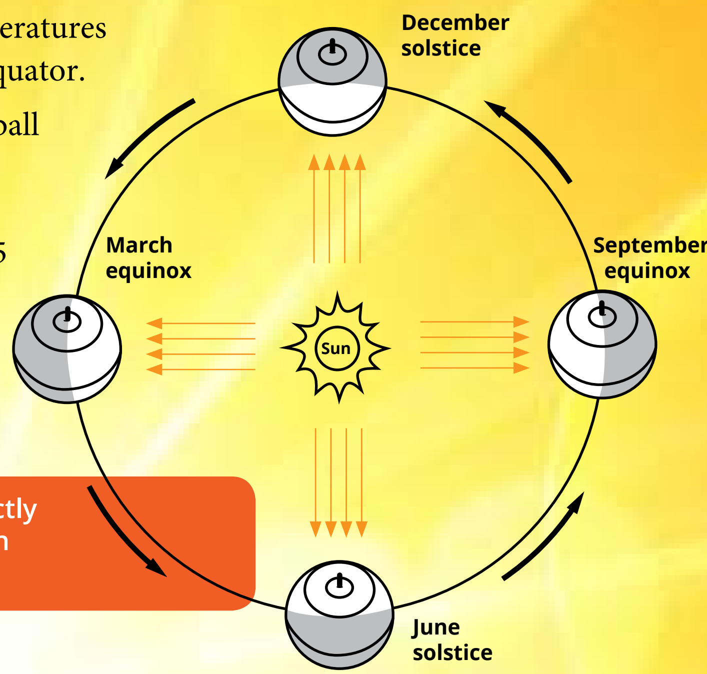
eo Kids

earth observatory for kids

All About that Tilt
Sun & Seasons

If the Earth had no tilt, there would be no seasons. Temperatures would just get colder the further you traveled from the equator.

Why is this? The Earth spins on an **axis**. When a basketball player spins a ball on their finger, they are spinning it on an axis. The axis for the basketball is vertical (straight up and down), but Earth spins on an axis that is tilted —23.5 degrees to be exact. Earth's axis always points in the same direction. Because of this, the part of Earth that receives the most direct rays from the Sun changes as the Earth travels around the Sun.



At the **equinox**, the Sun's rays shine most directly on the equator, and the Northern and Southern Hemispheres get the same amount of Sunlight.

During the summer **solstice**, the Sun shines most directly on the Tropic of Cancer, 23.5 degrees north of the equator, giving its most direct energy on Earth to the Northern Hemisphere.

During the winter solstice, the Sun shines most directly on the Tropic of Capricorn, 23.5 degrees south of the equator, giving its most direct energy on Earth to the Southern Hemisphere.

Vocabulary:

axis – An imaginary line that Earth spins around.
equinox – The dates when the Sun crosses Earth's equator and the lengths of day and night are equal.
solstice – The dates when the Sun reaches its highest or lowest point in the sky at noon, marked by the longest and shortest daylight hours of the year.

WINTER & SUMMER

For geographic purposes, the Earth is divided into a northern and southern hemisphere by an imaginary ring called the equator. Whichever hemisphere is more directly facing the Sun during the course of the Earth's orbit will receive more of the Sun's energy for more of the day.

Longer days mean more energy for plants to grow and for **phytoplankton** to bloom. As plants grow, the land on Earth looks greener from space and the oceans swirl with green phytoplankton blooms.

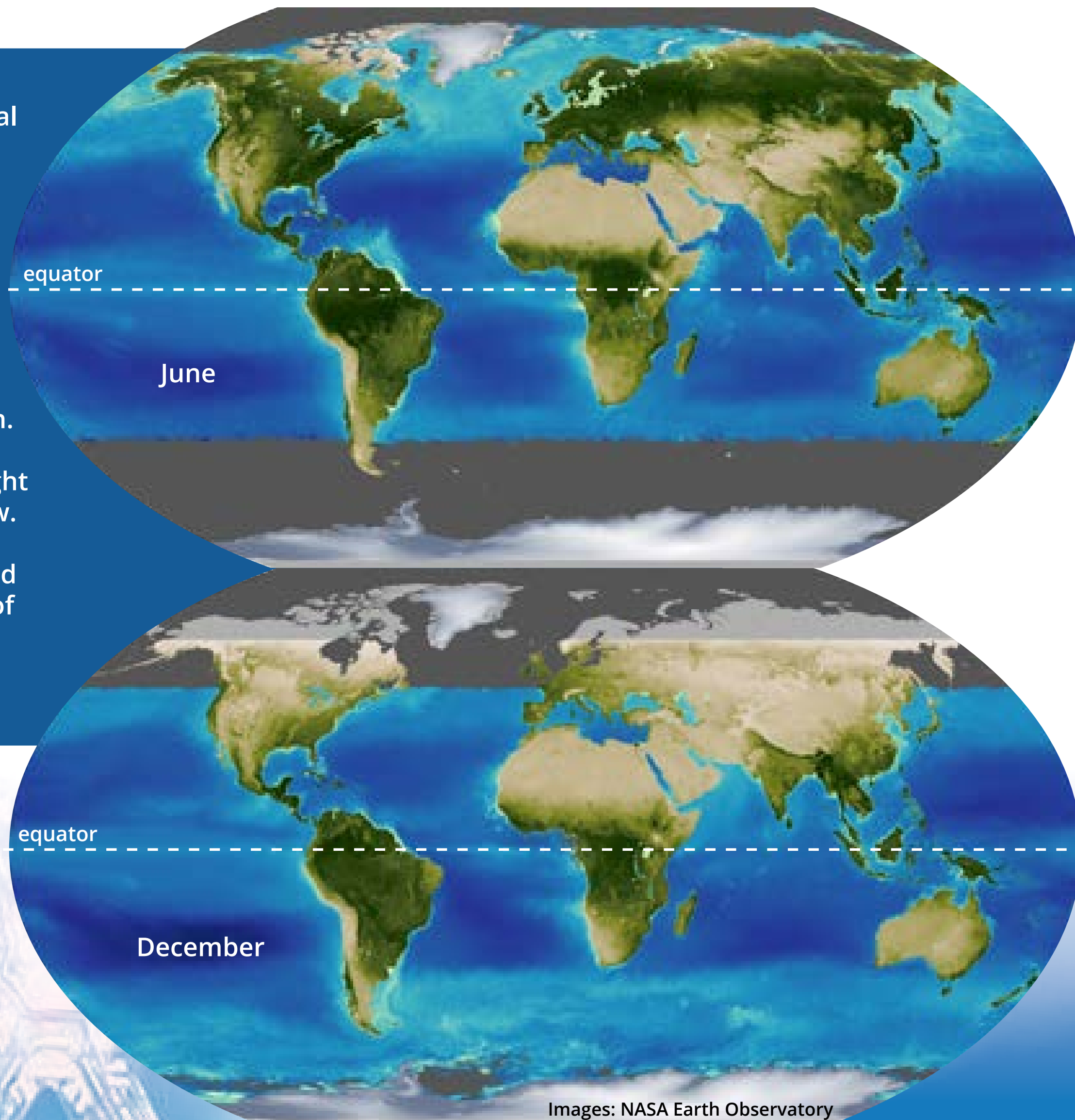
When the Northern Hemisphere experiences the blossoming of plants in the spring, plants in the Southern Hemisphere are turning yellow and brown as fall and winter come. NASA's satellites are able to monitor these seasonal cycles.

Vocabulary:

phytoplankton – Microscopic plant-like animals in the ocean.

These images of global greenness show the seasonal "green up" of the Northern Hemisphere in June and the Southern Hemisphere in December.

Land covered with plants are deep green. Water with a lot of phytoplankton are light bluish-green to yellow. Grey areas are where no data were collected during dark months of the year around the poles.



Maker Corner

Season-Dial Shadow Science

Have you ever looked at your shadow in the middle of a bright summer day? How about in the middle of winter? Did you notice anything different? Our shadows grow as summer fades to winter, but why? Check out this easy activity to see how the angle of the Sun affects your shadow.

Materials:

- protractor
- 30 cm (1 ft.) of string
- 1 container of clay
- small single point flashlight
- paper
- tape
- 2 pencils

1. Tie one end of the string to the hole in the protractor and tape the other end to the bright side of the flashlight.
2. Place a ball of clay at the corner of the paper.
3. Stand the pencil up straight in the clay.
4. Complete setting up the season-dial by squishing the protractor into the clay. Line up the pencil with the 90° mark. Line the protractor's straight edge with the diagonal of the paper.
5. Solve to find the noon Sun angle if you were standing at 45° N latitude during the summer solstice, the equinoxes, and the winter solstice.

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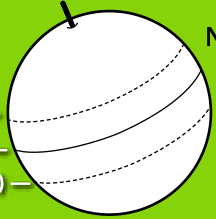
Calculating Noon Sun Angles

First, find the distance in degrees between the latitude of where you are and where the Sun's most direct rays are shining on Earth at that time of year. Then subtract that number from 90°.

The most direct rays of the Sun are shining at:

- 23.5°N on the summer solstice
- 0° (the equator) on the equinoxes
- 23.5°S on the winter solstice (note: degrees latitude are negative numbers south of the equator)



For example, if you were standing at 45°N latitude, the noon Sun angle at summer solstice would be:

45° N – 23.5° N = 21.5°
90° - 21.5° = 68.5° is the noon Sun angle

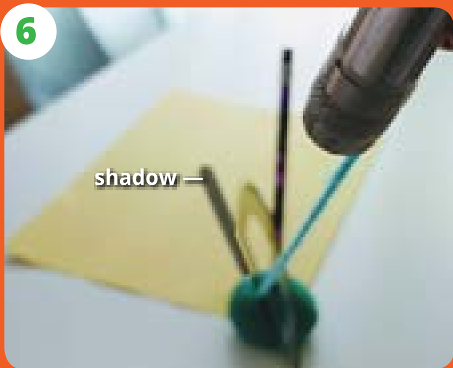
Find these Sun angles:
Noon Sun angle at equinoxes.

45° N – 0° N = 45°
90° - 45° = ____° is the noon Sun angle

Noon Sun angle at winter solstice.

45° N – 23.5° S = 68.5°
90° - 68.5° = ___° is the noon Sun angle

6. In a dark room, shine the flashlight along the string toward the pencil, making sure the string lines up with your noon Sun angle for each season. Mark the edge of the shadow on the paper, using the other pencil.



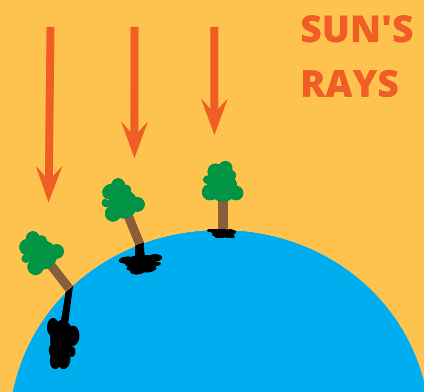
Align the string to the angle you calculated for the noon Sun angle. For example, if you were standing at 45°N latitude at the summer solstice, align the string to the 21.5° mark on the protractor.

7. What happens to the shadow throughout the year?

8. Repeat the experiment, but this time solve for your latitude.

What's Happening?

The hemisphere that is more directly facing the Sun at a given point in Earth's orbit receives more of the Sun's energy. When the Sun is directly over your head, you are receiving the Sun's most direct rays. But your shadow is shortest because it falls directly underneath you. As the tilt of the Earth changes relative to the Sun, the seasons change. On the winter solstice the angle of the Sun is lowest on the horizon, shining at you more than on you. This is why it casts a longer shadow in winter.



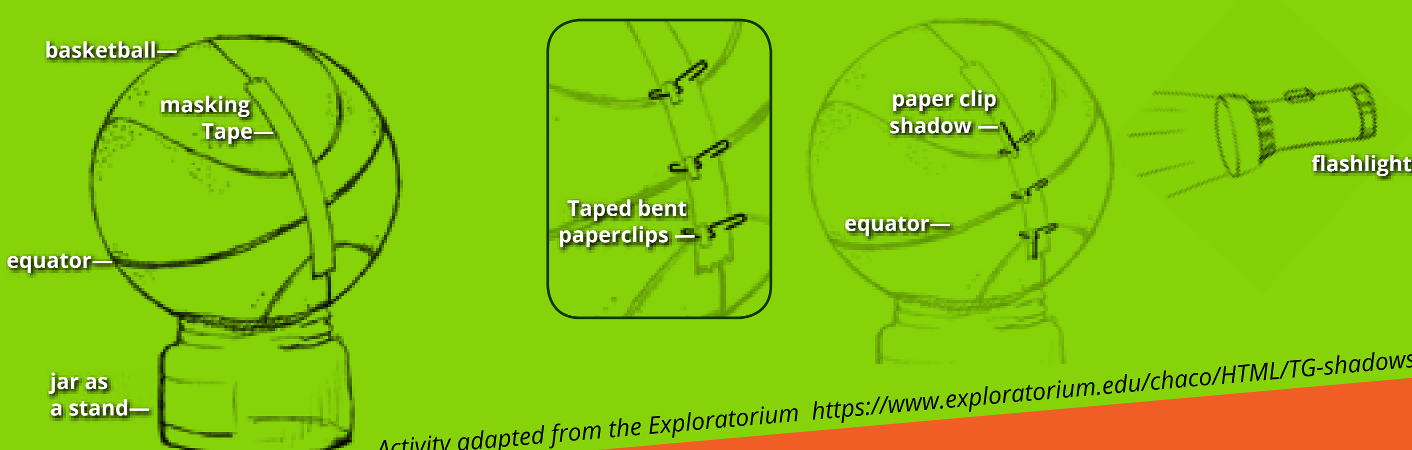
Shifting Shadows

Want to see how shadows shift depending on where you are on Earth? You can try this easy experiment with: a basketball, three paperclips, a jar, masking tape, and a light or lantern.

First, tape a line down the center of your basketball, cutting across all the ribs of the ball. Next, tape three bent paperclips to three neighboring ribs of the basketball along your masking tape line. Use an open jar as a stand by placing the ball on top. Then, turn down the lights and step back. Shine your light at the middle paperclip. What direction do the shadows of the other two paperclips point?

What's going on?

You just modeled an equinox. Your middle paperclip has no shadow because it is at the equator, where the Sun's rays are directly overhead. The top paperclip has a shadow that points north because it is in the Northern Hemisphere and the bottom paperclip has a shadow that points south because it is in the southern hemisphere. Shadows can tell you about seasons, but also about where you are on Earth.



Activity adapted from the Exploratorium https://www.exploratorium.edu/chaco/HTML/TG-shadows.html

Answers: Noon Sun Angle at Equinoxes = 66.5° and Winter Solstice = 43°