to understand radar ranges.

Materials: 1 student sheet per student

Teacher Instructions:

1. Before printing and copying the student sheet, you will need to draw in arcs with certain arc measure for the questions. Here are some suggested arc measures:

|  |  |
| --- | --- |
| **Question #** | **Arc Measure** |
| 2 | 180° |
| 3 | 90° |
| 4 | 60° |
| 5 | 12° |

1. (15 min) Go through the accompanying presentation for this lesson. For each slide, have students discuss and define the words based on the pictures, and then write the student or class-developed definition on their paper.
2. (25 min) Let students work in teams to calculate the different arc lengths and try to derive the equations on the provided student sheet.
3. (15 min) Have teams present how they calculated arc length and the equations they derived. Finalize these equations with the class as notes.
4. (5 min) If time permits, an extender would be calculating the length of a nautical mile on the moon or Mars.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_

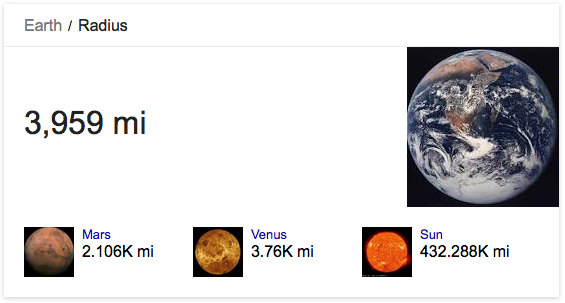
Arc Length Exploration: How long is a nautical mile?

In air and sea travel, the standard unit of measurement is a nautical mile. You’re probably more used to statute miles, or the miles that you see in daily life. This exploration will help you figure out how long a nautical mile is compared to your regular miles.

|  |  |
| --- | --- |
| **Vocabulary** | **Definition/Picture** |
| Nautical mile |  |
| Minute of arc |  |
| Arc | Arc measure -  Arc length - |
| Sector |  |
| Segment |  |
| Minor (arc, sector, segment) |  |
| Major (arc, sector, segment) |  |

For the rest of these questions, we will be working with a great circle of the Earth, or the largest circle that can be drawn on a sphere. This is how we will convert from 3D to 2D.

1. What is the circumference of the Earth? Show your calculations below.



2. How many miles would it take to go halfway around the Earth?

a. What is the measure of this arc?

b. What is the length of this arc?

3. How many miles would it take to go a quarter way around the Earth?

a. What is the measure of this arc?

b. What is the length of this arc?

4. How many miles would it take to go around the given arc?

a. What is the measure of this arc?

b. What is the length of this arc?

5. How many miles would it take to go around the given arc?

a. What is the measure of this arc?

b. What is the length of this arc?

6. How many miles would it take to go around a minute of arc? This is your nautical mile!

a. What is the measure of this arc?

b. What is the length of this arc? How long is a nautical mile?

7. Can you write an equation or explanation for how to find the length of an arc, given the central angle?

8. What about the area of a sector? It is very similar to finding arc length, but you are looking for area instead.

