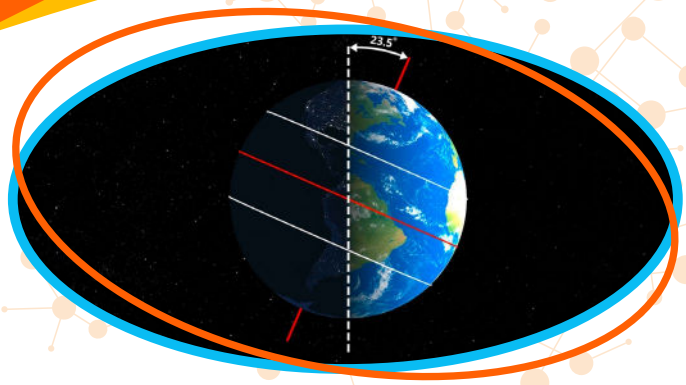
GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.



LESSON PLAN

CAUSES OF SEASONS
GRADES 6-8

SUMMARY

Students will develop and use a model of the Earth-Sun system to describe how the relationships between Earth and the Sun create the patterns of seasons and temperature differences in locations throughout the Earth.

NEXT GENERATION SCIENCE STANDARDS CORRELATION

MS- ESS1-1. Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and the seasons.

Science & Engineering Practices	Connections to Classroom Activity
Developing and Using Models	• Students use foam balls to create a model of the Earth-Sun system to describe the patterns of seasons. • Students draw a model of the Earth-Sun system to explain the pattern of monthly average temperature readings in specific locations.

Disciplinary Core Ideas	Connections to Classroom Activity
ESS1.B. Earth and the Solar System This model of the solar system can explain eclipses of the Sun and the Moon. Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	• Students develop and use models of the Earth-Sun system to describe how seasons are a result of the tilt of Earth and different amounts of sunlight intensity.

Cross Cutting Concepts	Connections to Classroom Activity
Patterns	• Students identify patterns in monthly average temperatures at specific locations. • Students use models to describe patterns in the Earth-Sun system that result in seasons.

DURATION

90 minutes

MATERIALS

- 1 small foam ball
- 1 larger foam ball
- 2 wooden skewers
- Lamps with light bulbs or flashlights
- Poster paper or board
- Markers

ENGAGE

Students work in pairs to identify patterns in the monthly average temperatures for Fort Worth, Texas, over the past 100 years. If students are finding the large data set overwhelming, you can provide them a graph of the average monthly temperatures for Fort Worth. Encourage these students to use both the data table and graph to identify patterns.

Students share their findings with the class. Record the patterns shared on the board or on poster paper.

EXPLORE

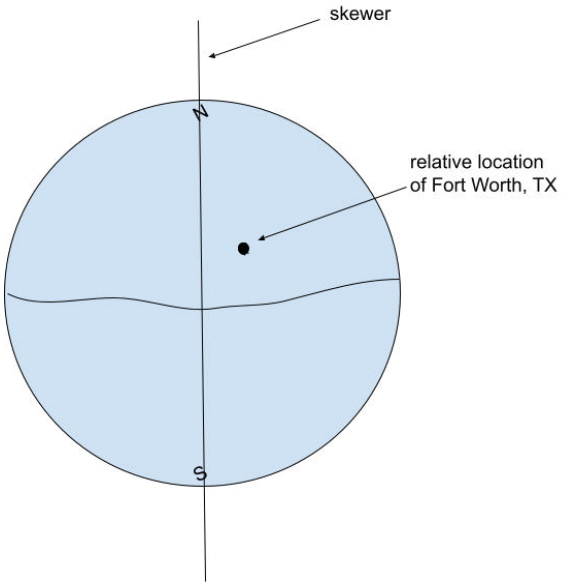
Tell students, “We are going to try to create a model to explain the patterns we found in the average monthly temperatures in Fort Worth, Texas, over the past 100 years.”

Each pair of students should follow these instructions:

1. Place the smaller foam ball on a wooden skewer to represent the Earth. The skewer represents the Earth’s axis.
2. Draw an N next to the skewer on one side of the foam ball to represent the north pole. Turn the foam ball over and draw an S next to the skewer on the other side to represent the south pole.
3. Hold the skewer perpendicular to the floor. Draw a circle around the foam ball to create a northern half (northern hemisphere) and southern half (southern hemisphere) of the foam ball. This line represents the equator.
4. Mark a dot to show the relative position of Fort Worth, Texas (use latitude of Fort Worth, Texas, to determine where to place the dot).

If needed, teachers may create the Earth models before class begins to save time. Using pre-made representations of Earth gets students to the sensemaking part of the lesson (creating an explanatory model) more quickly.

Place the larger foam ball on a wooden skewer to represent the Sun. Tell students, “Talk to your partner and come to an agreement about how you think the positions of Earth and the Sun change relative to each other from season to season.”



Next, give students the opportunity to use a lamp or flashlight as the Sun to test their ideas about the relative position of the Sun and Earth during each season. Students should be able to equate the amount of light (or brightness) falling on each hemisphere with the season.

While students are exploring the interactions between the components (parts) of the model, facilitate student sensemaking using guiding questions such as the following:

- Using the lamp, how might you determine when a hemisphere is receiving more direct light?
- How do you think Earth's tilt relative to the Sun changes from season to season?
- How are you representing the motion of Earth?
- What cause-and-effect relationships do you think exist between Earth and the Sun when it is summer in the Northern Hemisphere?

You might need to remind students Earth's axis is tilted 23.5° (with respect to plane of Earth's orbit) from vertical and always points toward the star Polaris. They will need to make sure the axis is always pointing in the same direction as they work to create their models. Consider telling students to keep their Earth axis pointed at the same wall in the classroom.

EXPLAIN

Bring students back together to share their thinking. Prompt them to try and use these ideas to help explain the patterns found as a class in the monthly average temperatures in Fort Worth, Texas, over the past 100 years. Ask students to turn and talk with their partner about questions that they still have about the phenomenon that were not answered by their models. Have each pair share one question and add these questions to the poster paper.

WATCH THE GENERATION GENIUS CAUSES OF SEASONS VIDEO AS A GROUP

ELABORATE

After watching the video, have students work in small groups or with a partner to draw a model to explain the patterns found as a class in the monthly temperatures in Fort Worth, Texas, over the past 100 years. Have students label each component (part) and show the relationships that exist between the components. For example, arrows can be used to show the motion of Earth relative to the Sun.

One new component that should be included in student-created models is light intensity. Guiding questions can be used again to support students in creating their models and making sense of the science ideas.

Bring the class together to create a class consensus model. A consensus model is drawn by the teacher in front of the class using input from students. Have each small group or partnership share one component or interaction of their model to include in the consensus model.

Ask students if the class consensus models explain the patterns in the Ft. Worth, TX average monthly temperature data. Consider providing student groups the name and location of cities located in the Northern and Southern Hemisphere and at varying distances from the equator and use their models to predict the pattern of temperatures over the course of one year. Students do not have to guess the actual temperatures; hot, warm and cold will suffice. For example, if students were given a location just south of the equator, they might say the temperatures are almost always hot because the intensity of sunlight is high year round, but it would be hottest in January because the Earth is tilted away from the Sun and the area south of the equator receives the most intense sunlight.

EVALUATE

There are multiple ways to assess your students' understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.

EXTENSION

Provide students with average monthly temperature data from other places around the world, including your local area. Provide graphs showing the hours of daylight per month for two regions located at different latitudes in the same hemisphere and compare those with average monthly temperatures for those two places. Have students make a list of the similarities and differences between two or more regions. Provide an opportunity for students to revise their small-group models to include explanations of these phenomena.