6. NIGHT AND DAY

How can you use models to describe and predict the apparent motion of the Sun and seasons?

As Earth rotates, you see different parts of space. During the day, the side of Earth you live on faces the Sun. As that part turns away from the Sun, it becomes night. The rotation of Earth changes day into night and night into day again.

If you watch objects in the sky, such as the Sun, they appear to rise in the east and move across the sky, and set in the west. What you are seeing is the apparent motion of these objects, not the real motion. Apparent motion is the way something appears to move. As Earth rotates from west to east, objects in the sky appear to move from the east to the west. Earth's rotation causes the apparent motion of many objects in space.

Explaining a phenomenon that you can not readily see and describe can be a challenge. This is especially true when your perspective may not be what is actually occurring. Think about a book sitting on your desk. From your perspective, it doesn't appear to be in motion. In actuality, to make one complete rotation in 24 hours, the book must move at close to 1000 miles per hour (1600 km/hr). Because gravity holds us tight to the surface of our planet, we move with the Earth and don't notice its rotation in everyday life.

In this activity, you will create a model of the Sun and Earth to better understand, and be able to describe the phenomenon of day and night.

Materials and Equipment

- Data collection system
- Light sensor
- Large globe, beach ball or Styrofoam® sphere
- Utility lamp or flashlight
- Meter stick
- Index card (2) 3 x 5 in
- Marker or pen
- Tape
- Protractor

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- If using a utility lamp with an incandescent light bulb, exercise caution as the bulb may be hot when in use.

Procedure

Part 1 - The Human Model of Rotation

1. Select Sensor Data in SPARKvue.
2. Connect the light sensor to your device.
3. Select the Illuminance measurement under the Ambient Light Sensor. Disable the Spot Light Sensor.
4. Select the Line Graph display.

5. Construct a human model as shown in Figure 1.

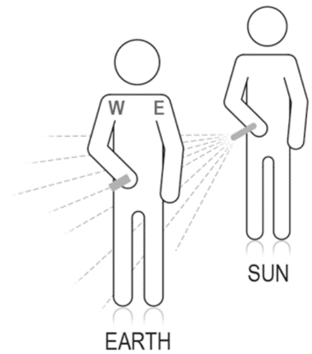


Figure 1. Human model of Earth and Sun

   a. Write the word “east” on one index card. Make a second card with the word “west”.
   b. Select a team member to be the “Earth model”. With the Earth model facing you, tape the east card on the left shoulder. Tape the west card on the right shoulder.
   c. The Earth model will hold the ambient light sensor facing outward at waist level.
   d. The flashlight or utility lamp is held or placed at a distance of 1 m, turned on and aimed at the back of the Earth model. This light is the Sun model.

6. The “Earth model” will slowly rotate from east to west (counterclockwise). If done correctly, the light from the Sun model will shine on the left shoulder first. Allow the Earth model to make three complete rotations in 30 seconds before stopping the data collection. The time does not need to be exact. Rename this Run "Human Model".

Part 2 - Spherical Model of the Earth and Sun Systems and Seasons

1. Use a large globe or spherical object to model the Earth.
   a. Attach the light sensor to the “Northern Hemisphere” at a point midway between the equator and the north pole. Use tape or rubber bands to attach the sensor such that the Ambient Light Sensor is facing outwards.
   b. Hold the Earth model with Sun model pointing towards the equator of the Earth model. The Sun model should be at a distance of 1 meter from the Earth model. The light sensor should be facing away from the light as shown in Figure 2 (Run 2).

2. Slowly rotate the Earth model counterclockwise around the axis from east to west. Complete three rotations in 30 seconds before stopping the data collection. The time does not need to be exact. Rename this Run "Sun on Equator".

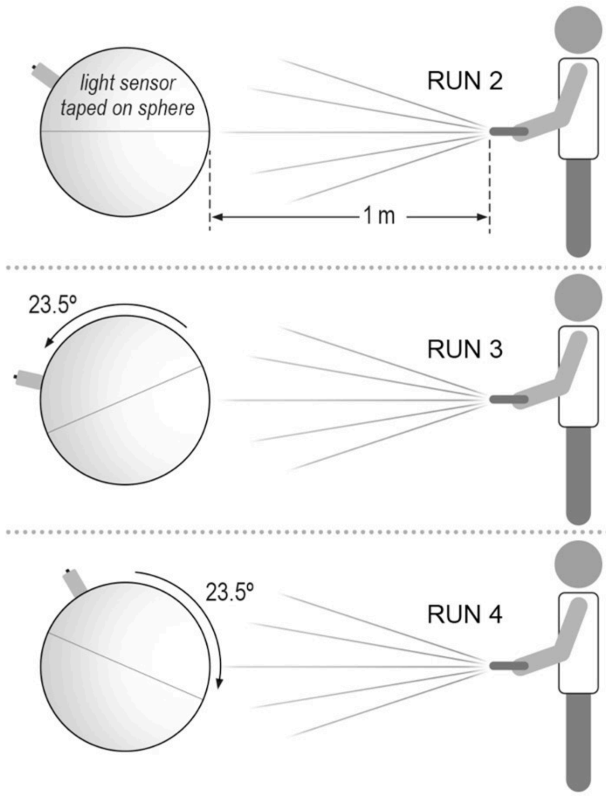
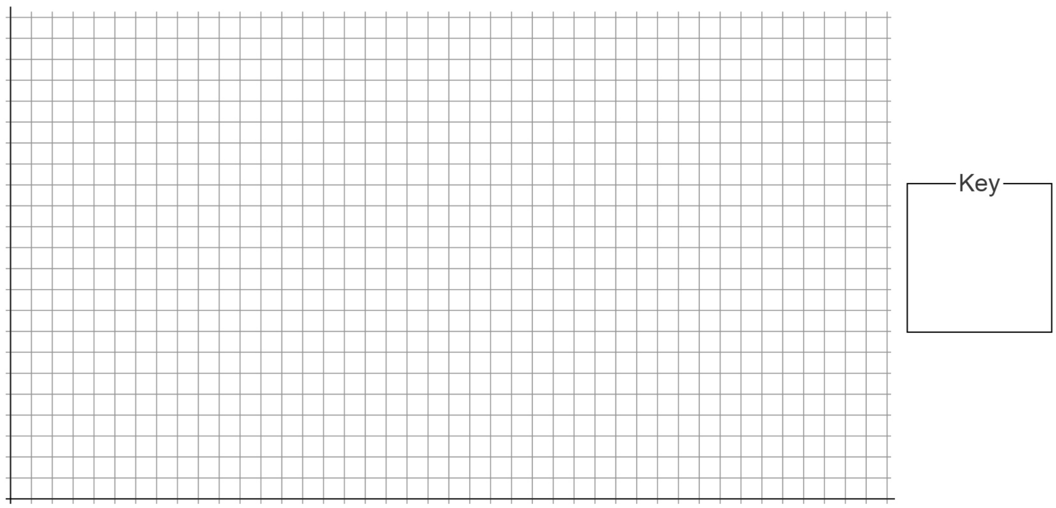


Figure 2. Spherical model of the Earth and Sun

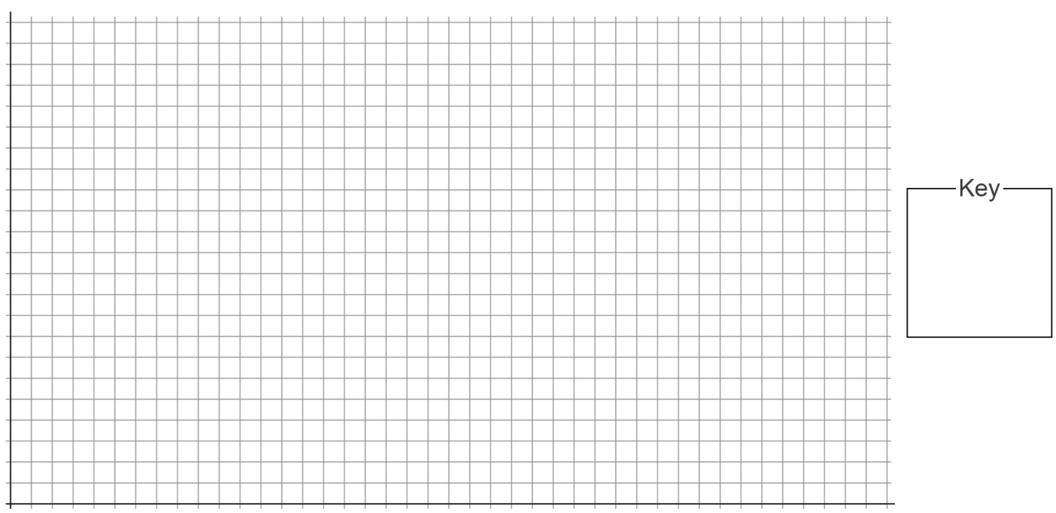
3. Use a protractor to estimate a tilt of the Earth model of 23.5° with the Northern Hemisphere facing away from the Sun model as shown in Figure 2 (Run 3).
4. Hold the Earth model with Sun model pointing away from the Northern Hemisphere of the Earth model. The Sun model should be at a distance of 1 m from the Earth model. The light sensor should be facing away from the light as shown in Figure 2.
5. Select Start to begin data collection.
6. Slowly rotate the Earth model counterclockwise around the axis from east to west. Complete three rotations in 30 seconds before stopping the data collection. The time does not need to be exact. Rename this Run "NH facing away from Sun".
7. Use a protractor to estimate a tilt of the Earth model of 23.5° with the Northern Hemisphere facing towards the Sun model as shown in Figure 2 (Run 4).
8. Repeat steps 2 - 4, but rename this Run "NH facing towards the Sun".
9. Save your data file as Night and Day or according to your teachers directions.

Data Collection

Graph 1: Night and day with human model



Graph 2: Light intensity with spherical Earth model



Questions and Analysis

1. Select “Run 1” data only. Describe the pattern seen on the graph of light intensity vs. time for the human model of the Earth and Sun system.

2. What are the benefits and drawbacks of this model?

3. Examine Graph 2 and Runs 2, 3 and 4. Compare the three Runs. Describe the similarities and differences seen between the three different Runs.

4. Which “Run” represents winter, and which “Run” represents summer? What information was used to make this determination?

5. Compare the winter and summer data only. What can be determined about the length of the day and the intensity of the light in these two seasons? How might this impact temperatures and climate during the winter and summer months?

6. What are the benefits and/or drawbacks of this model?