

# Our Place Under the Sun

Learn how Vermont got its climate and how climate influences lake life

## Summary

Students put in motion a model of the rotational relationship between the moon, earth, and sun to discover why Vermont has the climate it does and how climate influences the native species.

## Objectives

- ◆ To learn how Vermont's climate is connected to the rotational patterns of the moon, sun and earth.
- ◆ To realize how aquatic plants and animals adopt to Vermont's seasonal changes.
- ◆ To be able to identify the best sites for plants to grow.

**Chapter Connections:** *All About Vermont Lakes*, Chapter 4, *Trophic Levels and Monitoring*

## Background

The sun gives us light and heat from 93 million miles away. Plants and algae use sunlight to make energy through the process called photosynthesis. All other living species depend on the success of these plant producers for their food sources.

Cold blooded turtles, amphibians and snakes need the sun's heat to regulate their body temperature and to help with food digestion.

The presence of the sun is essential for life in and around our lakes. Behavior of many animals and plants is based on the intensity and duration of the sun. Many animals are active during the day and quiet through the night.

Plant and animal behavior will respond as Vermont changes from one season to the next. During the summer when the sun's rays are strongest, most plants have their growing season and animals are very active with feeding and nurturing young.

## Vermont Standards

### Vital Results

- 3.1 Relationships
- 4.6 Understanding Place

### Fields of Knowledge

- 7.15 The Universe, Earth and the Environment
- 6.19 Identity and Interdependence
- 6.16 Impact of Economic Systems

During the winter, when the sun's strength is weaker, amphibians experience a period of reduced activity called brumation. Other animals also are less active and may hibernate. Birds migrate to escape the cold weather and to go to places where they can find food growing.

The day and night cycle, and the seasons drive plant and animal growth and behavior and the way a lake ecosystem works. Aquatic plants, grow most vigorously during warm, long days. On calm days, in a lake, the dissolved oxygen levels will be the highest at nightfall after a full day of plant photosynthesis and the lowest just before sunrise the next day.

Day (light) and night (dark) are caused by the rotation of the earth around its own axis. It takes 24 hours for one full rotation. Daytime comes to Vermont as the earth rotates so Vermont faces the sun, while nighttime arrives when the earth rotates our location in the north eastern hemisphere away from the sun.

Seasonal changes are not related to the distance the earth is from the sun during its annual orbit. The earth has an elliptical orbit around the sun and is closest to the sun in January and furthest from it in July. This change in distance is too small to make a difference to climate, compared to the enormous distance the earth is away from the sun.

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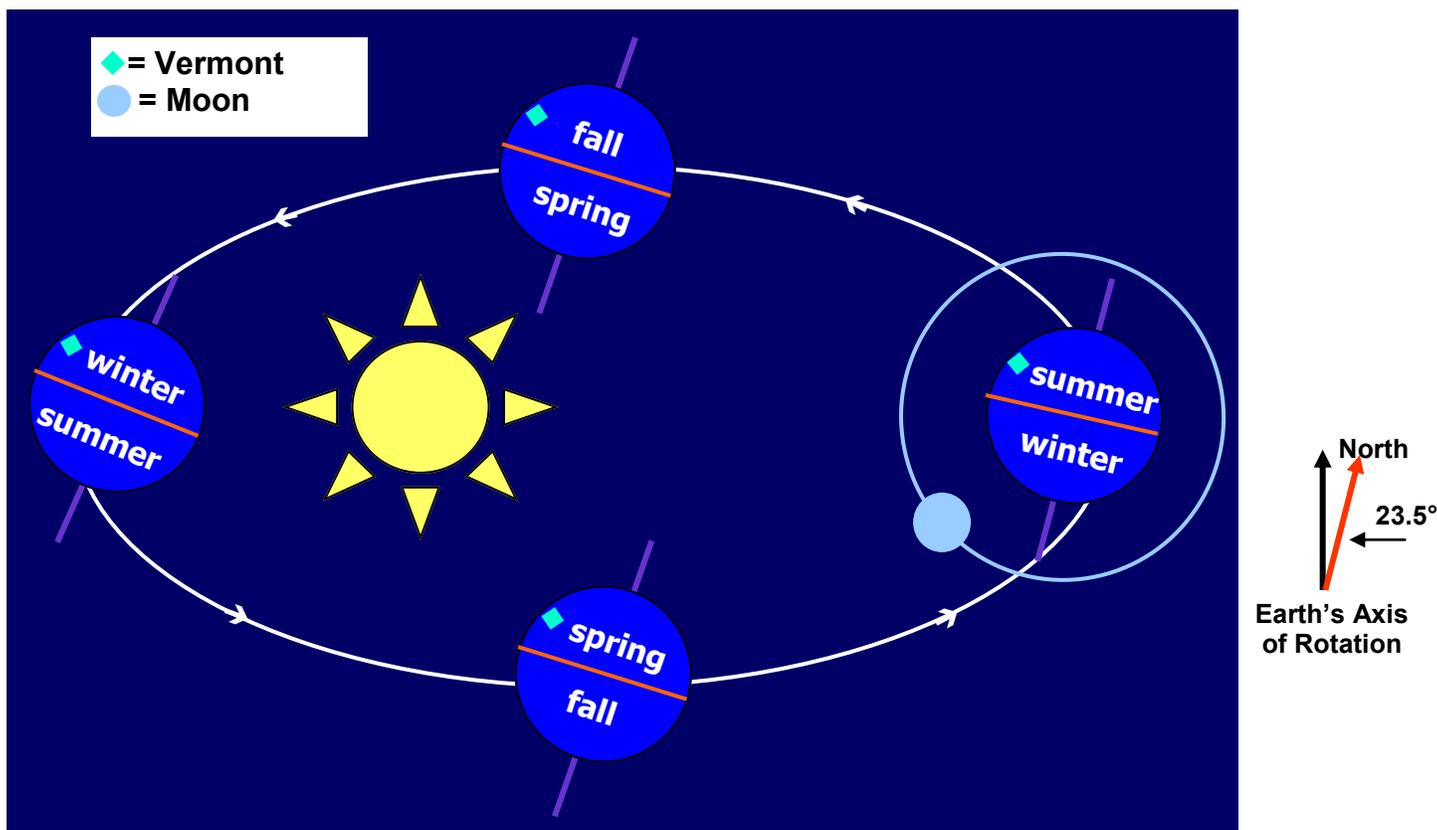
Seasons are caused by the earth being tilted on its axis by an average of 23.5 degrees. During the earth's orbit when the northern hemisphere is tilted toward the sun, it will be summer time in Vermont. As the northern hemisphere tilts towards the sun, it receives direct and therefore intense sun rays (meaning less sunlight gets scattered before reaching the ground), raising temperatures. Additionally, the high sun angle produces longer days. (Because the earth is a sphere and curved, the sun rays hit it at varying angles. The sun will be most hot and intense when it hits the earth directly with little angle.)

During winter, the northern hemisphere is tilted away from the sun. The sunlight reaches the earth less directly and at an angle, which scatters and decreases the intensity of the sunlight reaching the ground. In addition, the low sun angle produces shorter days.

In Vermont, we experience shadows because of the different angles that the sun shines down

on us. These shadows add cold pockets to our aquatic and terrestrial worlds. Colder water holds more dissolved oxygen than warmer water, so shaded lake shores provide better habitat for cold water species, like lake trout. Lake shores with a southern exposure and not shadowed from neighboring hillsides and shoreland trees, will likely be the site turtles are found basking on partially submerged logs.

The moon orbits the earth in approximately one month. Like the earth, the moon also rotates around its own axis. However, because the rotational period and orbital period are the same, we always see the same side of the moon. (The "dark side of the moon" refers to the side we never get to see from the planet earth!) Since the moon is not a star, like the sun, it does not emit its own light. What we see is the reflection of the sun's light on the moon. During its orbit cycle around the earth, sunrays hit the moon at different angles, causing the different moon phases.



The earth completes a full revolution around the sun in one year (counter clockwise). Throughout the trip, the earth's axis, which it rotates on during the 24 hour day cycle, always points in the same direction. The earth's axis is tilted at 23.5°, which is the reason for our seasons.

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The earth's tilt is responsible for our seasons, and it also plays a big role in shaping our climate. Climate is the long-term weather pattern for a certain region. Daily precipitation, wind, and temperature can be very unpredictable as these atmospheric conditions, or weather, change quickly. Weather occurs on a daily or short-term period, while climate describes the average weather for an area over a long period of time.

Seasons are characterized by climate. Vermont summers are known to be mild, with average temperatures in the 70s°F, while winters are cold, with the average temperature at 22°F. Weather can be unpredictable and changing daily, while climate is more steady.

Today, most scientists agree that our climate is changing because excessive levels of carbon dioxide are trapped in our atmosphere, causing a greenhouse effect that is warming up our planet. After studying how Vermont got its climate and how it influences the plants and animals living here, it is easier to understand how life in Vermont may be affected by changes brought about from global warming.



## The Activity

### Materials Needed:

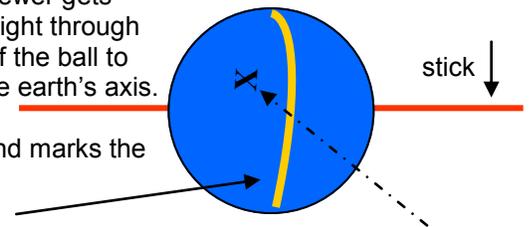
Sets of:

- 3 balls of different sizes\*
- 1 wooden skewer
- 1 rubber band
- A cup or can to use as a base to hold the “sun” (helpful for “animation,” not necessary)

\* Best to prepare the “earth” ball ahead. Pick the medium sized ball to represent the earth. Stick the skewer through it to create the axis. In the photo to the left, a tennis ball was used, but a styrofoam ball would be easier for inserting the “axis.” Wrap a rubber band around the middle of the ball to represent the equator.

A stick or skewer gets inserted straight through the middle of the ball to represent the earth's axis.

A rubber band marks the equator.



(let kids mark Vermont)

### Get Started

Divide the class into groups of 3 or 4 students. Give each group a set of materials. This activity is about discovery, so the least amount of explanation, the more challenging it is for the kids!

Have the kids mark on their earth, the location of Vermont. Ask them to make a model that shows the relationship between the earth, moon, and sun. Have them put their model in motion and answer the following questions with their animation.

- What causes day and night?
- What causes the seasons?
- Why are the seasons different in the northern hemisphere than those in the southern hemisphere?
- Why are the days longer in the summer than in the winter?
- Why do we always see the same side of the moon?

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## Follow Up Questions

Students will learn that the tilt of the earth is the cause for our seasons.

Discuss how the curvature of earth causes the sun to hit it at different angles. When the sun hits Vermont at varying angles, our day lengths and temperatures will change. When there is less atmosphere for sunrays to pass through, there will be warmer conditions because the sunrays can hit the earth more directly.

1. If the sun hits Vermont at different angles, how does this affect the plants and animals of Vermont? Consider the effect of shadows as well.

2. If, in fact, all locations on earth receive the same amount of daylight over a whole year, then why does Vermont experience below 30°F temperatures compared to warmer southern states during the winter? (The answer relates to the curvature of the earth and the varying angles of the sunrays.)

3. Choose posters or different things hung on the classroom walls to represent stars and constellations in space. Have the students re-run their models to learn why during sometimes of the year, we are able to see certain constellations and at other times, we can not see them.

## Additional Resources:

Check out the Vermont Agency of Natural Resources Climate Change Team information at: <http://www.anr.state.vt.us/anr/climatechange/>

This team is compiling natural resources data, such as annual ice-out dates, or lilac bud bloom to look at long-term trends in the environment. The team also makes suggestions for what can be done to minimize the causes to and effects from climate change.

EPA has published a short brochure on Climate Change in Vermont. It can be accessed on the web at:

[http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWJ5J/\\$File/vt\\_impct.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWJ5J/$File/vt_impct.pdf)

This activity is a good prelude for the water cycle. In addition to the earth's tilt, and the resulting seasons, the water cycle drives our weather and creates our climates.