



Drexel-SDP GK-12 LESSON

Lesson: Why We Have Seasons

Subject Area(s) Earth and Space

Associated Unit Astronomy, module 2

Lesson Title Lesson: Why We Have Seasons

Grade Level 6 (3-7)

Lesson # 4 of 4

Lesson Dependency None.

Time Required 30 minutes

Heading

Summary

In this lesson we'll learn about the Earth's axis tilt of $23\frac{1}{2}$, and how the direct rays of the sun oscillate in north/south directions from the equator. At the end of the lesson, we will look at a graph plotting sunrise and sunset times from the last several months to extrapolate and make predictions.

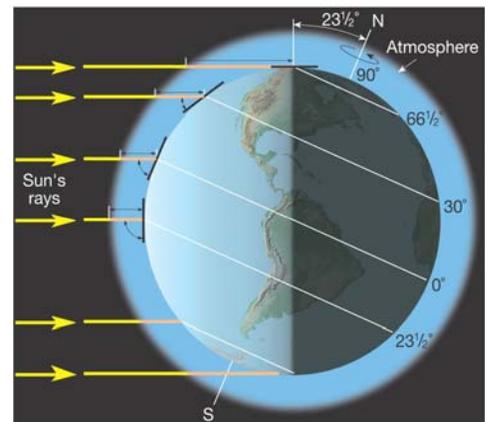


Image 1

ADA Description: Picture shows the tilt of the earth and angle of incidence of sun rays

Caption: Tilt of the earth and angle of incidence of sun rays

Image file name: fg02_04.jpg

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Engineering Connection

Engineers often must use solar panels to generate electricity for remote locations such as field research sites and spacecrafts. In a remote area, there is no luxury of a wall socket and electricity coming from the power company. In order to plan, the engineer must be very aware of the latitude of the location (e.g. how far north or south of the equator) to understand how much sunlight to expect. Also, the engineer must be aware of what season it is, because the amount of sunlight varies from winter to summer. In this lesson, students will understand WHY it matters what latitude we live in, and what season it is, because of the tilted angle of the earth.

Keywords

Astronomy, axis, equinox, seasons, solstice, tilt

Educational Standards (PA)

- Science: Physical Science, Chemistry and Physics – Astronomy 3.4.D
- Math: Computation and Estimation 2.2

Pre-Requisite Knowledge

Be familiar with the rotation of the earth and its revolution about the sun

Learning Objectives

After this lesson, students should be able to:

- **Describe what is a tilted axis**
- **Explain that the seasons are dependent on the angle of incidence of the sun,**
- **Explain how we measure a year's worth of time**
- **Describe if their location is above or below the tropics**

Introduction / Motivation

Why does it get cold in the winter? Why, when it's winter in Philadelphia, is it summer in South Africa? Do you think that in Philadelphia we are closer to, or farther away from the sun in the winter? In this lesson, we will dispel some common myths about the reason for the seasons, and learn how the Earth's tilt affects whether we feel warm or cold in the winter.

(This lesson is intended to help students understand why the seasons change, why planting takes place toward the summer solstice, and how to read, interpret and make predictions of a graph showing sun rise and sun set times from the last several months.)

Lesson Background & Concepts for Teachers

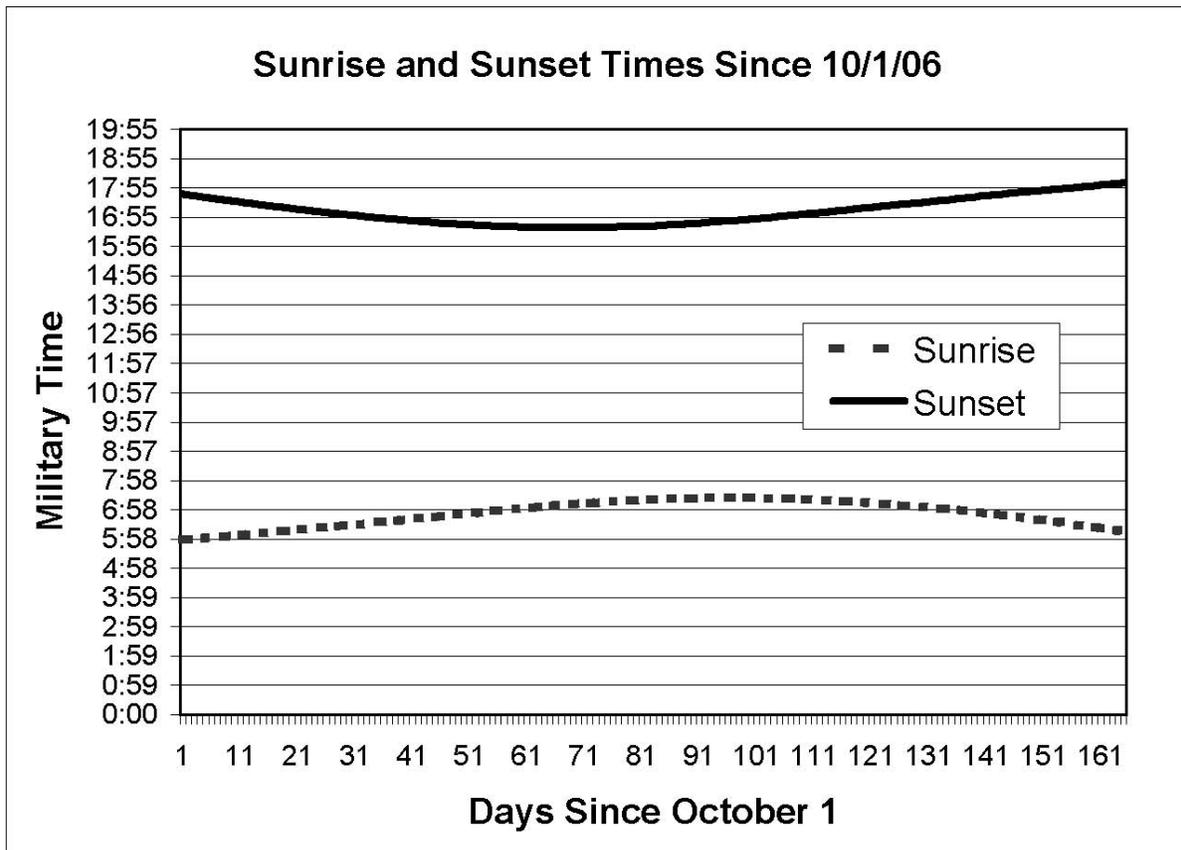
Step 1: Present the background material.

- a) What is **radiation**?
 - a. Radiation can travel through a **vacuum**; space is a vacuum
 - b. Radiation is absorbed by matter; the **atmosphere** is made of **matter**
 - c. **Visible spectrum** – (needed for **photosynthesis**)
 - d. **Invisible spectrum** – (needed for warm climate)

- b) **Angle of incidence** affects density of sun rays
 - a. Like quantity (hours) of sunlight, plants rely on the angle
 - b. Angled sun rays spread same amount of sun over larger area
- c) Angle of incidence changes with the seasons
 - a. Affected by the tilt of the Earth
 - b. Position of Earth w.r.t the sun determines the angle of incidence
- d) Philadelphia's sun rays
 - a. Will never achieve 90° direct sun rays!
 - b. Where is Philadelphia located in **latitude**? Inside or outside **tropics**?
 - c. What is significant about the area between the **tropics** (90° rays)
- e) The seasons
 - a. What is a **solstice**? When are summer and winter solstices in Phila?
 - b. What is an **equinox**? When do they occur?

Step 2: Distribute graphs asking students to make some **predictions**:

- a) What does the area between the curves represent? (length of a day)
- b) When is the area between the curves the smallest? (winter **solstice**)
- c) What happens after that date? (curves **diverge**)
- d) Will they **diverge** forever? (begin to **converge** on summer **solstice**)



Step 3: Discuss the material. If you were an engineer, do you think you could count on the seasons occurring at the same time each year, or do you think it's changing, like a weather pattern? Why or why not? Quickly review the material as a class in a Q&A format to see if they've understood what's been presented.

Vocabulary / Definitions

Word	Definition
Radiation	Energy that is transmitted in the form of rays
Visible spectrum	A phenomenon through which all objects attract each other. The more mass an object has, the greater its gravitational force.
Angle of incidence	The angle between a ray of light incident on a surface and a line drawn perpendicular to the surface
Latitude	Measurement of the distance from the equator
Tropics	The part of the Earth's surface between the Tropic of Cancer and the Tropic of Capricorn; characterized by a hot climate
Solstice	When the vertical rays of the sun are directly over the Tropic of Cancer or the Tropic of Capricorn. These represent the days with the most and the least daylight (depending upon what hemisphere you're talking about).
Equinox	Two times of the year when night and day are about the same length. The Sun is crossing the Equator.
Converge	To come together
Diverge	To drift apart

Associated Activities

None.

Lesson Closure

Follow with the Mathematics Activity: Calculate your weight on another planet

Assessment

Lesson Summary Assessment

If you require the students to take notes, ask to see the students' notebooks to ensure they have recorded the lesson notes. You may also design a short quiz of 5-6 questions to see if the students were listening. In addition, you may use the rubric below based upon classroom observations.

Students will be evaluated on a scale from 0 to 4 on:

Attentiveness

Participation

Contributors

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