Idea Bank

CHANGING SEASONS

To teach students about seasonal changes, I developed an activity in which students visualize how the Sun's rays diffuse more during winter in the Northern Hemisphere (when the Earth's north axis is pointed away from the Sun) than they do in the summer (when the Earth's axis is pointed toward the Sun).

The activity is inexpensive and easy to set up. Necessary materials include a flashlight, a ringstand, a globe, a paper star, tape, and a pencil. The set-up must be done before students begin the activity. First, I use numbered pieces of paper to mark four places on a table to position the globe—1 is spring, 2 is summer, 3 is autumn, and 4 is winter. I then place the ringstand and flashlight on the table closest to position 4; this way the globe will be closest to the flashlight in "winter" and furthest away during the "summer."

Next, I place the paper star (which represents Polaris) on the wall above position 4. Finally, I lay the flashlight on the ringstand and adjust the height of the ringstand so that the flashlight shines on the Tropic of Capricorn when the globe is placed in position 4 with its northern axis pointing toward Polaris (see photo, right).

Working in groups of three or four, students begin by placing the globe in position 1 and moving it counterclockwise around the table to each "season." I emphasize the importance of keeping the axis pointed toward Polaris at all times. With the globe in each position, the students answer the following questions:

1. Where is the light being received most directly?
2. How is the Sun's energy being distributed?
3. What season is it?

Once students finish the basic lab, I give them a worksheet with other questions to answer. These include questions about the number of daylight hours at various places on the Earth, how seasons in the Northern Hemisphere compare to those in the Southern Hemisphere, and how the distance from the Sun to the Earth relates to the seasons. Usually students will have to repeat the activity to answer all of the questions. Students must also determine where on the Earth the Sun's rays directly hit at noon on the spring equinox (the equator), the summer solstice (Tropic of Cancer, 23.5° N), the fall equinox (the equator), and the winter solstice (Tropic of Capricorn, 23.5° S). Students can then relate this information to the tilt of the Earth being 23.5°.

When students understand that the tilt of the Earth affects the seasons, they can discuss what seasons would be like if the Earth were not tilted and what the seasons are like on Uranus, which is tilted almost completely on its side. The students once again take the globe through all four positions, first with the globe positioned so there is no tilt, and then with the globe tilted 90 degrees.

To visualize changes in day length, students place a straight line of toothpicks on the globe, each toothpick at a 90 degree angle to the surface of the globe. The toothpicks can be adhered to the globe with a small piece of Play-Doh. When the flashlight is on, students can see not only the difference in day length as it relates to season and geographical position but also how the flashlight's

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rays spread out more across the surface of the globe when the flashlight is positioned further north or south of the equator. This can be visualized very clearly with the room lights turned off.

Because the flashlight is off-center on the table, students understand that the Earth's distance from the Sun is not the reason for the seasons. The activity can also be set up so the position of the globe more accurately simulates Earth's orbit—the Earth should actually be closest to the Sun shortly after the winter solstice (January 3, perihelion) and furthest away from the Sun shortly after summer solstice (July 4, aphelion).

I assess this activity in two ways. First, I check students' answers to the questions mentioned earlier. Most students answer the three introductory questions correctly. After the activity, students answer these follow-up questions:

1. What causes the seasons?
2. If it is summer in the Northern Hemisphere, what season is it in the Southern Hemisphere?
3. Does the distance from the Sun have any effect on the seasons?

Another way to assess students is to use a rubric (Figure 1). The rubric developed for this activity provides a clear understanding of expected outcomes and gives students a precise quantitative score (Jensen,

FIGURE 1.

Rubric for assessing seasons activity.

TOPIC	SCORES			
	4.	3.	2.	1.
Collaborative effort: Student takes charge of actions during group activity.	Student willingly participates in group activity, volunteers for active roles, encourages sharing of ideas and opinions, cooperates with other groups.	Student needs encouragement to participate, stays on task, accepts role within group, shares ideas with others, works well with other groups.	Student requires prompting to work with the group, must be reminded to stay on task, accepts team role, grudgingly shares ideas, unhappy to work with other groups.	Student is uninvolved with the efforts of the group, does not focus on the task, refuses to accept a role within the group, does not share ideas, will not work with other groups.
Skills and processes: Student uses scientific skills and processes and intuitive reasoning ability to explore, discover, and explain why there are seasonal changes.	Student explores various relationships of the Sun's rays and tilt of the Earth to the position of the globe, makes observations, records proper findings, demonstrates problem solving.	Student explores limited relationships of the Sun's rays and the Earth's tilt to the position of the globe, makes some observations, records some proper findings, tries to solve problems.	Student needs assistance to find relationship of Sun's rays and the Earth's tilt to the position of the globe, makes few observations, records few findings, does not demonstrate problem-solving skills.	Student does not try to relate the Sun's rays and the Earth's tilt to the position of the globe, does not make any observations, does not record any findings, does not attempt to solve problems.
Content analysis: Student responds to discussion questions and intuitive learning.	Student relates the distribution of the Sun's rays, the tilt of the Earth, and the position of the globe to the seasons; compares seasons of Earth to other planets; relates day length to Earth's tilt and position; communicates clearly and coherently.	Student relates the distribution of the Sun's rays, the tilt of the Earth, and the position of the globe to the seasons; does not compare the seasons of the Earth to other planets; does not relate day length to Earth's tilt and position; communicates understandably.	Student has difficulty relating the Sun's rays, the Earth's tilt, and the position of the globe to the seasons; does not compare seasons of the Earth to other planets; does not relate day length to Earth's tilt and position; communicates poorly.	Student does not relate distribution of the Sun's rays, the Earth's tilt, and the position of the globe to the seasons; does not compare the seasons of the Earth to other planets; does not relate day length to Earth's tilt and position; will not respond to discussion questions.

1995; Luft, 1997). This activity is always one of my favorites because students learn a lot and make very positive comments.

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REFERENCES

Jensen, K. 1995. Effective rubric design. *The Science Teacher* 62(5):34–37.

Luft, J. 1997. Design your own rubric. *Science Scope* 20(5):25–30.