

Astronomy

4-3 The student will demonstrate an understanding of the properties, movements, and locations of objects in the solar system. (Earth Science)

4-3.1 Recall that Earth is one of many planets in the solar system that orbit the Sun.

Taxonomy level: 1.2-B Remember Conceptual Knowledge

Previous/Future knowledge: Planets orbiting in the solar system are being considered for the first time. Students in 1st grade (1-3.1) studied the Sun as an object in the daytime sky but did not study planets or even the fact that Earth is a planet. In 8th grade (8-4), students will study the characteristics of the planets more fully.

It is essential for students to know that Earth is a planet that orbits around the Sun. There are also other planets that also orbit the Sun; some are closer to the Sun than Earth and others are farther away. Some are small, rocky planets like Earth (Mercury, Venus, Mars); some are large planets with a surface made of gas (Jupiter, Saturn, Neptune, Uranus) unlike Earth.

Planets Planets are bodies, natural satellites, that orbit the Sun, a star.

Earth Earth is the third planet from the Sun in the solar system

Sun The Sun is the name for the central star in our solar system.

The sequence of the named planets from the Sun outward is also part of this recall.

It is not essential for students to know specific data about each planet, for example, distance from sun, time of revolution or rotation. Students do not need to name the planets with rings, nor do they need to identify the names of or number of moons a planet has. Students do not need to order the planets by any characteristic other than their orbiting arrangement as they revolve around the Sun.

Assessment Guidelines:

The objective of this indicator is to *recall* that Earth is a planet along with other planets that orbit the Sun; therefore, the primary focus of assessment should be to remember that there are planets that orbit the Sun. However, appropriate assessments should also require students to *identify* a planet by name or position; *recognize* planets whose surface is like or unlike Earth; or *recognize* the Sun as the star around which planets orbit.

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4-3.2 Compare the properties (including the type of surface and atmosphere) and the location of Earth to the Sun, which is a star, and the Moon.

Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: This information on Earth, the Moon, and the Sun is being considered for the first time. Students in 1st grade (1-3.1), studied the Sun and the Moon as objects in the sky but did not study their properties as objects in space. In 8th grade (8-4), other properties from other planets will be studied and compared.

It is essential for students to know that even though the Sun, the Moon and Earth are all in the solar system, they have different properties.

Earth

- Earth has a rocky surface as a planet and also has water on it.
- It has an atmosphere of gases around it.
- It orbits millions of miles from the Sun as the third planet in the solar system.

Sun

- The Sun is a star, a large ball of glowing gases that is extremely hot.
- It does not have a rocky surface and its atmosphere glows and gives off light.
- It is located at the center of the solar system.
- Earth and other planets revolve around it.

Moon

- The Moon is the natural satellite that orbits the Earth.
- It has a rocky, dusty surface with many craters and no water.
- It has no atmosphere.

It is not essential for students to know more specific data about Earth compared to the Sun and the Moon, for example, time of revolution or rotation with this indicator.

Assessment Guidelines:

The objective of this indicator is to *compare* the properties and locations of Earth, the Moon, and the Sun; therefore, the primary focus of assessment should be to detect ways that these objects are alike and different as to type of surface, atmosphere, and location. However, appropriate assessments should also require students to *identify* the object based on its description; or *illustrate* the objects by their location in the solar system.

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4-3.3 Explain how the Sun affects Earth.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-3.2), students recalled that the Sun is the source of heat and light for Earth but did not study the cause for this. In 8th grade (8-4.2,3), students will study the characteristics and features of the Sun more fully as it affects Earth including the effects of solar radiation, solar flares, and solar wind.

It is essential for students to know that the Sun as a star produces heat and light deep down inside of it.

- The Sun produces and gives off its own heat and light.
- Earth receives that heat and light after they travel through space.
- The Sun is the source of almost all energy on Earth:
- Plants take the Sun's energy and use it to make food energy.
- The Sun's energy causes weather conditions on Earth.
- Heat from the Sun causes the process of evaporation of water on Earth's surface.
- The Sun's energy is stored in fossil fuels (for example, coal, oil, or natural gas) that formed from some organisms that died long ago.

It is not essential for students to know the nuclear process that takes place so that the Sun can produce heat and light. They do not need to know the types of radiation that the Sun gives off.

Assessment Guidelines:

The objective of this indicator is to *explain* the effects that the Sun has on Earth; therefore, the primary focus of assessment should be to construct a cause-and-effect model of the various ways that Earth is affected by the Sun. However, appropriate assessments should also require students to *recall* that heat and light energy are given off by the Sun; or *exemplify* ways that the Sun's energy affects life on Earth.

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4-3.4 Explain how the tilt of Earth's axis and the revolution around the Sun results in the seasons of the year.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In kindergarten (K-4) students demonstrated an understanding of seasonal weather changes. In 2nd grade (2-3.3), students illustrated the weather conditions of different seasons. In 8th grade (8-4.5), students will study the cause for the seasons including the amount of heating of Earth due to the angle of the Sun's rays and the affect of daylight hours.

It is essential for students to know that Earth has distinct seasons which result from the tilt of its axis and its revolution around the Sun.

- Earth revolves around the Sun one time each year in about 365 days.
- Earth has seasons because Earth's axis is tilted.
- Because of the tilt, the number of daylight hours changes throughout the year.
- As Earth revolves around the Sun, different parts of Earth get more sunlight.
- The tilt also causes the northern or the southern part of Earth, to point toward the Sun.
- When the tilt is toward the Sun, the season is summer; when the tilt is away from the Sun, the season is winter.
- The two hemispheres have opposite seasons.
- The seasons do NOT depend on the distance of Earth from the Sun.

Axis

- Earth rotates around an imaginary straight line called an axis that runs through the planet's center.

Revolution

- The movement of Earth as it makes an orbit around the Sun in one year.

Seasons

- The effects on Earth due to the change in the amount of sunlight caused by the tilt of Earth's axis.
 - Summer occurs when part of Earth is tilted most toward the Sun
 - Autumn and spring occur when neither part of Earth is pointed directly toward or away from the Sun.
 - Winter occurs when part of Earth is tilted away from the Sun.
 - The sequence of the seasons during the year is summer, autumn/fall, winter, and then spring.

It is not essential for students to know about the angle of the Sun's rays.

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Assessment Guidelines:

The objective of this indicator is to *explain* how the tilt of Earth's axis and the revolution around the Sun results in the seasons of the year; therefore, the primary focus of assessment should be to construct a cause-and-effect model of the ways that Earth's seasons are affected by these two factors. However, appropriate assessments should also require students to *recall* information about Earth's axis or revolution; *classify* by sequencing the seasons; or *infer* or *illustrate* a season based on the description or drawing of the tilt of the axis.

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4-3.5 Explain how the rotation of Earth results in day and night.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-3.1), students compared the day and night sky but did not relate that to the Earth's rotation. First grade (1-3.3) also recognized that the Sun and the Moon appear to rise and set but the explanation of the cause was not addressed at that time. In 8th grade (8-4.4), students will study many of the motions of the Earth and Moon and relate those motions to various effects.

It is essential for students to know that:

- Earth *rotates* (spins) on its axis and completes one rotation in 24 hours.
- Earth rotates from west to east, therefore, the Sun appears to rise in the east and set in the west.
- Because of this rotation, only the side of Earth facing the Sun is lit and therefore experiences day; the side of Earth not facing the Sun experiences night.

It is not essential for students to know about the rotation of other planets.

Assessment Guidelines:

The objective of this indicator is to *explain* how the rotation of Earth results in day and night; therefore, the primary focus of assessment should be to construct a cause-and-effect model of how rotation causes day and night. However, appropriate assessments should also require students to *recall* information about rotation; or *illustrate* day or night on a model or drawing.

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4-3.6 Illustrate the phases of the Moon and the Moon's effect on ocean tides.

Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-3.4), students illustrated changes in the Moon's appearance including patterns over time. In 3rd grade (3-5.4), students explained the relationship between the motion of an object and the pull of gravity. In 8th grade (8-4.4), students will study many of the motions of Earth and the Moon and relate those motions to various effects, including phases and tides. Eighth grade (8-4.7) also explains the effects of gravity on tides and considers tides in relationship to the pulls of both the Sun and the Moon.

It is essential for students to know that the Moon reflects light from the Sun and just like Earth, half of the Moon is always lit by the Sun.

- Because of the positions of the Sun, the Moon, and Earth, the Moon appears to change shape.
- The amount of reflected light from the Moon that is seen from Earth determines the phase.
- The changing shapes of the Moon are called *phases*. There are four main phases:
 - *New moon* – the entire half/side of the Moon facing Earth is dark.
 - *Quarter moon* – half of the side of the Moon facing Earth is lighted and the other half is dark; the Moon appears as a half circle; there are two quarter moon phases in the cycle.
NOTE TO TEACHER: Students may see the name also as Half moon.
 - *Full moon* – the entire half/side of the Moon facing Earth is lighted; the Moon appears as a full circle.
 - *Crescent moon* – a small section (less than a quarter moon) of the half/side of the Moon facing Earth is lighted.
- The change in the Moon's phases from new moon to new moon takes about four weeks, 29½ days.

It is essential for students to know that the Moon and Earth pull on each other because of gravity.

- The Moon's pull on Earth makes the surface level of the ocean rise and fall; this change in level is called *tide*:
- High tide is when the ocean water level is the highest; there are two high tides each day.
- Low tides occur between high tides.

It is not essential for students to know about the eclipse of the Moon.

Assessment Guidelines:

The objective of this indicator is to *illustrate* phases of the Moon and the Moon's effect on tides; therefore, the primary focus of assessment should be to give or use illustrations to show aspects of these concepts. However, appropriate assessments should also require students to *recall* information about the Moon's reflecting light, the time it takes for a complete phase cycle to complete, or the cause of tides; or *classify* by sequencing the order of the Moon phases.

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4-3.7 Interpret the change in the length of shadows during the day in relation to the position of the Sun in the sky.

Taxonomy level: 2.1-B Understand Conceptual Knowledge

Previous/Future knowledge: This indicator is new material for this grade and is the only grade where this concept is developed. A connection can be made with the behavior of light as it strikes an object in the Properties of Light topic (4-5). In 8th grade (8-4), shadows are studied in the eclipses of the Sun and the Moon.

It is essential for students to know that objects on Earth cast shadows that help show Earth's rotation. The angle of the Sun, low in the sky to higher in the sky, changes the length of the shadow cast behind an object.

- In the morning, the Sun appears low in the sky; objects cast long shadows.
- As Earth rotates, the Sun's appears higher in the sky, and the shadows get shorter.
- At noon, with the Sun overhead, objects cast short shadows or no shadow at all.
- As Earth continues to rotate and the Sun appears lower in the sky toward evening, the shadows get longer again.

It is not essential for students to know about the types of shadows cast, umbra, or penumbra. Students do not need to make or interpret sundials.

Assessment Guidelines:

The objective of this indicator is to *interpret* the change in the length of shadows during the day in relation to the position of the Sun in the sky; therefore, the primary focus of assessment should be to change one form of presentation, like a description or drawing, into another that shows this relationship. However, appropriate assessments should also require students to *predict* a time of day based on the amount of shade; or *recognize/recall* the reason that shadows change shape or the reason the Sun is in different positions in the sky.

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4-3.8 Recognize the purpose of telescopes.

Taxonomy level: 1.1-A Remember Factual Knowledge

Previous/Future knowledge: This indicator is new for this grade. In 8th grade (8-4.10), students will compare the purposes of the tools and technology that scientists use to study space (including various types of telescopes, satellites, space probes, and spectroscopes).

It is essential for students to know that telescopes are tools that aid in the study of objects in outer space.

- A *telescope* can gather more light than the eye, so it makes faint, faraway objects seem brighter and closer.

It is not essential for students to know about the design of reflecting and refracting telescopes, nor do they need to construct or experience the use of a telescope.

Assessment Guidelines:

The objective of this indicator is to *recognize* the purpose of telescopes; therefore, the primary focus of assessment should be to locate from memory what the purpose of this tool is in the study of outer space. However, appropriate assessments should also require students to *identify* a telescope from a picture or drawing.