Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

2275 Speedway, Mail Code C9000
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(512) 471-5847
www.esi.utexas.edu

Sunlight and Temperatures

Lesson Plan for Grades: 6th – 8th
Length of Lesson: 2 hours

Authored by: UT Environmental Science Institute
Date created: 08/01/2016

Subject area/course: Science, Earth

Materials:

- Angle of the Sun and Solar Energy (per team)
  - Yardstick or meter stick
  - Tape
  - Flashlight
  - Ruler
  - Protractor
  - Pen/paper
- Computers with internet access
- Pens, markers & posters for gallery walk

TEKS/SEs:

§112.18, §112.19, §112.20. Science

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

§112.20. Science

(7) Earth and space. The student knows the effects resulting from cyclical movements of the Sun, Earth, and Moon. The student is expected to:

(C) model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons

Lesson objective(s):

Students will

- Describe what are the equinoxes and solstices and when they happen.
- Calculate the duration of sunlight on a given day.
- Learn how tilt of the earth's axis affects sunlight duration and temperature in different locations.

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Differentiation strategies to meet diverse learner needs:

- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as verbal instruction and demonstration.

ENGAGEMENT (15 minutes)

- Teacher leads a discussion - what are some things that affect how hot a day can get (clouds, amount of sunlight, location, distance from the sun)?
- Teams try a quick experiment to see how sunlight and temperature are affected by the angle. Each team measure the amount of light produced by a flashlight when placed at different angles (90, 45 & 25 degrees). Teams should also note how bright or dim the light is for each instance.
- Teams briefly share their results with the rest of the class. Teacher introduces the project for this lesson: discover how the tilt of the earth can affect sunlight and temperatures in different places around the U.S.

EXPLORATION (20 minutes)

- Teams research one of the questions and present to the whole class.
  - What is the effect of distance on heat?
  - What is the effect of viewing angle on heat?
  - How does the amount of daylight change in different parts of the Earth?
  - What happens during the Vernal Equinox?
  - What happens during the Summer Solstice?
  - What happens during the Autumnal Equinox?
  - What happens during Winter Solstice?
    - Teacher walks around the room asking questions about what the students are doing.
    - Teacher listens to student ideas as they talk to each other.
    - Teacher provides support to students as needed (without providing the answer).

EXPLANATION (40 minutes)

- Each team does a 5-minute presentation about one of the questions related to sunlight and heat.
  - What is the effect of viewing angle (earth's tilt) on temperature?
  - How does the amount of daylight change in different parts of the Earth?
  - What happens during the Vernal Equinox?
  - What happens during the Summer Solstice?
  - What happens during the Autumnal Equinox?
  - What happens during Winter Solstice?
    - Teachers encourage students to explain concepts in their own words.
    - Teachers provide important ideas that students provide.
    - Teachers introduce vocabulary, formal labels or definitions as needed.

ELABORATION (45 minutes)

- Teams will now compare a city in Texas with one of the following locations around the U.S.:

Anchorage, Alaska	Orlando, Florida	San Francisco, California	Honolulu, Hawaii
Seattle, Washington	St. Paul Minnesota	New York, New York	Barrow, Alaska

- Teams must gather the following data:
  - Dates for the solstice and equinox for the previous year.
  - Sunrise and Sunset times for their two cities for the solstice and equinox dates.

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- Average temperatures for last year for the solstice and equinox dates in their selected locations.
- Teams will use the data gathered and a do a 5-minute presentation about what happened in their cities. Which location had longer daylight hours in the summer? Does the location affect temperatures in the summer?
- Teams by three other teams using the rubric provided.
  - Teachers ask student to use the new vocabulary appropriately.
  - Teachers encourage students to incorporate real world connections.

EVALUATION (throughout)

- Students will be evaluated on their presentations using the rubrics provided.
  - Teachers ask questions that provide insight into student progress.
  - Teachers observe students as they create posters and look for evidence of understanding.

SOURCES AND RESOURCES

- Dr. Michael Webber's *Hot Science – Cool Talks* #65, "Pecan Street Project: Smart Grids and Austin's Energy Future", www.hotsciencecooltalks.org
- Hot Chalk Lesson Plans, "Latitude, Angle of Sun and Solar Energy", http://lessonplanspage.com/sciencecisummerlatitudeangleofsunsolarenergy612-htm/
- U.S. Naval Observatory – Astronomical Applications Department, Sun or Moon Rise/Set Table for One Year, http://aa.usno.navy.mil/data/docs/RS_OneYear.php
- NC State University, Tilt and Latitude, http://climate.ncsu.edu/edu/k12/.Tilt
- National Weather Service, "The Seasons, the Equinox and the Solstices", www.weather.gov/cle/Seasons
- Weather Underground, "Historical Weather", https://www.wunderground.com/history/

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STUDENT HANDOUT (EXPLORATION): (20 minutes)

Your team will do a 5-minute presentation about ONE of the questions related to sunlight and heat.

- What is the effect of distance on heat?
- What is the effect of viewing angle (tilt) on heat?
- How does the amount of daylight change in different parts of the Earth?
- What happens during the Vernal Equinox?
- What happens during the Summer Solstice?
- What happens during the Autumnal Equinox?
- What happens during Winter Solstice?

Use the following references to learn more about the tilt, sunlight and temperature:

- NC State University, Tilt and Latitude, http://climate.ncsu.edu/edu/k12/.Tilt
- National Weather Service, "The Seasons, the Equinox and the Solstices", www.weather.gov/cle/Seasons

Your Question:
Explanation:

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STUDENT HANDOUT (ELABORATION): Daylight in U.S. (45 minutes)

Your team will compare the duration of sunlight in different locations in the U.S.

1. Choose the two locations you will use for comparison. Table 1 will be a location in Texas. Table 2 will be another location from the ones listed below:
   Anchorage, Alaska **Orlando, Florida** **San Francisco, California** **Honolulu, Hawaii**
   Seattle, Washington **St. Paul Minnesota** **New York, New York** **Barrow, Alaska**

2. Find the dates of the Equinoxes and Solstices for the previous year and add them to the "Date" column for each table.

3. Go to the U.S. Naval Observatory, "Sun or Moon Rise/Set Table for One Year", http://aa.usno.navy.mil/data/docs/RS_OneYear.php

   a. Use "Form A" and add the year you used to find the equinoxes/solstices.
   b. Select the "sunrise/sunset" table from the "Type of Table" drop down menu.
   c. Select the appropriate state, and add the City or Town name.
   d. Click the "Compute Table" button.

4. A new web page appears with the sunrise and sunset times for every day of the year you selected. Add the sunrise and sunset times for your first location. Repeat the process for your second location.

   Note: The times are provided in a 24-hour clock. To figure out regular times:
   a. Get the number listed in the table. If less than 1200, the first two digits are the hour and the last two are the minutes (for example 0735 is 7:35 a.m.).
   b. For times larger than 1200, just subtract 1200 from the listed time. For example, 2038 – 1200 = 838 which is 8:38 p.m.

5. Calculate the duration of daylight for the equinoxes and solstices in each location.

6. Go to Historical Weather (https://www.wunderground.com/history/) and get the average temperature for the equinoxes and solstice dates for each of your cities.

7. Create a poster with the information you discovered. Your team will do a five-minute presentation of your poster sharing the following information:
   a. Two locations you picked.
   b. Which location had longer daylight hours in the summer?
   c. Does the location affect temperatures in the summer?

8. Evaluate three team posters using the rubrics provided.

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Location #1: , Texas					
	Date	**Sunrise Time**	**Sunset Time**	**Duration of Daylight (hrs., min.)**	**Average Temperature**
Vernal Equinox					
Summer Solstice					
Autumnal Equinox					
Winter Solstice					

Table 1

Location #2:					
	Date	**Sunrise Time**	**Sunset Time**	**Duration of Daylight (hrs., min.)**	**Average Temperature**
Vernal Equinox					
Summer Solstice					
Autumnal Equinox					
Winter Solstice					

Table 2

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STUDENT HANDOUT: Poster Evaluations

Team: ____________________

1	2	3	4
Only one location is listed. Dates, times or temperatures are missing. Daylight duration not calculated.	Two locations are listed. It is missing the temperature, dates or time. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is calculated.

Comments: Questions:

Team: ____________________

1	2	3	4
Only one location is listed. Dates, times or temperatures are missing. Daylight duration not calculated.	Two locations are listed. It is missing the temperature, dates or time. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is calculated.

Comments: Questions:

Team: ____________________

1	2	3	4
Only one location is listed. Dates, times or temperatures are missing. Daylight duration not calculated.	Two locations are listed. It is missing the temperature, dates or time. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is not calculated.	Two locations are listed. Dates, times and temperatures are listed. Daylight duration is calculated.

Comments: Questions: