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A Year Viewed from Space

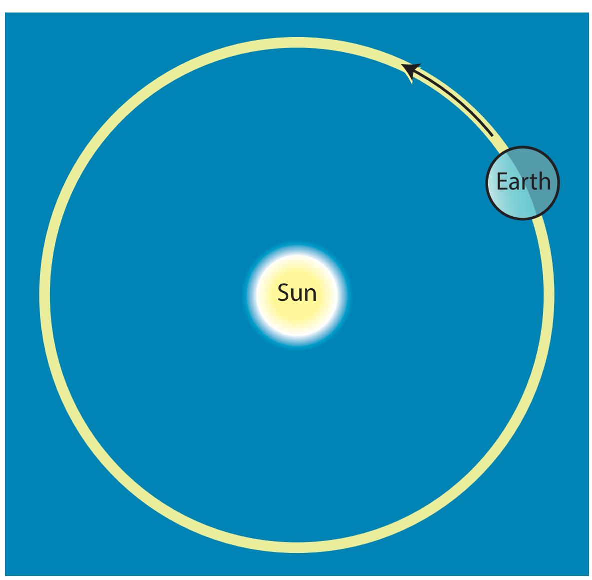
COMPUTER SIMULATION

A YEAR IS THE amount of time it takes Earth to complete one orbit around the Sun. Although the calendar shows 365 days in a year, Earth's year is actually about 365.24 days long. This is because Earth spins on its axis a little more than 365 times while making one complete orbit around the Sun. Earth's **axis** is the imaginary line passing through Earth's North Pole and South Pole. Each year on Earth, we observe patterns of changing temperatures, daylight hours, and seasons.

In this activity, you will use a computer simulation to model Earth's orbit around the Sun to help understand why we observe these patterns.

GUIDING QUESTION

What does Earth's orbit around the Sun have to do with seasons?



Diagrams like this one of Earth and its orbit around the Sun are much too small to show sizes and distances to scale, but they can help show how Earth orbits around the Sun.

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MATERIALS

For each student

1 computer with Internet access

1 Student Sheet 1, "Earth's Year Viewed from Space: Side View"

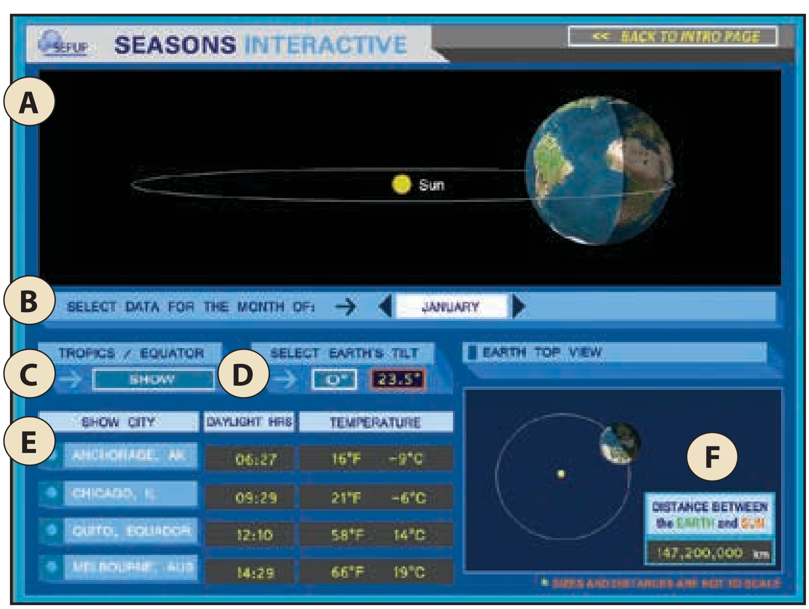
1 Student Sheet 2, "Earth's Year Viewed from Space: Top View"

PROCEDURE

Part A: Analyzing Data on Earth's Tilt and the Seasons

1. Open the Seasons Interactive Simulation, and review the introduction. Find each of the following on the screen:
   - North America and the United States
   - the Northern Hemisphere
   - the equator
   - the Southern Hemisphere
2. Begin the simulation by clicking in the "Continue to Interactive" box on the upper right of the screen. Find Earth and the Sun.

   Note: The size of Earth and the Sun, and the distance between Earth and the Sun, are not to scale.
3. Use the following diagram to find and set the six noted items on the screen:



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(A) **EARTH SIDE VIEW** shows Earth and its orbit.

(B) **MONTH SETTING**: Use the arrows to move from month to month.

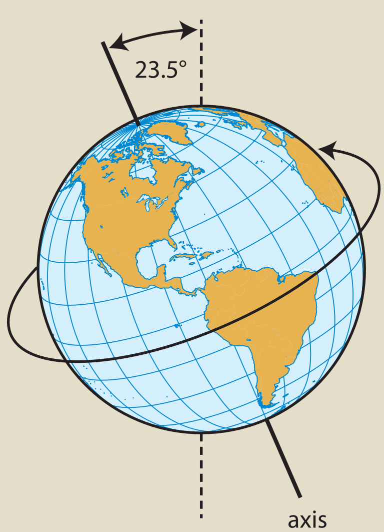
(C) **TROPICS/EQUATOR SETTING**: Make sure this is set to show.

(D) **EARTH'S TILT SETTING**: Make sure this is set to 23.5°, the actual tilt of Earth.

(E) **SHOW CITY BUTTONS**: Try clicking on each of these to see what happens. Then turn them all off.

(F) **EARTH TOP VIEW** shows Earth from above the North Pole in its orbit around the Sun.

4. Compare Student Sheet 1, "Earth's Year Viewed from Space: Side View," with the side view of the Sun and Earth at the top of your computer screen.
5. On the simulation, set the month for December, and click on the "Chicago, IL" button under "Show City."
6. Look at the top view and side view of Earth, and record each of the following on Student Sheet 1 for December in Chicago:
   - the position of Earth and direction of its tilt
   - the number of daylight hours



Earth's tilt refers to the fact that Earth's axis is not perpendicular or parallel to Earth's orbital plane around the Sun. Earth's axis is actually tilted about 23.5 degrees from perpendicular.

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7. Repeat Step 6 three more times: once for March, once for June, and once for September.
8. What do you think the number of daylight hours for Chicago would be in December, March, June, and September if Earth had 0 degrees (°) of tilt? Record your ideas.
9. Change the tilt to 0 degrees, and then describe what happens to daylight hours and temperature in Chicago as you change the months of the year and as Earth orbits around the Sun.
10. Return the tilt to 23.5 degrees. Now click on "Melbourne, Aus." Notice that Melbourne is in the Southern Hemisphere. Explore its daylight hours as you change the months. In your science notebook, record the following:
    - Melbourne's average daylight length in December and June
    - Melbourne's average temperature in December and June

Part B: Analyzing Data on the Earth-Sun Distance

11. In the simulation, look at the "Earth Top View." Notice how the distance from Earth to the Sun is displayed in kilometers at the bottom right corner.
12. Many people claim that Earth's seasons are caused by changes in Earth's distance from the Sun during different times of year. Write down whether you agree or disagree with this claim.
13. Set the month to December, the beginning of winter in the Northern Hemisphere. Record the distance from Earth to the Sun and the average temperature in the appropriate spaces on Student Sheet 2, "Earth's Year Viewed from Space: Top View."
14. What do you think the distance from Earth to the Sun will be at the start of spring (March)? of summer (June)? of fall (September)? Discuss your predictions with your partner.
15. Repeat Step 13 for March, June, and September. With your partner, discuss whether the data support or go against your predictions.

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ANALYSIS

1. In what month is the Northern Hemisphere most tilted toward the Sun?
2. In what month is the Northern Hemisphere most tilted away from the Sun?
3. Using what you learned from the computer simulation, explain how Earth's tilt affects the seasons and daylight length.
4. Does Earth's tilt change over the course of a year? Explain.
5. In which month(s) is Earth
   a. closest to the Sun?
   b. farthest from the Sun?
6. Based on what you have observed about the distance from Earth to the Sun, does the distance from Earth to the Sun determine the seasons? Explain using evidence from this activity.

EXTENSION

Graph the daylight length vs. month for one of the cities presented in the simulation or for your city in the United States. Compare it to the graph you did in the "Changing Sunlight" activity. How are the graphs similar? How are they different?