Big Freeze Pre-visit

Classroom Activities

Brief Synopsis

Students will research annual changes in daylight hours, average temperatures, and solar elevation. They will then compare the day-length with the corresponding daily temperatures. Students will explore the relationships between changes in daylight, changes in temperature, and how the elevation of the sun affects both.

Ages: Designed for 5th—8th grade

Time Considerations: 2 hours

Materials:

- Notebook paper
- Graph paper (3-4 sheets/group)
- Colored pencils or fine-tip markers
- Pencils/pens
- "Days Go By" Activity Worksheet (included)
- Overhead projector
- World Map transparency (included)
- Transparency markers
- Internet access

Vocabulary:

Planet, Axis, Orbit, Tilt, Rotation, Season, Temperature, Solar, Elevation, Degree, Hemisphere

Outcomes:

1. Students will explain what factors cause seasonal change.
2. Students will be able to describe seasonal differences in cities around the world.
4. Students will examine similarities and differences between seasons in the Northern and Southern Hemispheres.
5. Students will discuss factors that affect global climates.

Minnesota Academic Standards:

Science: 8.III.C, 9-12.III.B

Math: 5.III.A, 5.IV.A, 6.IV.A, 6.IV.B, 9-11.II.A, 9-11.III.A

Language Arts: 5.I.A, 5.I.B, 5.I.C, 5.III.A, 6.I.A, 6III.A, 7.I.A, 7.I.B, 7.III.A, 8.I.B, 8.III.A, 9-12.II.A, 9-12.II.C, 9-12.II.E

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Background:

Many living things prepare for winter by going through physiological changes, some of which are extreme. Because these changes cannot happen over night, plants and animals depend on clues that tell them it is time to start changing for winter. The change in daylight length is one of these important clues. Understanding the relationship between the tilt of the earth and the amount and strength (heat) of sunlight, helps to explain how so many plants and animals can complete these seemingly strange changes in time to be ready for winter.

Activity: Days Go By

As the earth orbits around the sun, it is constantly rotating around an axis, causing the regular changes we know as night and day. But the earth's axis is tilted at an angle, and it is this combination of orbit and tilt that is responsible for the earth's seasons. Students will divide up into groups to record three sets of data for different areas around the world.

Procedure:

1. Gather the materials listed on the left. A world map template is included in these materials if you would like to create a transparency for students to mark their city's location, or you may use your own map or poster.
2. Print off the list of selected world cities for students to choose from, and the activity worksheet on which students will record their findings (one worksheet per group).
3. Have students divide up into groups of 3 to 4 individuals.
4. Have each group choose a city from the list provided; make sure that no two groups have selected the same city (Tip: Have groups pick cities from many different latitudes). Have groups find and mark their city on the world map transparency. Select a year that all groups will use; the previous full year works best (i.e. if it's 2008, use 2007 records). Give each group a "Days Go By" activity worksheet to record their city's data.

Step 1: Finding day length. Day-length refers to the number of hours each day during which there is daylight. How to find day length for your city:

- Visit the website: **http://www.sunrisesunset.com/custom_srss_calendar.asp**
- Find your city on the "*Select a city*" menu.
- Select the month and year.
- Deselect the twilight, moonrise/moonset times, and moon phase options.
- Click on the *Select* button.

- Record the **sunrise** and **sunset** times for the first day of the month (i.e. January 1).
- Repeat these steps until you have the sunrise and sunset times for the first day of all twelve months (January – December) of the designated year.

Step 2: Finding monthly temperatures. Each group will need to find the average monthly temperatures for their city.

How to find the temperature records:

- Visit the website: **http://www.weatherbase.com/**
- Enter the city and country into the search box. Click on "*Search*".
- Click on the city name.
- Record the average temperature for each month

Step 3: Finding solar elevation. Solar elevation refers to the angle between the direction of the sun and the (idealized) horizon; it tells us how high the sun is above the horizon.

How to find the solar elevation:

- Visit the website: **http://www.srrb.noaa.gov/highlights/sunrise/azel.html**
- Select your city from the **city** menu.
- Select the **month**, enter the date and year.
- Enter 12:00:00 in the **time** menu (select the 24-hr option).
- Click on **Calculate Solar Position**, then record the **solar elevation** from the box below.
- Repeat these steps until you have recorded the solar elevation for the first day of each month for the entire designated year.

5. On three ***separate*** sheets of graph paper, graph the following:
   1) Average monthly temperatures;
   2) amount of sunlight present each month;
   3) the solar elevation for each month of the year.
6. Students should present their findings to the class. Discuss the connection between the three sets of information they have graphed.

Other questions to discuss could include:

- How do the three factors change throughout the year? How are they related to each other?
- What causes this seasonal change in day-length?
- Which influences temperature more: The *amount* of daily sunlight, or the *elevation* of the sun? Why?
- What are the similarities and differences in the three measurements between cities in different parts of the world?
- How does your city's location affect the three factors you measured?
- How would the seasons be different if (your state) was located in the Southern Hemisphere (south of the equator)?
- What are some other factors besides day-length and solar elevation that can affect a region's climate?

Teacher Tips

- Have additional graph paper available for students who may need it.
- A globe or ball can be useful for helping students visualize how the earth is tilted on it's axis.
- For ideal results when graphing the three sets of information, the months should be on the x-axis. (See the example graphs included.)
- You can have the groups graph their results on transparencies instead of graph paper, which may make it easier for them to display their results for the class.

Additional Resources

http://aa.usno.navy.mil/data/docs/RS_OneDay.php
Complete sun and moon data for each day, presented by the U.S. Naval Observatory Astronomical Applications Department.

http://www.lpi.usra.edu/education/skytellers/seasons/activities/light.shtml
Website with day-length activities and questions for students about seasonal dynamics associated with day-length.

http://csep10.phys.utk.edu/astr161/lect/time/seasons.html
Website discussing what causes the seasons, including images and diagrams.

http://www.scienceu.com/observatory/articles/seasons/seasons.html
Website discussing what causes the seasons, including images and diagrams.

Days Go By Worksheet

Names: _____

City: _____

Year (using for records): _____

Day Lengths:

	Sunrise time	Sunset time	Hours of Daylight
January 1			
February 1			
March 1			
April 1			
May 1			
June 1			
July 1			
August 1			
September 1			
October 1			
November 1			
December 1			

Monthly Temperatures:

	Average temp.		Average temp.
January		**July**	
February		**August**	
March		**September**	
April		**October**	
May		**November**	
June		**December**	

Solar Elevation:

	Solar Elevation		Solar Elevation
January 1		**July 1**	
February 1		**August 1**	
March 1		**September 1**	
April 1		**October 1**	
May 1		**November 1**	
June 1		**December 1**	

World Cities List

Anchorage, United States
Beijing, China
Berlin, Germany
Bombay, India
Buenos Aires, Argentina
Cairo, Egypt
Cape Town, South Africa
Caracas, Venezuela
Hong Kong, China
Honolulu, United States
Jerusalem, Israel
London, England (United Kingdom)
Los Angeles, United States
Mexico City, Mexico
Minneapolis, United States
Moscow, Russia
New Delhi, India
New York City, United States
Ottawa, Ontario, Canada
Paris, France
Rio de Janeiro, Brazil
Rome, Italy
Sydney, Australia
Tokyo, Japan

Sample data graphs