CLASSROOM ACTIVITY

Where Does the Sun Set?

General information

★ Grade level: Elementary - cycles two and three; secondary all cycles

★ Students per group: Individual activity

★ When: Before the Planetarium visits your school

★ Duration: A few minutes a day for a few weeks, or spread throughout the school year

★ Where: At school or home (outdoor observations)

★ Type of activity: Observation, visualization

★ Subjects covered: Science and technology

★ Essential knowledge (elementary) and compulsory concepts (secondary): The cycle of day and night — The rotation of the Earth — The seasons

★ Subject-specific competencies (elementary and secondary): Propose explanations or solutions to scientific or technological problems — Make the most of scientific and technological tools, objects and procedures — Communicate in the languages of science and technology

★ Cross-curricular competencies (elementary and secondary): Use information — Solve problems — Exercise critical judgment — Use creativity — Cooperate with others — Communicate appropriately

Summary

Students must observe and note where the Sun sets on the horizon every day over a long period, ideally several weeks. The longer the observation period is, the better the results will be. Students transfer the data to a drawing representing the local west horizon in order to create a horizon calendar like those used long ago by indigenous peoples of the Americas (medicine wheel), Europe (Stonehenge) and Africa.

Starting point

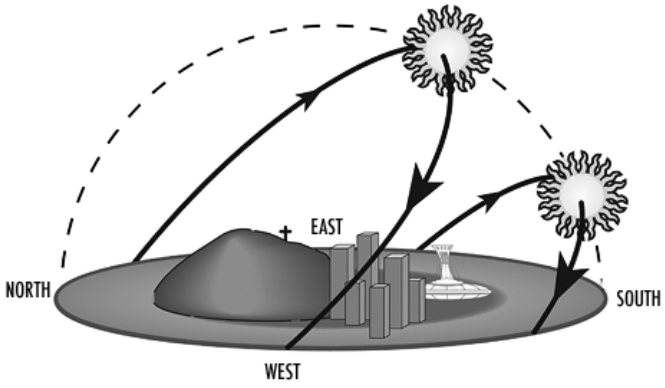
Where on the horizon does the Sun set? Is its position at sunset always the same?

Preconceptions

When students are asked about the position of sunrise and sunset, they usually reply that the Sun rises in the east and sets in the west. Also, many students believe that the noon Sun is directly overhead. Most students don't realize that sunrise and sunset positions change during the year. Very few students see a link between changing sunrise and sunset positions on the horizon, the varying height of the noon Sun above the southern horizon, and the changing seasons.

Basic concepts

The position of sunrise and sunset changes constantly throughout the year. The Sun rises exactly in the east and sets exactly in the west only two days a year: the spring and fall equinoxes (around March 21 and September 23). In the temperate latitudes of the northern hemisphere, the Sun rises in the northeast in summer and in the southeast in winter, whereas it sets in the northwest in summer and in the southwest in winter.

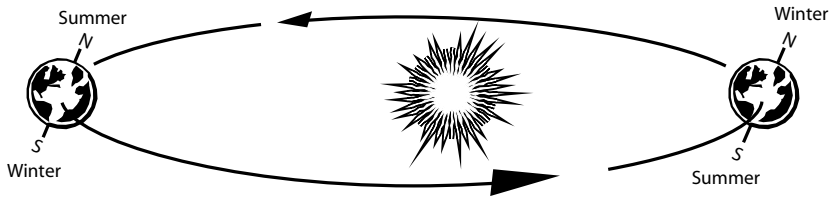


The extreme positions of sunrise and sunset are reached on the days of the solstice. The Sun rises at the most northeastern point and sets at the most northwestern point on the day of the summer solstice (around June 21). This is also the longest day of the year in the northern hemisphere. On this day, the noon Sun reaches its maximum height above the southern horizon for the entire year (but it doesn't reach the zenith in Quebec).

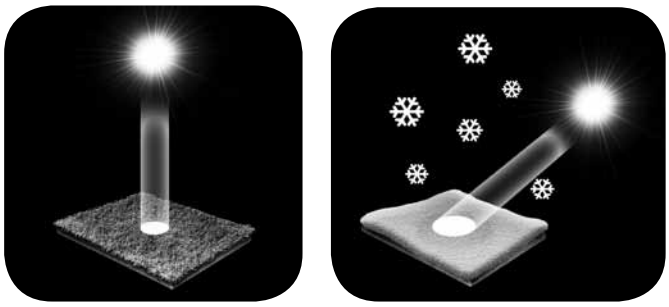
The Sun rises at the most southeastern point and sets at the most southwestern point on the day of the winter solstice (around December 21). This is the shortest day of the year in the northern hemisphere. On this day, the height of the noon Sun is at its lowest point for the year.

Stone rows like the medicine wheels in Western Canada and the American West and the megalithic monuments in England (Stonehenge) and Western France often mark out the extreme positions of sunrise and sunset.

The annual variation in the position of sunrise and sunset, as well as the height of the noon Sun above the southern horizon, is a direct result of the tilt of the Earth's axis of rotation (axis of the poles) in relation to the plane of its orbit around the Sun, and the fact that the axis of the Earth's poles always points toward the same location in space. Therefore, when the Earth's North Pole is tilted toward the Sun, our star climbs high in the sky in the northern hemisphere at noon, and days are long and hot here. This period is summer in our hemisphere. At the same time, the South Pole is tilted away from the Sun. As a result, days are short and cold in the southern hemisphere. This period is winter down there.



Six months later, the situation is reversed: the South Pole now tilts toward the Sun, while the North Pole tilts away. The noon Sun climbs high in the sky in the south but remains low in the north. Days are long in the south and short in the north. Summer arrives in the south, and winter in the north.



As for temperature differences between the summer and winter for a given hemisphere, they can be explained by two factors that are distinct but complementary. First, the variation in the length of a day from season to season means that, at Quebec's latitude, daylight is longer in summer (16 hours of daylight versus eight hours of darkness) than in winter (eight hours of daylight versus 16 hours of darkness), allowing for a greater transfer of energy in summer than in winter. Second, the variation in the angle of incidence of sunrays in relation to the surface also plays a key role. When summer sets in, the Sun climbs high in the sky and its rays hit the surface almost at a right angle. The transfer of heat is at its peak, and so the weather warms up. Six months later, the Sun remains low on the horizon. The small angle of incidence of its rays means that the transfer of heat is considerably reduced. The same quantity of heat is spread over a much larger surface than in summer. So the weather cools down and winter sets in.

Goals

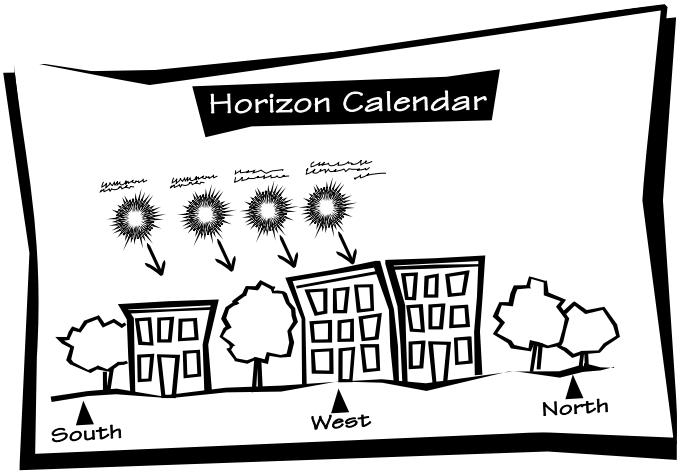
By the end of this activity, students will be able to:

- Note the position of sunset in relation to their local horizon
- Explain how the position of sunset changes from season to season

Observing the apparent movements of the Sun and stars is one of the fundimentals of astronomy. Such observations allowed our ancestors to create the first calendars. This simple activity, which is spread over months, will encourage students to observe the world they live in and how it changes. This lesson is an excellent introduction to the phenomenon of the seasons. You can link the lesson to human sciences because students learn how different cultures on Earth used the Sun's position on the horizon at sunset and sunrise to develop a calendar for farming, religious rites and migrations.

Warning : ***It can be very dangerous to look directly at the Sun with the naked eye without proper protection. Warn students not to look directly at the Sun. They should wait till it disappears behind a building or below the horizon before they note where it set.***

Steps in the activity

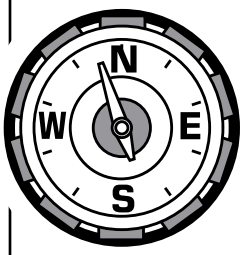


Preparation

Students can do this activity at home or at school depending on the time the Sun sets. No matter where they observe sunsets, once they finish the activity, they'll have a horizon sun calendar like those once used by many Native American tribes.

You need an entire year to create a complete horizon calendar, but this activity is still useful if you do it for only two or three months because students note that the Sun's position at sunset really changes. Sunset position changes most quickly near spring and fall equinoxes (September and March) and most slowly near winter and summer solstices (December and June).

Students should each create their own horizon calendar consisting of a drawing of the western horizon seen from their vantage point. You can also create a horizon calendar on a classroom wall by drawing on a large sheet of paper the position on the horizon where the Sun sets as seen, for example, from the schoolyard. Each week, ask two students to observe the sunset from this vantage point near the school and to transfer their observations to the class's horizon calendar. Add additional information to your calendar (important dates in the school year, holidays, and so on). As a result, students begin associating changes in the Sun's position at sunset with events in their daily lives.

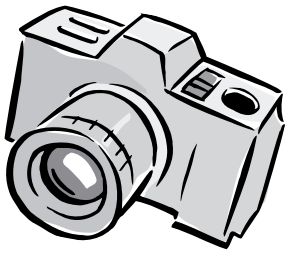


If you use a compass to find the north, remember that it shows the magnetic north and not the geographic north. Depending on the latitude and longitude of your location, magnetic deviation in relation to geographic north varies by a few degrees, but this variation will remain fairly constant throughout your observation period.

This activity is a wonderful experience to share as a family. Encourage parents to assist as much as they can with their children's observations.

Supplies

- A pencil and paper
- A compass
- A camera (optional)



Assignment

❶ Ask students to tell you where they think the Sun set the night before. Ask them to predict where it'll set tonight, in a week, in a month, and in three months and six months. Jot down their answers and keep them to review later.

❷ Tell students to observe the Sun's position at sunset. They should choose a location near their home or school where they can see the sunset (they can also observe it indoors through a large window). They must note where the Sun sets on the horizon. Ask them to draw an outline of the western horizon seen from their vantage point and to note on their drawings the position where the Sun sets. They should also note the date and time of each of their observations.

They should repeat their observation from the same location as often as they can over several weeks (as long as possible).

❸ Using a compass, they should mark the directions northwest, west and southwest on their drawings.

❹ Encourage a discussion of the results in class among students. Did the Sun set where they thought it would? Did it set farther south, farther north or in the same direction compared with the previous day or week?

Wrap-up

Ask students to predict where the Sun will set in three months and in six months. Note their predictions in pencil on the classroom wall used for the horizon calendar. You can check their predictions after three months and six months.

Going Further

❶ Ask students to imagine how they might make a calendar using information gathered in this activity.

❷ Have students repeat the activity, this time observing where the Sun rises.

❸ Do students see a relationship between the location where the Sun sets and the time when it sets?

Adapted from PASS (Planetarium Activities for Student Success), Vol. 11, Astronomy of the Americas.
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