5-8 Activity

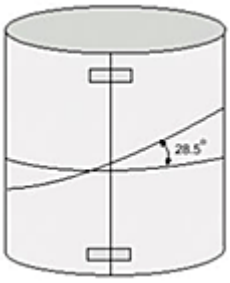
Sine Curve Orbits

Student Sheet(s)

Objective
To show why a sine curve orbital plot is created when an orbit is portrayed on a flat map.

Materials

- Earth globe
- Paper
- Tape
- Marker
- Scissors
- Protractor



Procedure

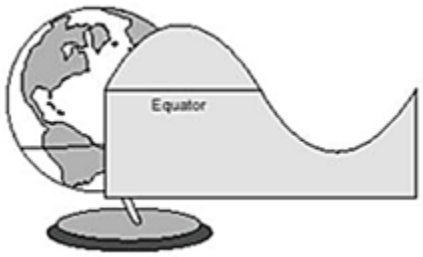
1. When shown on a flat map, circular satellite orbits resemble sine curves. To show why this happens, wrap and tape a cylinder of paper around an Earth globe.

2. Use a marker pen to draw an orbit around the cylinder. Start with an orbit inclined 28 degrees.

3. Draw the line around the cylinder so that it falls on a plane inclined to the globe's equator by 28 degrees.

4. Remove the cylinder and cut the paper along the line you drew. If you drew the line carefully, the edge of the cut will fall on a plane.

5. Unwrap the cylinder and look at the shape of the orbit.



Sine Curve Orbits

Teacher Sheet(s)

Objective: To show why a sine curve orbital plot is created when an orbit is portrayed on a flat map.

Level: 5-8

Subjects(s): Mathematics, Science

Prep Time: Less than 10 minutes

Duration: 20 - 30 minutes

Materials Category: General Classroom

National Education Standards

Science:

Math: 18a, 22c

Technology (ISTE):

Technology (ITEA):

NGS Geography Standards:

Materials:

- Earth globe
- Paper
- Tape
- Marker
- Scissors
- Protractor

Related Links:

JPass

Mathematics of Space

Amateur Radio in Space

Supporting NASAexplores Article(s):

A Room With A View

Pre-Lesson Instructions:

None

Background Information:

Orbital maps displayed in Mission Control at the NASA Johnson Space Center show three Space Shuttle orbits at a time. A small Space Shuttle orbiter is displayed on one of the orbits over the geographic position the actual orbiter is flying. The curve of the orbits resembles a sine curve. The steepness of the curve is determined by the angle in which the Space Shuttle was launched in respect to Earth's equator. Many Shuttle orbits are inclined at 28.5 degrees. This is the geographic latitude of the Kennedy Space Center. When a Shuttle is launched due east, its orbit is inclined 28.5 degrees. This happens because an orbit must be concentric with the center of Earth. In geographic terms, the orbit must be a great circle.

Some satellites do not produce sinusoidal orbits because their orbits are not circular around the earth [for example, Chandra or Image]. An excellent resource to explore is J-Track.

Guidelines:

1. Read article and discuss the positioning of the ISS over the Earth.
2. Hand out supplies and do the activity. This activity is difficult for younger students (drawing the orbit) and might be better suited for a demonstration (especially if there is limited availability of globes).
3. After completion and clean-up, discuss the activity.

Discussion/Wrap-up:

Talk about the shape of the orbit. Explain what a sine wave is and that in space the craft is actually orbiting in a circle (as this activity showed). As the orbit is traced on the ground, the sine wave advances over the surface of the earth so the spacecraft visits different parts of the globe with each complete trip around it.

Extensions:

- Create other cylinders for different orbits such as 35 degrees and 51.6 degrees (orbit of the International Space Station). Compare the steepness of the curves when the cylinders are flattened.
- Use J-Track and a Mercator projection of the earth to track orbits of various spacecraft.
- Use J-Pass to find where objects will appear in the night sky.