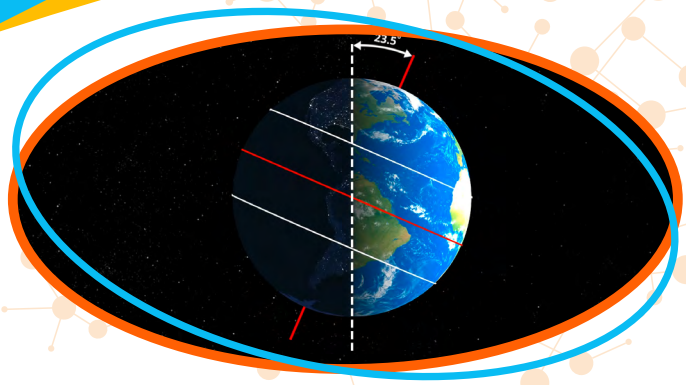
GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.



TEACHER GUIDE

CAUSES OF SEASONS
GRADES 6–8

COMMON MISCONCEPTIONS

- **Earth's orbit brings it closer to the Sun in the summer and farther away from the Sun in the winter.**
  The Northern and Southern Hemispheres experience opposite seasons. Earth's orbit is nearly circular, so variations in distance from the Sun have very little effect compared with the effects of the variations in the angle of incoming sunlight. The differing angle of incoming sunlight is caused by Earth's tilt toward or away from the Sun, depending on Earth's position in orbit around the Sun at that time of year.

- **The intensity of sunlight is always greater in a region that has more hours of daylight.**
  For two different latitudes north of a tropical region, the intensity of sunlight is always greater at the place that is closer to the tropical region, even though there may be more hours of daylight in some regions further north. The intensity of sunlight is not dependent on the number of hours of sunlight. It depends on the angle in which the sunlight hits that location on Earth.

- **The equator always has the most hours of daylight, and the North Pole always has the fewest hours of daylight.**
  Sometimes the North Pole has the most hours of daylight compared with everywhere else on Earth, and sometimes it has the fewest. But the equator always has 12 hours of daylight every day of the year.

THE EARTH-SUN SYSTEM

Earth and the Sun interact within a cyclical system balanced by motions and forces. This means that there are many cycles within this system, including the following: Earth orbits the Sun once per year, Earth rotates on its axis once every 24 hours, and Earth's Northern and Southern Hemispheres have a specific position in relation to the Sun for each season. The exact positions of the components or parts of the Earth-Sun system can be modeled to explain phenomena related to seasonal changes such as hours of daylight and average temperature.

INTENSITY OF SUNLIGHT

The Sun produces a constant amount of energy that emanates from its surface. The intensity of sunlight refers to the amount of incoming solar energy, or radiation, that reaches Earth's surface. The angle at which the rays of sunlight hit Earth determine the sunlight's intensity. The intensity of sunlight that hits Earth varies significantly depending on the geographic location, the time of year, and the time of day. The Sun's rays are most intense when the Sun is directly overhead and the angle of sunlight hitting Earth measures 90°. At most times and locations, the Sun forms an angle with

the horizon that is less than 90°, causing the sunlight to be less intense. The smaller the angle, the greater the surface area over which the Sun's rays spread, thus creating a lower intensity of sunlight.

CAUSES OF SEASONS

Earth has seasons because its axis is tilted. Earth rotates on its axis as it orbits the Sun, but the axis always points in the same direction. The Northern and Southern Hemispheres experience warmer summers and colder winters at opposite times of the year because of the differences in intensity of sunlight for each of these regions. In December, the Sun shines more directly on the Southern Hemisphere, with the North Pole pointing away from the Sun. This creates winter in the Northern Hemisphere and summer in the Southern Hemisphere. In June, the Sun shines more directly on the Northern Hemisphere, with the North Pole pointing toward the Sun. This creates winter in the Southern Hemisphere and summer in the Northern Hemisphere.

TEACHER TIPS

As students build and draw models of the Earth-Sun system, use guiding questions to help facilitate the sensemaking process. Sensemaking is actively trying to figure out how the world works. In this lesson, students manipulate physical models and draw models to help develop an understanding of the science ideas necessary to explain the patterns in average monthly temperatures and hours of daylight that align with each season.

ABOUT THIS LESSON

This lesson was created by the National Science Teaching Association (NSTA) to pair with the Generation Genius video and support *NGSS*.

They have requested we provide the following background with this lesson:

The Next Generation Science Standards (NGSS) are the national standards on how students learn science, and they are based on contemporary research presented in *A Framework for K–12 Science Education (the Framework).* The shift in science teaching and learning required by the Framework is summarized in this infographic: A New Vision for Science Education.

At the start of each Generation Genius lesson, students are presented with a phenomenon, then they try to explain it. Students will notice they have gaps in their knowledge and ask questions, which motivates them to build ownership of science ideas they need in order to explain how or why the phenomenon occurred. The way students build ownership of science and engineering ideas is through active engagement in the science and engineering practices (SEPs). This process of sensemaking, or doing science to figure out how the world works, is one of the major shifts the *Framework* encourages.

To engage in the SEPs, students should be part of a learning community that allows them to share their ideas, evaluate competing ideas, give and receive critiques, and reach consensus. Students can start by sharing ideas with a partner, then with a small group, and finally, with the whole class. This strategy creates opportunities for all students to be heard, build confidence, and have something to contribute to whole-class discussions. Each Generation Genius lesson provides conversational supports to facilitate such productive student discussions to contribute to sensemaking.

Excited to continue your shift toward the new vision for science education? Check out the Generation Genius Teacher Guide page on the NSTA website for resources and strategies to engage every student in your classroom in **doing** science.