The Reason for Seasons

**Content Objective**:

* Standard 2: Students will understand how the Earth’s tilt on its axis changers the length of daylight and creates the seasons.

**Language Objective**:

* Standard 1: Write arguments focused on discipline-specific content; Standard 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to the task, purpose and audience.

**Essential Question**: *How does the position of the Earth affect the temperature in different regions?*

**Intended Learning Outcomes**:

* 1. Use Science process and Thinking Skills.
* 2. Communicate Effectively Using Science Language and Reasoning.

**Digital Resources**: Use the following cite (among others) for weather information [www.weather.com](http://www.weather.com) .

**What kind of writing instruction and/or the intended outcome result in**: *Informative and explanatory writing.*

**Strategies**: *no multiple revisions* (to save sanity)

**Texts** *(Narrative and informational):*

* Mysterious Change of the Seasons, Reasons for Seasons (Allison); others as chosen by teacher.

**Assessment**:

Year-end journal, graphs, monthly oral or written observations of seasonal changes.

**The Reason for Seasons**

**Science Standard II**: *Students will understand how the Earth’s tilt on its axis changes the length of daylight and creates the seasons.*

**Math Standard 6 SP 5**: *Summarize and describe distributions in relation to their context*.

**Reading Standard (**Key ideas and details**) 1***: Cite specific evidence to support analysis of primary and secondary sources.*

**Writing Standard** (Text Types and purposes) **1**: *Write arguments to support claims in an analysis of substantive topics or text using valid reasoning and relevant and sufficient evidence.*

**Background knowledge**:

Have you ever run laps on a track? When you complete one lap you are back in the same place you started. Earth moves around the sun in a path that nearly repeats itself (like running a track) about every 365.25 days. Earth's path around the sun is called its orbit.

Earth's axis of rotation is an imaginary line that passes through Earth's North and South poles. Earth rotates around this axis, which causes day and night. Earth's axis of rotation is not straight up and down with respect to its orbit, but is tilted by about 23.5 degrees with respect to this up and down direction.

If you have ever watched the North Star, you may have noticed that it seems to stay in the same place in the sky all of the time. It is almost directly above Earth's North pole. This shows that Earth's axis of rotation points in the same direction while Earth both rotates on its axis and moves in its orbit around the sun. About June 21 every year, Earth is at a place in its orbit where the northern side of its axis is tilted toward the sun. Six months later, about December 21, Earth is on the other side of the sun where its northern axis is tilted away from the sun.

When the northern side of Earth is pointed away from the sun in December, the sun appears low in the sky and the angle of the sun's rays is small. In June when the northern side of Earth is pointed toward the sun, the sun appears high in the sky, and the angle of the sun's rays is large. In the spring and fall the angle of the sun's rays is half way between the angle in winter and the angle in summer.

The days with the least amount of daylight are not the coldest days, nor are the days with the most amount of daylight the warmest days. This is because some materials can be heated and cooled quickly (especially metals). Other materials can absorb heat without changing their temperature very much, so it takes a long time to heat and cool them. Water is a good example of this. About 3/4 of Earth's surface is covered by water which causes the heating and cooling of Earth to take place slowly. Although the maximum amount of heat received by the sun in the Northern hemisphere occurs on June 21, the highest average temperatures occur about one month later. Similarly, the lowest average temperatures occur after the date when the Northern Hemisphere receives the least amount from the sun.

**Materials**:

* Outdoor thermometer, graphing paper, sunrise, sunset and temperature dates for SLC, board with three (or more) cuts in it, two angled at 23.8 (degrees) in opposite directions and one at 90 (degrees), three or more #10 can lids spray-painted black (preferably flat black but semi-gloss would work).

**Instructional Procedures**:

In this activity students will learn how Earth's axis of rotation affects the angle of sunlight and the length of day. Students will learn the relationship between the amount of light falling on the Earth and the temperature experienced by various parts of the planet. They will record the temperatures; both those experienced locally (SLC) and those experienced in a different part of the planet (e.g. Peru, Switzerland, etc.) over a three month period. Students will compare day length with given “real time” temperatures, and graph both.

1. Teacher and students will share and discuss the article “The Mysterious Change of Seasons.” Students will be able to draw the inference that the amount of sunlight to which a portion of the planet is exposed determines the temperature experienced by people living there.
2. Set the board and can lids outside in a sunny spot (preferably one that will be undisturbed during the time of the experiment). Face the can lids toward the sun for maximum exposure. After a short time in the sun, tell the students they are to choose a can lid and feel its temperature. This would be a good time to discuss the scientist’s use of senses for observational purposes. Have them record their observations of the heat from the can lids in their science journals.
3. Arrange for an outdoor thermometer to be placed outside your classroom (not in direct sunlight). Have students record the high temperature for the days. You will need to work out a system for finding the high reading. An alternative to tracking and recording the actual temperatures is to find and record the official weather temperatures in the newspaper or on the Internet. Tell students they will be recording daily (weekly, monthly) temperatures throughout the year … teacher’s choice. Each group of students will then determine a geographical place (Southern Hemisphere, northern Hemisphere, etc.) to follow temperature-wise, for the coming year. As students record these temperatures they will be averaging them each month and graphing their results for both hemispheres.
4. Before going outside to measure, decide as a class on a format for keeping track of the records in student science journals. Have students record the date, time and temperature in their science journal. Have students calculate the average (include mode, median, and range in these calculations) and graph the results on a weekly or monthly basis.
5. Continue to make observations with the whole class throughout the year. Have students also use the internet to find temperatures of their chosen planetary location(s). In the beginning, little change will be noticed, but it will set the pattern for further observations. Graph the results monthly. Use the graphs and data to create a set of future weather predictions.
6. Also, once a week have students note that the sun rose at … (xyz time) and is supposed to set at (wxy) time throughout the school year . Have students calculate the amount of time the sun was shining. Periodically discuss with your class what is happening to the length of the day and relate it to the changes one sees in the temperature. Have them note what is happening to the amount of daylight. This is a good time to discuss the changing sunrise and sunset times. Discuss why this is happening. Be sure students know that Earth's axis of rotation is the reason for the sun's changing position (summer = almost directly overhead at noon, while in winter the sun would appear to be at an angle of approximately 35 (degrees) to the vertical.

**Assessment:**

Checklist for monthly graph and journal.

Checklist for end of year project.

**Some possible extensions**:

1. Students locate and track on the internet the live feed of various temperatures and sun positions throughout the world.
2. Compare using different graphs.
3. Use this demonstration to show students how water heats and cools relatively slowly. Fill a pan with water and place it on a hot plate, turned on high. Help students notice that the pan heats up quickly, but the water does not. Monitor the temperature of the water throughout the experiment. Turn the hot plate down slightly to medium-high. Observe whether the water becomes immediately cooler. It does not. Actually the water temperature may go up. The water temperature does not respond quickly to temperature changes. Relate this to how the earth's surface (3/4 water) does not heat up or cool down immediately.

**Internet Resources**:

https://mail.graniteschools.org/owa/14.2.283.3/themes/resources/clear1x1.gifhttps://mail.graniteschools.org/owa/14.2.283.3/themes/resources/clear1x1.gif

Smith, Pamela C

You make me laugh! Thanks Sent from my iPad

10:01 AM

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[http://www.science-class.net/Astronomy/Seasons.htm](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fwww.science-class.net%2fAstronomy%2fSeasons.htm)

[http://physics.weber.edu/schroeder/astro/](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fphysics.weber.edu%2fschroeder%2fastro%2f)

[http://fuse.pha.jhu.edu/~wpb/globe.html](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2ffuse.pha.jhu.edu%2f%7ewpb%2fglobe.html)

[http://geology.com/](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fgeology.com%2f)

[http://www.nsta.org/publications/interactive/aws-din/aws.aspx](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fwww.nsta.org%2fpublications%2finteractive%2faws-din%2faws.aspx)

[http://www.physics.ucla.edu/k-6connection/](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fwww.physics.ucla.edu%2fk-6connection%2f)

[http://osr.org/en-us/articles/great-space-and-astronomy-lesson-plan-ideas/](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fosr.org%2fen-us%2farticles%2fgreat-space-and-astronomy-lesson-plan-ideas%2f)

[http://goodsitesforkids.org/Astronomy.htm](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fgoodsitesforkids.org%2fAstronomy.htm)

[http://coolcosmos.ipac.caltech.edu/cosmic\_classroom/ask\_astronomer/video/index.html](https://mail.graniteschools.org/owa/redir.aspx?C=Jpe7CdwY1Eqwgej7Y2OlNwce9hrqHc8IUnmZzPYWaAkNx4ujURptyZiwBx5AidbA61iPFAb3pYE.&URL=http%3a%2f%2fcoolcosmos.ipac.caltech.edu%2fcosmic_classroom%2fask_astronomer%2fvideo%2findex.html)