4. SEASONS AND TEMPERATURE

Patterns of the apparent motion of the Sun and seasons can be described, predicted, and explained with models.

Objectives

- Establish patterns of apparent motion of the Sun.
- Predict and explain patterns of apparent motion using models.
- Identify cause and effect relationships with patterns and models.
- Recognize the relationship between the tilt of the axis and seasons.
- Understand that models can be used to represent systems and their interactions.

Materials and Equipment

- Data collection system
- Temperature sensor
- Large globe, beach ball, or Styrofoam® sphere
- Utility lamp
- Meter stick
- Tape
- Protractor
- Incandescent light bulb, 75-watt

Safety

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

- When using a utility lamp with incandescent bulb, exercise caution as the bulb may be hot.

Procedure

Part 1 – Spherical Model of the Earth and Sun System at Equinox

1. Select Sensor Data in SPARKvue.

2. Connect the temperature sensor to your device.

3. Use a large globe or spherical object to model the Earth.

   a. Attach the temperature sensor to the "Northern Hemisphere" at a point midway between the equator and the north pole. If you are using a globe, place the tip of the sensor on Canada. Use tape or rubber bands to attach the sensor such that the tip of the sensor is exposed.

   b. With the lamp off, hold the Earth model with the utility lamp (Sun model) pointing towards the equator of the Earth model. The Sun model should be at a distance of .5 meter from the Earth model. The temperature sensor (on Canada) should be facing towards the light as shown in Figure 1.

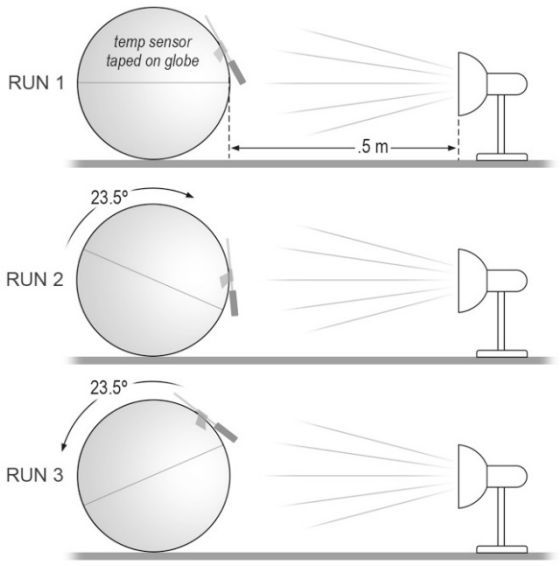


Figure 1. lamp and temperature sensor in 3 positions

4. Turn on the lamp. Select Start to begin data collection.

5. With the Earth model in a stationary position, collect data for 60 seconds. At the end of 60 seconds stop the data collection, and turn off the light. This is Run #1.

Part 2 – Spherical Model of the Earth and Sun System and Seasons

6. Use a protractor to estimate a tilt of the Earth model of 23.5 degrees with the Northern Hemisphere facing towards the Sun model as shown in Figure 1.

7. Turn on the light and select Start to begin data collection. Collect data for 60 seconds. Stop data collection and turn off the light. This is Run #2.

8. Use a protractor to estimate a tilt of the Earth model of 23.5 degrees with the Northern Hemisphere facing away from the Sun model as shown in Figure 1.

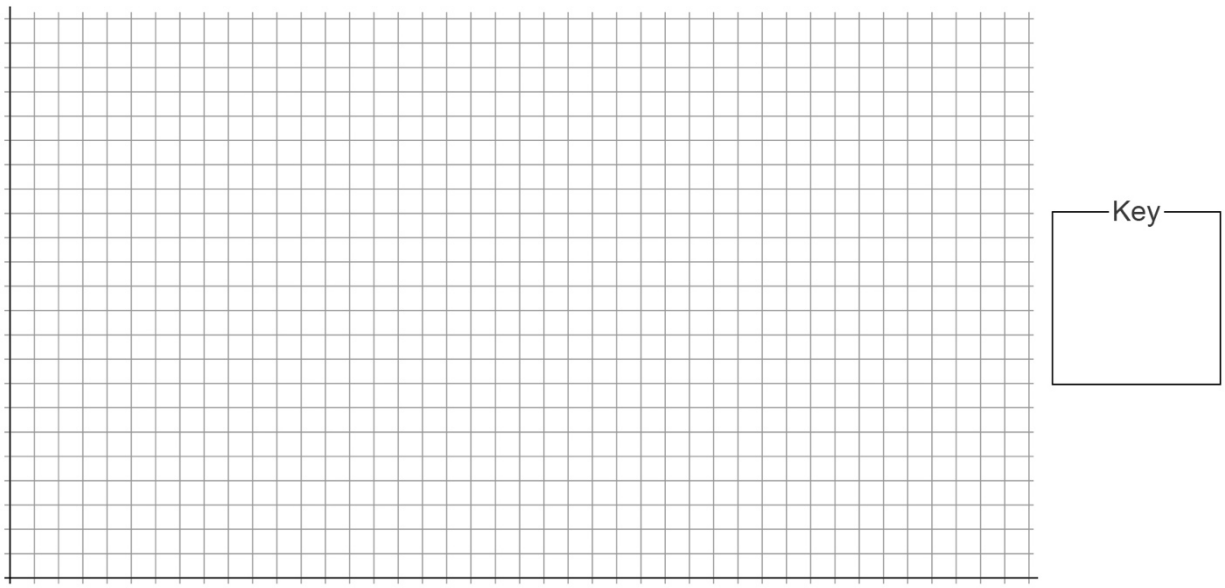
9. Turn on the light and select Start to begin data collection for 60 seconds. Stop data collection and turn off the light. This is "Run #3".

Data Collection

Spherical Model of the Earth and Sun System at Equinox

Recreate the graph of *temperature* versus *time* for Runs #1, 2 and 3 on Graph 1. Label both axes, include units, and use the correct number scale. This is Runs #1, 2 and 3.

Graph 1: Runs #1, 2 and 3 -Temperatures at Equinox, tilted towards the Sun and tilted away from the Sun



Questions and Analysis

Part 1 – Spherical Model of the Earth and Sun System at Equinox

1. Examine Graph #1 for temperature changes at equinox, tilted towards the Sun and tilted away. Compare the graphs for each run. What patterns can be established in the data?

2. Examine Graph #1 for temperature changes at equinox, tilted towards the Sun and tilted away. What are the maximum temperatures of each run after 60 seconds? What is the explanation for the difference in temperatures?

3. Using the data from Graph #1, which "Run" represents spring/fall, which "Run" represents winter, and with "Run" represents summer? What information was used to make this determination?

4. Compare the winter and summer data. What is the difference in temperatures between these two? What explains this difference?

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