# U020 Blue Planet Modeling Globe™

The Blue Planet Season Modeling Globe™ shows the seasons of our planet over a year's time and physically portrays the exact location of the day and night terminator. A "6" diameter globe with 24 hour meridians drawn on its surface sits angled 23.5° on the rotating table. Turning this table changes the globe's seasonal aspect – one such revolution demonstrates the four seasons and each day is indicated on the table's calibrated scale. The globe can also be rotated on its axis to mimic daily motion. The smoked acrylic box serves as the physical terminator in this mechanical simulation. Notice that Earth, as viewed from the North, is seen to rotate counterclockwise. In the model, the surface of the globe is seen to emerge from the box along the sunrise terminator and retreat into the box along the sunset terminator. You can easily set any date and time to see how the Earth is illuminated by the Sun at that point in time and to see the line of sunrise and sunset banding the Earth.

## Setting time and date

The illustrations on the last page will serve as a guide through the following procedures. To set the time, you must first find your meridian and its intersection with the equator. You might have to imagine the great circle passing through the poles and your location because yours might not be printed on the globe. Rotate the globe clockwise so that this intersection point is at the sunrise side of the terminator, which is at the left side of the terminator wall of the box. The edge of the box will be seen to pass through your location on the globe only at two times of year. Now rotate the globe counterclockwise counting the number of hours from 6 a.m. to your current time. The model is seen to portray the extent of solar illumination for the time of year and time of day for which it is set. To adjust rotation for the minutes according to your wristwatch time, keep in mind that 1° of rotation corresponds to 4 minutes of time. The method we just used, while not strictly an accurate representation of time, is a very close approximation. It should be noted that sunrise time at the equator does not occur at 6 a.m. every day. It varies +/- 16 minutes max., and the Sun rises at 6 a.m. only four times in the year cycle: on the solstices and on the equinoxes. The shifting of the sunrise time at the equator is due to the compounded components of earth motion around the sun. The path of this shifting is familiar to some of you as a figure 8. It is shown on some globes and is called an analemma. This is a graphic representation of the equation of time, and can be further explored at (www.analemma.com).

## Why does the terminator shift over time?

This globe is simulating Earth's season. As you already know, days are much longer in duration during summer, as opposed to the short days of winter. Conversely, nights are much shorter in the summer, and are longer in winter. The length of day and night are similar during spring and autumn. For example, try concentrating on Wisconsin: note that for a period of time Wisconsin rotates through a wider swath of light (summer), while later, Wisconsin rotates through a narrower swath of light (winter).

## Why do these seasons occur?

Contrary to a popular misconception, the Sun is not closer during summer – in fact, the Sun is further from Earth during summer! Wisconsin experiences summer as the hottest time of the year because Wisconsin's surface is tilted more toward the Sun and is more nearly perpendicular to the rays from the Sun. The Earth's axis is tilted toward the Sun during the summer months. Regions in the northern hemisphere receive larger quantities of sunlight energy and rotate through a wider swath of sunlight each day. On the other hand, during the summer months southern hemisphere locations are tilted away from the Sun, and rotate through a narrower swath of sunlight each day. If you live in Argentina, the months of June, July and August are the coldest times of the year with the shortest days.

Six months later, the situation is reversed. Now the northern hemisphere is tilted away from the Sun, so we experience shorter days and cooler temperatures. Now the southern hemisphere is tilted toward the Sun and days are longer and warmer. During autumn and spring, Earth's axis is not tilted much toward or away from the Sun. The result is that days and nights are about the same length across the world. Temperatures are moderate, somewhere in between the cold and warm extremes that occur after June and

December.

**How do I know when these seasons occur?**

The date for our maximum tilt toward the Sun is the Summer Solstice and our region experiences the maximum tilt away from the Sun at the Winter Solstice. The points in between offer no tilt toward or away from the Sun and are the Vernal and Autumnal Equinoxes (when the nighttime is of the same length as the daytime.

Watch the Blue Planet Season Modeling Globe™ very carefully again. Try to determine the point where the most intense light reaches the highest point above the equator. That will be the Summer Solstice, the time when the northern hemisphere receives maximum sunlight and the longest days. Now watch for the points when the most intense light falls on the equator. This occurs twice a year, during the Vernal (Spring) Equinox and Autumnal Equinox. Finally, note the point where the most intense light reaches the lowest point below the equator. That is the Winter Solstice, the time when the northern hemisphere receives the minimum sunlight and the shortest days.

**So what?**

We don't need the Blue Planet Season Modeling Globe™ to tell us **when** seasons occur; we have calendars for that! But very few of us understand **why** temperatures change or **why** the length of day changes during the year. In the agriculture-based societies that existed more than 150 years ago, everyone was well aware of the relationship between the angle of the Sun in the sky and the season of the year. Ancient cultures watched the Sun every day and celebrated on the day of the Winter Solstice. They knew that on every day that followed, the Sun would rise higher in the sky and the oppressive winter nights would soon grow shorter.

Observe the Blue Planet Season Modeling Globe™ one more time, looking for the reasons for the seasons as the sunlight plays across the face of our rotating home. Think about the Sun, the life-sustaining force of our existence. Relate the shift in the terminator to the changes of our seasons. Think about the curious reason why every culture has a vacation break suspiciously close to the date of the Winter Solstice, Finally, keep checking up on the Sun; note that during the summer it rises to almost directly overhead at noon, while during the winter the Sun is still low in the sky at noon.

The device is always ready to use, requires no source of electricity, but can give an up to the minute view of who on the planet are in sunlight, who are in darkness. Who are the people greeting the sunrise and what are the territories preparing for nightfall. All of these changes are always happening, somewhere on Earth.

**Typical Classroom Time Allocation:**

To prepare this product and rehearse a standard demonstration should take no more than ten minutes. Actual experiments and activities will vary with needs of students and the method of instruction, but all can usually be concluded within one class period.

The page of illustrations may be duplicated for student handouts or used as a master to prepare a projection transparency. These illustrations greatly facilitate the simple instructions for using the Blue Planet Season Modeling Globe™ to explore the reasons for the seasons and the general principles of solar illumination.

**Feedback:**

If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.