Sky Science

Teacher Guide

Essential Question

What can we learn from studying the day and night skies?

Targets

1. **What does studying the sky teach us about the Sun and the stars?**
- How can we observe objects in the sky safely?
- What patterns can be seen in the stars?
- What can we learn about the movement of objects (Sun, stars, planets, Moon) in the sky by observing them?

2. **What makes our solar system unique?**
- What is Earth's place in the universe?
- How do other planets compare to Earth?

Pre-Assessment

Student Activity

Think about these questions:

- How does our sky change throughout the day and the night?
- What is our **solar system**, and what objects are in our **solar system**?
- What is the **Universe** and what is in it?
- How can we measure and observe things in the sky, the **solar system**, and the **universe**?

Jot your answers to the four questions in the boxes of the *Frayer Model*. This is not a quiz; your teacher wants to know what you already know about sky science.

Teacher Notes

Students have many misconceptions of our universe, the celestial bodies in it, the movement of planets, stars, moons, etc. Some of the common fallacies related to this unit are as follows:

- The objects in the sky move, not the Earth (The Sun goes up and down and around the Earth.)
    - The Sun is stationary in the Solar System. The Earth rotates from East to West and orbits the Sun at the same time.
- The Earth is closer and farther away from the Sun during various seasons

- The seasons are due to the tilt of the Earth on its axis. In the winter, the Earth is tilted away from the Sun; in the summer, the Earth is tilted towards the Sun.

- The shadows are longest at noon.
    - Your shadow changes because of the position of the Sun with respect to the horizon. If the Sun is low to the horizon, the shadow is long. If the Sun is high overhead, the shadow is shorter.

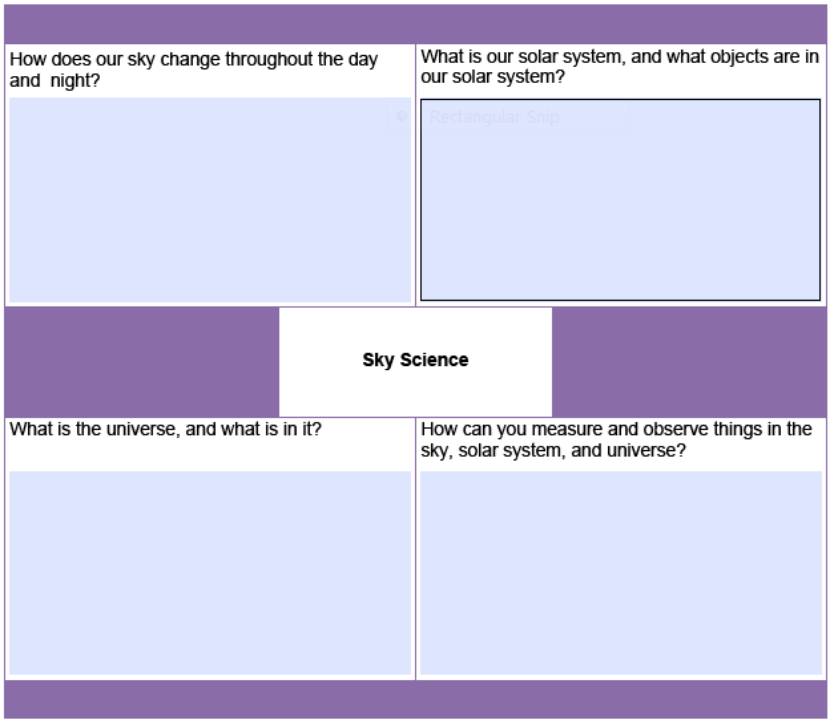
- The moon is “larger” when it is “closer” to the Earth at moonrise.
    - The size of the moon does not change. The moon appears larger near the horizon because of magnification by the Earth's atmosphere.

To identify alternative ideas (misconceptions) students bring to this unit, address them, and ensure that they are changed. This unit is best done in the fall when the nights are long and not too cold, but it can also be done in February because winter skies are often the clearest for stargazing. Some of the data collection for this unit must be done in the evening. Therefore, parental assistance is needed for some activities.

If students live near a local observatory, encourage them to check their local observatory for free evening night-sky guided viewing. This is commonly available.

A current list of Alberta observatories and planetaria is provided on this website: http://www.cascaeducation.ca/files/planet_scicenter_obs.html

The Royal Astronomical Society of Canada (RASC) website is a good place to look for local members who hold sky-viewing opportunities for the public. http://www.rasc.ca/



What does studying the sky teach us about the Sun and the stars?

Section 1 Vocabulary

Term	Definition
astronomy	study of all things in the universe
axis	imaginary line running through the centre of an object
Big Dipper	group of seven stars that are part of the larger constellation called the Great Bear, or *Ursa Major*
comet	body made up of ice and dust that orbits the Sun
constellation	group of stars that have been given their name based on their arrangement or pattern
crescent	one of the two phases of the moon on either side of the new moon or the full moon (The moon appears as a sliver of light.)
first quarter	phase of the moon we see when the moon is at a 90-degree angle with respect to Earth and Sun and we see half the moon illuminated and half in shadow
full moon	phase of the moon we see when the moon is on the opposite side of Earth from the Sun and we one complete side of the moon
galaxy	large grouping of stars in space; containing millions or billions of stars
Galileo	famous astronomer who invented the telescope and made some of the first discoveries from observing objects in space
gibbous	one of the two phases of the moon on either side of the full moon (The moon appears as a three-quarter circle.)
gnomon	upright pointer of a sundial that casts a shadow
horizon	visible line that separates the ground from the sky
inner planet	one of the four planets closest to the Sun – Mercury, Venus, Earth, Mars; made mostly of rock and metal
Little Dipper	grouping of seven stars, including the North Star, that are part of the larger constellation called the Little Bear, or *Ursa Minor*
milky way	galaxy of stars to which our solar system belongs
new moon	first of the moon's phases in which the moon is between Earth and

	Sun (The side facing Earth receives no sunlight; therefore, it is invisible from Earth.)
Northern Hemisphere	northern half of Earth in which Canada is located (The southern half of Earth is called the Southern Hemisphere.)
orbit	curved path that planets and other bodies follow around the Sun, or the path that moons follow around planets
phase	any one of the stages in the cycle of the moon's orbit around Earth
planisphere	map showing the relative location of stars and constellations
Polaris or North Star	star that is due north in the sky
rotation	motion of an object spinning on its axis
satellite	natural or human-made body that orbits a planet
solar system	Sun and its entire family of planets and other orbiting bodies
Southern Hemisphere	southern half of Earth in which Australia is located (The northern half of Earth is called the Northern Hemisphere.)
space probe	spacecraft launched to collect information about planets and other bodies in the universe
sundial	instrument that shows the time of day by the shadow cast by the Sun
sunspots	areas of solar activity that are visible as dark spots on the sun's surface
universe	all space and everything that exists in it
waning	shrinking (This describes the phases of the moon as it appears to be withdrawing from full to half to nothing.)
waxing	growing (This describes the phases of the moon as it appears to be enlarging from nothing to half to full.)

How can we observe objects in the sky safely?

Discover – Solar Viewer

Teacher Notes

- This activity has students learn how to build a simple solar viewer while also learning about sun viewing safety.
- Remind students **NEVER** to look directly at the Sun.
- Students will use their solar viewer to track changes in the rotation of the Sun by recording the location of sunspots.

Observe – Learning About Space

Teacher Notes

- Students are expected to identify technologies and procedures by which knowledge about planets and other objects in the night sky has been gathered.
- Numerous space probes have been sent into space. Obviously, students are not expected to know all these. They should be familiar with a few, but more importantly, they should gain knowledge of how space probes can collect information, and they should recognize the past, current, and future importance of space probes in contributing to our knowledge of our universe.

Exit Pass

Student Activity

Submit your *Learning about Space* information Pages for your teacher to assess. Click the *Submit* button when you are done.

Suggested Answers

Space Technology	Where did it go?	What was it designed to do?	What information did it collect?
Keck telescopes	Located in Hawaii on Earth	Uses adaptive optics to provide the clearest and farthest images of space visible from Earth	Information about various galaxies including a "juggling" galaxy and an usual rectangular shaped galaxy
Radio telescopes	Located on Earth	Detect radio wave signals being given off by cosmic objects (stars, galaxies, etc.)	Can provide more detailed images of galaxies and other deep space objects not possible using light telescopes
International Space Station	In orbit around the Earth	Used to conduct science experiments in space	-Has studied the effect on the human body of living long-term in space -Studying how plants grow in space
Explorer 1; Jan. 31, 1958	To space to study Earth	Satellite – designed to measure the radiation environment in Earth orbit	-Discovered radiation belts around Earth held in place by the planet's magnetic field -Experiment by Dr. James Van Allen revealed a much lower cosmic ray count than expected. The existence of these radiation belts was confirmed by another US satellite launched two months later -Radiation belts became known as the Van Allen Belts in honour of their discoverer
Voyager 2; Aug. 20, 1977	Jupiter, Saturn, Uranus,	-Primary mission was the exploration of Jupiter and Saturn.	-During its travels through the outer solar system, Voyager 2 visited all four gas giant planets

	Neptune	-Discovered active volcanoes on Jupiter's moon Io and intricacies of Saturn's rings -Explored Uranus and Neptune and is the only spacecraft to have visited those outer planets	-Discovered and photographed many of the planets' moons
Mars Exploration Rover – Opportunity; July 7, 2003	Mars	-*Opportunity* was second of two rovers launched in 2003 to land on Mars -Begin traversing the Red Planet in search of signs of past life	-Since landing on Mars in 2004, *Opportunity* has made several discoveries about the Red Planet, including evidence that long ago at least one area of Mars stayed wet for an extended period -conditions could have been suitable for sustaining microbial life
Aquarius; June 10, 2011	Sun – synchronous orbit with the Sun	-During three years, the Aquarius mission is designed to provide the first global observations of sea surface salinity to give climatologists better understanding of role of oceans in Earth's water cycle and weather patterns -global climate change	-Primary instrument built by NASA and launched aboard the Argentinean space agency's Satélite de Aplicaciones Científicas spacecraft -Uses sensors that measure sea level, ocean color, temperature, winds, rainfall and evaporation -Information will be more complete of how the ocean works, how it is linked to climate, and how it may respond to climate change
Spitzer Space Telescope; Aug. 25, 2003	The Universe	Designed to study the early universe in infrared light	-The first telescope to see light from a planet outside our solar system -Has made important discoveries about comets, stars, exoplanets, and distant galaxies

The description of the technology (if not from the choices provided) is located here: http://www.jpl.nasa.gov/missions/index.cfm.

What patterns can be seen in the stars?

Discover – Constellation Scrapbook

Teacher Notes

- Astronomers have divided the sky into 88 constellations. Student are not expected to know and identify all these, but they should be familiar with the more common ones such as the Big Dipper, the Little Dipper, Ursa Major, Ursa Minor, Orion, Cassiopeia, Scorpius, Leo, some of the 12 Zodiac, etc.
- Students are expected to know that constellations have been identified by many cultures since ancient times and have stories associated with them.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This scrapbook activity could be done with a partner.

Partner Up

Complete this activity with a partner. Follow these steps:

1. Post a request in our class discussion board or talk to your teacher to see if anyone is available to work with you.
2. Talk with your partner and decide when you can meet virtually.
3. Start a meeting with your partner and discuss how you would like to complete the digital scrapbook.
4. You need to construct a shared document in Google Drive. Both can work together on all the constellations at the same time or you can divide them and each is responsible for completing two constellations.
5. Work together to complete the digital scrapbook.
6. Save a copy of the completed digital scrapbook in your *Sky Notebook*.

Discover – Mapping the Stars

Teacher Notes

- Students construct a star map (planisphere) to help identify the constellations in the night sky.

Discover – The Night Sky

Teacher Notes

- Students use the Starry Night Star Chart program to observe star movements over several hours. This is more practical than having students do this outside because these changes may be more difficult to measure. If possible, encourage students to try the activity outside looking at the stars in their own night sky. This important activity for students allows them to observe first-hand the changes to the night sky over time.
- Observing the Southern Horizon allows students to see how stars move from East to West, which indicates the Earth's rotation.
- At this stage, identifying most constellations is too difficult for most students without assistance. The key purpose to this activity is for students to make note of *changes* to night sky over time.
- The best opportunities for night sky viewing in Alberta occur away from bright lights (streetlights, etc) and during the fall and winter.
- Encourage students to visit an observatory of planetarium in their area to provide some guidance in identifying some of the constellations, stars, and planets that might be visible to them.

Exit Pass

Student Activity

Submit your *Night Sky Viewing Log.*

Possible Answers

Answers will vary (depending on exact location and season), but drawings should show students' understanding that the stars have changed positions over the progression of time. In general, drawings should indicate stars moving across the Southern Horizon from East to West.

What can we learn about the movement of objects (Sun, stars, planets, Moon) in the sky by observing them?

Observing – Motion of the Earth

Teacher Notes

- Students are expected to recognize that the apparent movement of objects in the night sky is regular and predictable. They should explain how this apparent movement is related to Earth's rotation.
- Although this apparent movement has been introduced previously in relation to the movement of constellations through the night sky, it is expanded upon in more detail here.
- This activity addresses some common misconceptions about the movement of the Earth relative to other objects in space. Students are required to recognize which explanation best includes some common astronomical observations.

Observe – Seasonal Differences

Teacher Notes

- Many people think the seasons are caused by variations in our distance from the Sun. Although the Earth's orbit is slightly elliptical, it is almost circular, and the variation in distance between the earth and sun is not enough to account for our seasons.
- The seasons are caused by the tilt of the Earth. The Earth holds its rotation axis (tilt) fixed in space as it moves around the sun. In summer, the Northern Hemisphere tilts toward the Sun. Temperatures are warmer because the midday Sun shines more directly head on, increasing the amount of solar energy the Earth receives. In addition, we have more hours of daylight to provide us with more heat energy.
- In the winter, when the Northern Hemisphere tilts away from the Sun, the Sun's rays strike the earth at a lower angle, and the energy from the sunlight is spread over a larger area, which reduces its effectiveness at heating the ground. Combined with shorter daylight hours, the temperatures are cooler in winter.
- The seasons in the Northern and Southern Hemispheres are opposite.
- The emphasis is not on what causes the seasons but rather the students need to recognize how the angle of the Sun is determined by the tilt and relative movement of the Earth. This determines the amount of sunlight received by various parts of Earth throughout the year.

Discover – Making a Sun Clock

Teacher Notes

- Students **must** understand that the Sun should **never** be viewed directly or by using simple telescopes or filters. They must understand that safe viewing requires appropriate methods and safety precautions!
- The time it is depends upon where one is on the planet. That is why students use a compass to orient themselves in this activity. A compass needle (which is attracted to the magnetic field of the earth) points in a direction called *magnetic north.* That is not exactly the same as *true north,* or *geographic north,* which is the direction of the earth's North Pole. Students set up their Sun Clock so that it uses geographic north as a reference point. If they do not line up the diagram printout with geographic north, the Sun Clock will not give them the right time of day.
- If students are not near any of the cities on the list, they can still use the Sun Clock. They must go out at night and look for the North Star. On the ground, they must mark an arrow that pointing toward the North Star. That is geographic north. The next day, they can position their printout of the Sun Clock diagram with the Geographic North arrow (in the top right-hand corner of the diagram) pointing in the same direction that they marked on the ground (toward geographic north). <u>This may be used as an extension of the activity the teacher can suggest to students.</u>
- The position and length of a shadow depends on the time of day—but it also depends on the season of the year. That is because the sun's position at a certain time of day is different in various seasons.

Discover – Phases of the Moon

Teacher Notes

- Students are expected to recognize that the moon's phases are regular and predictable, and they should describe the cycle of its phases.
- This moon phase activity allows students to "act out" the phases of the moon in about 30 minutes. Students are doing in 30 minutes the activity of the moon completing one full circle around Earth in about 30 days.

Exit Pass

Student Activity

Describe how the movement or position of objects in the sky can explain the following occurrences:

1. Why does the Big Dipper look different during various times of the year?
2. Why can we use shadows to tell time?
3. Why is there more daylight during the summer near the North Pole?
4. Why does the moon look different on different nights?

Possible Answers

1. As the earth rotates and orbits around the Sun, the stars visible from our section of Earth change depending on which direction Earth is facing.
2. The Sun's position in our sky changes as the earth rotates throughout the day. Shadows change position depending on our location on earth and the time of day. These changes are predictable and can be used to track the passage of time using a sundial or gnomon.
3. The tilt of the Earth causes the North Pole to be closer to the Sun in the summer. This means that the path of the Sun is higher in the sky during the summer. Because the Sun has a longer path to travel through the sky, there is more daylight during the summer season.
4. As the moon orbits the Earth, varying amounts of the moon's surface are exposed to the Sun's light. We see this reflected surface of the moon from Earth. The amount of surface visible changes as the moon moves around the Earth.

Assessment 1 – Studying the Sky Resource

Student Assessment

A Grade 6 class has learned about how to study safely the movement of objects in the sky. The teacher would like a review resource for students to use individually to help them review for an end-of-the-year test.

Instructions

1. Your task is to construct a resource that the teacher can provide to her students so that they can review information about the universe.
2. You will construct a PowerPoint presentation to answer the question "What can I learn from studying the sky?" for the students and the teacher.
3. Before beginning your review resource, what information do you think is important to include in your resource? What does the audience (the students and the teacher) need to know about the universe?
4. Be sure to read carefully the criteria, the **Studying the Sky Resource Rubric,** and the **Studying the Sky Resource Self-Assessment** *before* you begin so that you understand clearly the expectations of this assessment.

Criteria

Your information resource should include the following:

- ☐ a title slide with a title for your PowerPoint and your name
- ☐ 1 or 2 slides for an explanation of how we can observe safely objects in the sky using various technologies
- ☐ 2-3 slides that explain
  - o 2 constellations
  - o how the constellations are named and identified in the sky
- ☐ 1 or 2 slides that explain the seasonal differences on Earth due to the tilt of the Earth as it orbits the Sun
- ☐ 1 slide that explains the apparent movement of the stars and other planets because of the rotation and orbit of Earth
- ☐ 1 slide that explains the apparent movement of the Sun because of the rotation of Earth
- ☐ 1 or 2 slides that explain the changing appearance of the moon because of its orbit
- ☐ On each slide, you will provide at least two pictures to illustrate your written description.
- ☐ Your PowerPoint will be neat, organized, and colourful.
- ☐ You may refer to resources used in this section to help you construct a well-informed resource.

Studying the Night Sky Rubric

	Excellent	Proficient	Adequate	Limited
I can explain how we can safely observe objects in the sky using different technologies.	Provides a comprehensive and engaging explanation of how we can safely observe objects in the sky.	Provides a clear and relevant explanation of how we can safely observe objects in the sky.	Provides a basic explanation of how we can safely observe objects in the sky.	Provides a vague or inaccurate explanation of how we can safely observe objects in the sky.
I can explain the patterns that can be seen in the stars.	Provides a comprehensive and engaging explanation of patterns that can be seen in the stars.	Provides a clear and relevant explanation of patterns that can be seen in the stars.	Provides a basic explanation of patterns that can be seen in the stars.	Provides a vague or inaccurate explanation of patterns that can be seen in the stars.
I can explain why seasonal differences occur on Earth as it orbits the Sun.	Provides a comprehensive and engaging explanation of why seasonal differences occur on Earth as it orbits the Sun.	Provides a clear and relevant explanation of why seasonal differences occur on Earth as it orbits the Sun.	Provides a basic explanation of why seasonal differences occur on Earth as it orbits the Sun.	Provides a vague or inaccurate explanation of why seasonal differences occur on Earth as it orbits the Sun.
I can explain how the Sun appears to move in the sky.	Provides a comprehensive and engaging explanation of how the Sun appears to move in the sky.	Provides a clear and relevant explanation of how the Sun appears to move in the sky.	Provides a basic explanation of how the Sun appears to move in the sky.	Provides a vague or inaccurate explanation of how the Sun appears to move in the sky.
I can explain why the stars and planets appear to move in the sky.	Provides a comprehensive and engaging explanation of why the stars and planets appear to move in the sky.	Provides a clear and relevant explanation of why the stars and planets appear to move in the sky.	Provides a basic explanation of why the stars and planets appear to move in the sky.	Provides a vague or inaccurate explanation of why the stars and planets appear to move in the sky.
I can explain how the moon changes appearance as it moves through the sky.	Provides a comprehensive and engaging explanation of how the moon changes appearance as it moves through the sky.	Provides a clear and relevant explanation of how the moon changes appearance as it moves through the sky.	Provides a basic explanation of how the moon changes appearance as it moves through the sky.	Provides a vague or inaccurate explanation of how the moon changes appearance as it moves through the sky.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This assessment is ideal to invite peer review.

Check It

When your presentation is complete, share it to your group for feedback.

1. Post your presentation in our class discussion board.
2. Ask your group to view your project and give you feedback using the **Studying the Sky Feedback Form** located on the class discussion board.
3. Group members will leave you feedback based on the rubric and these criteria:

- Does the student explain how we can safely observe objects in the sky?
- Does the student explain how patterns can be seen in the stars?
- Does the student explain how the Sun, moon, stars, and planets appear to move in the sky?
- Identify two ideas in the presentation that are presented in the most engaging manner, and explain why you feel that way.
- Identify one idea you would revise, and make specific suggestions to how it might be improved.
- What is your general impression of the presentation? Select three words or phrases to describe the work.

Sample Feedback Form

Has someone in your group asked you to view his or her presentation and give feedback?

1. Read the **Studying the Sky Review Rubric**.
2. View the presentation, look at the images, and read the student's ideas about what the universe is.
3. Think about the following criteria before you provide feedback.
   - Has the student explained each adequately?
   - How can we safely observe objects in the sky?
   - How patterns can be seen in the stars?
   - Why do the Sun, moon, stars, and planets appear to move in the sky?
   - Identify the two ideas in the presentation that are presented in the most engaging manner and explain why you feel that way.
   - Identify one idea you would revise, and make specific suggestions to how it might be improved.
   - What is your general impression of the presentation? Select three words or phrases to describe the work.
4. View the presentation two or three more times as you consider the rubric and criteria.
5. Click the boxes in the rubric to identify the grade you would give this presentation.
6. Provide written feedback.

Sentence starters for providing feedback:

- You might think about _____.
- You might consider _____.
- What if you _____?
- I had trouble understanding _____. You might want to clarify this part.
- I noticed that _____.
- It helped when you _____.
- I liked _____ because _____.

Please provide your feedback here:

What makes our solar system unique?

Section 2 Vocabulary

Term	Definition
axis	imaginary line running through the centre of an object
crescent	one of the two phases of the moon on either side of the new moon or the full moon; the moon appears as a sliver of light
equator	imaginary line circling Earth, dividing it into the Northern and Southern Hemispheres
first quarter	phase of the moon in which we see part of it when it is on the opposite side of the Earth from the Sun
full moon	phase of the moon in which we see the complete circle when the moon is on the opposite side of Earth from the Sun
galaxy	large grouping of stars in space; containing millions or billions of stars
gibbous	one of the two phases of the moon on either side of the full moon; the moon appears as a ¾ circle
gnomon	upright pointer of a sundial that casts a shadow
gravity	force of attraction between two objects
inner planet	one of the four planets closest to the Sun (Mercury, Venus, Earth, Mars) made mostly of rock and metal
light-year	distance a beam of light travels in one year
Local Group	cluster of about 30 galaxies to which our own Milky Way galaxy belongs
lunar eclipse	passing of the moon into Earth's shadow
Milky Way	galaxy of stars to which our solar system belongs
natural satellite	naturally-occurring body that orbits a planet; for example, our moon around our Earth
new moon	first of the moon's phases; moon invisible from Earth because it is between Earth and the Sun, so the side facing Earth receives no sunlight
orbit	curved path that planets and other bodies follow around the Sun, or that moons follow around planets

outer planet	one of the planets furthest from the Sun (Jupiter, Saturn, Uranus, Neptune) made mostly of gases
phase	one of the stages in the cycle of the moon's orbit around Earth
planet	ball of rock or gas orbiting the Sun; *planet* comes from the Greek word meaning *wanderer*
rotation	motion of an object spinning around its axis
solar eclipse	passing of the moon between the Sun and Earth, hiding part or all of the Sun from a small area on Earth
solar system	Sun and its entire family of planets and other orbiting bodies
sundial	instrument that shows the time of day by the shadow cast by the Sun
universe	all space and everything that exists in it
waning	the phases of the moon when the moon appears to be shrinking
waxing	the phases of the moon when the moon appears to be growing

What is Earth's place in the universe?

Observe – How Big is the Universe?

Teacher Notes

- The size of the universe is a difficult concept for students to grasp because it is so vast compared to their world here on Earth – even if they have travelled the around the world.
- Students must understand the universe in terms of both distance and time.

Discover – The Scale of the Solar System

Teacher Notes

- The closest planet to the sun is Mercury, and it is about 57 million kilometres (36 million miles) from the sun. Earth is orbiting the sun at a safe—and comfortable—distance of 150 million kilometres (93.2 million miles).
- These are big distances that students find difficult to understand. By using some very small household objects and a lot of space on the floor or ground, we can get a better sense of just how far apart the Sun and planets are, especially in comparison with their sizes.

Exit Pass

Student Activity

Using your knowledge from this section, answer the following questions.

1. List in the correct order, with Earth as the smallest part, the components of the universe.
2. Starting from the Sun, list the planets in correct order.

Possible Answers

1. Earth, solar system, Milky Way galaxy, nearby galaxies, distant galaxies, how far we can see
2. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune

How do other planets compare to Earth?

Observe – The Planets of the Solar System

Teacher Notes

- Students are required to recognize that the other seven known planets that revolve around our Sun have characteristics and surface conditions that are different from those of Earth. Students are expected to identify examples of those differences.
- On August 24, 2006, the International Astronomical Union (IAU) defined a planet within the solar system. The new definition excluded Pluto as a planet and added it as a member of the new category of "dwarf planets" along with Eris and Ceres. An informative website about the de-classification of Pluto is http://www.universetoday.com/13573/why-pluto-is-no-longer-a-planet/.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This research activity could be done with a partner.

Partner Up

Complete this activity with a partner. Follow these steps:

1. Post a request in our class discussion board or talk to your teacher to see if anyone is available to work with you.
2. Talk with your partner and decide how you will divide the reading for this research activity. You need to divide the 8 planets between your partner and you to complete the required research.
3. Remember to share the Observation Chart in Google Drive so that you are both working in the same document.
4. Set a date for completion. "Let's have this done by…"
5. Read your partner's entries in the chart. Do you have any questions?
6. Plan a day and time when you can discuss and answer each other's questions.

Discover – Planet for Sale!

Teacher Notes

- This activity has students stretch their imaginations and work with a partner to "sell" a planet other than Earth. In the process, they will be comparing this planet to Earth, outlining any similarities and differences.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This activity could be done with a partner.

Partner Up

Complete this activity with a partner. Follow these steps:

1. Post a request in our class discussion board or talk to your teacher to see if anyone is available to work with you.
2. Talk with your partner and decide when you can work together to complete the activity. Determine which items you are going to both have on hand for the activity.
3. Plan a day and time when you can discuss and complete the activity together.
4. You need to divide the tasks evenly and then set a timeline for completion of these tasks. Then, set regular times to meet to discuss your progress, issues that may arise, etc.

Observe – The Moons of the Solar System

Teacher Notes

- Students are expected to recognize that not only Earth but other planets have moons. They should identify examples of similarities and differences in the characteristics of those moons.

Exit Pass

Student Activity

1. Submit your Planet for Sale pamphlet and Venn Diagram comparing Earth's moon to another moon.

Possible Answers

Answers will vary greatly depending upon which facts the student chooses. However, information should be based on the information gathered from the observation charts.

Moons in Our Solar System

	Luna	**Callisto**	**Io**	**Titan**	**Ganymede**
Planet it revolves around	Earth	Jupiter	Jupiter	Saturn	Jupiter
Distance from planet (km)	384,400	1,883,000	421,600	1,221,850	1,070,000
Diameter (km)	3474	4800	3629	5150	5276
Surface Temperature (°C)	100 (day) to -173 (night)	-220 to -172	-183 to -143	-178	-203 to -121
Surface Gravity	17% of Earth's	13% of Earth's	18% of Earth's	14% of Earth's	15% of Earth's
Surface Conditions	craters, mountain ranges, lava plains	heavily cratered	active volcanism	lakes of liquid methane and ethane	grooved terrain on cratered surface

Assessment 2: A Guide to Our Solar System

Student Assessment

Throughout this section, you learned about the characteristics of the planets of the **solar system** as well as some of their moons. You have a better idea of how Earth and the other planets fit into this solar system and the universe as a whole. If alien visitors from another galaxy came to visit our solar system, would you be able to show them around?

Imagine you are a tour guide developing a visitor's guide to our solar system. You want explain how the planets and the solar system fit into the universe as a whole. The visitor guide should also offer interesting and useful information about the various planets in the solar system and how they compare to Earth.

You may choose any of the following formats for your Solar System Guide:

- pamphlet or poster
- PowerPoint presentation
- video or movie

Remember to read carefully the criteria, **Solar System Guide Rubric,** and the **Solar System Self-Assessment** before you begin so that you understand clearly the expectations of this assessment.

Criteria

Your Solar System Guide should include the following:

- Images and a description of how our solar system fits with the scale of the remainder of the universe (our galaxy and our galaxies)
- A brief description and picture of each planet in our solar system and its moons (if any)
- An explanation of how each planet is different from Earth
- An explanation of how the other moons are different from Earth's moon

Refer to resources used in this section to help you construct a well-informed guide. Remember to read carefully the criteria and **Solar System Guide Rubric** before you begin so that you understand clearly the expectations of this activity.

Solar System Guide Rubric

	Excellent	Proficient	Adequate	Limited
I can describe Earth's location is relative to the rest of the universe.	Provides a comprehensive and engaging explanation of Earth's location relative to the rest of the universe.	Provides a clear and relevant explanation of Earth's location relative to the rest of the universe.	Provides a basic explanation of Earth's location relative to the rest of the universe.	Provides a vague or inaccurate explanation of Earth's location relative to the rest of the universe.
I can explain how other planets compare to Earth.	Provides a comprehensive and engaging explanation of how other planets compare to Earth.	Provides a clear and relevant explanation of how other planets compare to Earth.	Provides a basic explanation of how other planets compare to Earth.	Provides a vague or inaccurate explanation of how other planets compare to Earth.
I can explain how other moons compare to Earth's moon.	Provides a comprehensive and engaging explanation of how other moons compare to Earth's moon.	Provides a clear and relevant explanation of how other moons compare to Earth's moon.	Provides a basic explanation of how other moons compare to Earth's moon.	Provides a vague or inaccurate explanation of how other moons compare to Earth's moon.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This assessment is ideal to invite peer review.

Check It

When your guide is complete, share it to your group for feedback.

1. Post your guide in our class discussion board.
2. Ask your group to view your project and give you feedback using the **Solar System Guide Feedback Form** located on the class discussion board.
3. Group members will leave you feedback based on the rubric and these criteria:
    - Has the student explained Earth's location in the universe, how other planets compare to Earth, and how other moons compare to Earth's moon?
    - Identify the two ideas in the guide that are explained in the most engaging way, and explain why you feel that way.
    - Identify one idea you would revise, and make specific suggestions to how it might be improved.
    - What is your general impression of the guide? Select three words or phrases to describe the work.

Sample Feedback Form

Has someone in your group asked you to view his or her guide and give feedback?

1. Read the **Solar System Guide Rubric**.
2. View the guide, look at the images, and read the student's ideas about what the solar.
3. Think about the following criteria before you provide feedback.
    - Has the student explained Earth's location in the universe, how other planets compare to Earth, and how other moons compare to Earth's moon?
    - Identify the two ideas in the guide that are explained in the most engaging way, and explain why you feel that way.
    - Identify one idea you would revise, and make specific suggestions to how it might be improved.
    - What is your general impression of the guide? Select three words or phrases to describe the work.
4. View the guide two or three more times as you consider the rubric and criteria.
5. Click the boxes in the rubric to identify the grade you would give this guide.
6. Provide written feedback.

Sentence starters for providing feedback:

- You might think about _____.
- You might consider _____.
- What if you _____?
- I had trouble understanding _____. You might want to clarify this part.
- I noticed that _____.

- It helped when you _____.
- I liked _____ because _____.

Please provide your feedback here:

Final Assessment

Essential Question

What can we learn from studying the day and night skies?

Student Assessment

This is a Choice Board creative learning assessment to allow you to demonstrate your understanding of the essential question.

Instructions

1. On the Choice Board below, you will find several activities with which to demonstrate your learning.
2. You may choose to complete any **three** learning activities in a row or the activities in the **four** corners.
3. Follow the activity instructions to know the format you should use to submit your work. Consult the Skill Builders to provide further instruction.
4. Be sure to read carefully the **Choice Board Rubric** *before* you begin so that you understand clearly the expectations of this assessment.

Remember Make a Photostory to display the eight planets of the solar system. Include their location in relation to the Sun and one interesting fact about each planet.	**Construct** You have been chosen to construct a classroom planetarium for students to observe the "night sky". Your job is to choose a portion of a night sky that you would like the students to observe. (**Note**: You need to explain how you would make the planetarium and draw pictures of it, but you do not have to construct it. You can if you want – and have the time! ☺	**Apply** Write a message to be sent into space. Use 10 pictures from magazines and/or Internet sites to produce a "we were here" message to be sent into space to any intelligent extraterrestrial life. The message must communicate what to expect of the various seasons on Earth. Be sure you include why the seasons occur.
Analyze Compare and contrast three space technologies used to gather information about other planets and/or moons using a Triangular organizer. List similarities and differences in their characteristics.	**Understand** Write journal entries as though you were Galileo recording your first observations with a telescope. Include diagrams and descriptions of what you have observed of objects moving in the sky. What do these observations tell you about how the Sun, Earth, and moon move relative to each other?	**Remember** Choose three constellations in the night sky. Make a poster that describes the constellations and explains their background and how to identify them.
Design Design a device to demonstrate how you can use humans to plot the Sun's movement during one day. You must use members of your family and/or friends as the "materials" in your experiment to produce a sundial made with humans (not marks on a piece of paper). Be sure to include materials, procedure, and possible observations.	**Apply** Make a video of yourself teaching others about how to identify the phases of the moon. Include a demonstration of the phases of the moon using models.	**Evaluate** As an experiment, the Canadian government has decided to begin a colony on one of the other planets in our solar system. Which planet do you think would best serve this purpose? Explain your reasons.

Choice Board Rubric

	Excellent	Proficient	Adequate	Limited
Organizes information	Organization of information is comprehensive, distinct, and useful.	Organization of information is logical and categories are clear and useful.	Organization of information is basic and sometimes confusing.	Organization of information is ineffective.
Communicates key ideas and information	Communication of key ideas and information is convincing throughout the activity.	Communication of ideas and information is effective throughout the activities.	Communication of ideas and information is adequate during the activity.	Communication of ideas and information is ineffective during the activity.
Presents Information	Information is presented that engages and holds the interest of the reader.	Information is presented that communicates to the reader.	Information is presented that communicates to reader, but it does not sustain interest throughout.	Information is presented that does not suit the needs or interests of the reader.
Demonstrates understanding	Thorough and insightful understanding of the unit's concepts with comprehensive explanation of concepts uses relevant facts.	Clear understanding of the unit's concepts and with explanation of concepts uses relevant facts.	Understanding of the unit's concepts and explanation of concept significance uses generalities.	Little or no understanding of the unit's concepts is shown with an unclear explanation of concepts.

Collaboration Opportunity

Students who are moving through this course as a cohort would benefit from collaboration activities. This assessment is ideal to invite peer review.

Check It

When your choice board responses are complete, share them with your group for feedback.

1. Post your responses in our class discussion board.
2. Ask your group to view your responses and give you feedback using the **Choice Board Feedback Form** located on the class discussion board.
3. Group members will leave you feedback based on the rubric and these criteria:
    - Has the student included various responses that identify clearly what we can learn from studying the day and night skies?
    - Identify the two responses from the Choice Board that are presented in the most engaging manner, and explain why you feel that way.
    - Identify one response you would revise, and make specific suggestions to how it might be improved.
    - Suggest two additional pieces of information that the student might consider including.
    - What is your general impression of the Choice Board responses? Select three words or phrases to describe the work.

Sample Feedback Form

Has someone in your group asked you to view his or her responses and give feedback?

1. Read the **Choice Board Rubric**.
2. Read the responses carefully.
3. Think about the following criteria before you provide feedback.
    - Has the student included various responses that identify clearly what we can learn from studying the day and night skies?
    - Identify the two responses from the Choice Board that are presented in the most engaging manner, and explain why you feel that way.
    - Identify one response you would revise, and make specific suggestions to how it might be improved.
    - Suggest two additional pieces of information that the student might consider including.
    - What is your general impression of the Choice Board responses? Select three words or phrases to describe the work.
4. Read the responses two or three more times as you consider the rubric and criteria.
5. Click the boxes in the rubric to identify the grade you would give these resonses.
6. Provide written feedback.

Sentence starters for providing feedback:

- You might think about _____.
- You might consider _____.
- What if you _____?

- I had trouble understanding _____. You might want to clarify this part.
- I noticed that _____.
- It helped when you _____.
- I liked _____ because _____.

Please provide your feedback here:

Resource Reference List

Below is a complete list of all the resources that are used to support learning in this unit.

Introduction to Sky Science

NASA – Astronomy Picture of the Day

http://apod.nasa.gov/apod/astropix.html

Sundials – Video

http://www.youtube.com/watch?v=tI0GqYJha1Q

What does studying the sky teach us about the Sun and the stars?

NASA – Stonehenge

http://sunearthday.nasa.gov/2005/locations/stonehenge.htm

Canada's Stonehenge

http://www.redicecreations.com/article.php?id=20738

- ## How can we observe objects in the sky safely?

NASA What are Sunspots? – Video

http://www.youtube.com/watch?v=uHdJ1lAHejw

NASA Eclipse Web Site

http://eclipse.gsfc.nasa.gov/solar.html

NASA Curiosity Image Gallery

http://www.nasa.gov/mission_pages/msl/multimedia/gallery-indexEvents.html

NASA Curiosity's Seven Minutes of Terror - Video

http://www.youtube.com/watch?v=HGYmf-HBi0A

Mission Control NASA

http://www.jpl.nasa.gov/missions/

W.M. Keck Observatory

http://www.keckobservatory.org/index.php/about/the_observatory/

How Radio Telescopes Work – NRAO

http://www.nrao.edu/index.php/learn/radioastronomy/radiotelescopes

International Space Station – NASA

http://www.nasa.gov/mission_pages/station/main/index.html

NASA Missions Index

http://www.nasa.gov/missions/index.html

Landsat Science – NASA

http://landsat.gsfc.nasa.gov/

- ## What patterns can be seen in the stars?

Stargazing LIVE: Light Pollution – Video

http://www.youtube.com/watch?v=vXcokdpgUWs

Constellations – Video

http://www.brainpop.com/science/space/constellations/preview.weml

The Constellations

http://stars.astro.illinois.edu/sow/const.html

Why Coyote Howls: A Star Story

http://www.lpi.usra.edu/education/skytellers/constellations/preview.shtml

ADLC Digital Lesson: Mapping Stars

http://www.youtube.com/watch?v=42YtFdWSZn0&feature=youtu.be

Digital Star Wheel

http://www.nrc-cnrc.gc.ca/eng/education/astronomy/constellations/planisphere.html

Galileo Galilei – BrainPOP

http://www.brainpop.com/science/famousscientists/galileogalilei/preview.weml

Diurnal Motion - Video

http://www.youtube.com/watch?v=JCr_Pz4h2Bw

Ursa Major The Big Dipper – Video

http://www.youtube.com/watch?v=hepzUgFhgis

Synaptic Sky

http://www.synapticsystems.com/sky/learnsky.html

Starry Night Sky Chart

http://www.starrynighteducation.com/skychart/skychart.php

- **What can we learn about the movement of objects (Sun, stars, planets, Moon) in the sky by observing them?**

Telling Time – A History of Timekeeping – Video

https://www.youtube.com/watch?v=PXiyqWnixqo

Sun, Moon, and Earth's Orbit

http://www.childrensuniversity.manchester.ac.uk/interactives/science/earthandbeyond/soonmoonearth/

Day and Night

http://www.childrensuniversity.manchester.ac.uk/interactives/science/earthandbeyond/dayandnight/

How the Sky Works

http://www.abc.net.au/science/articles/2009/08/11/2647703.htm

Seasons Simulator

http://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.swf

Sundroid

http://www.sunrisesunsetmap.com/

Sun Clock Diagram

http://www.exploratorium.edu/science_explorer/clock_diagram.html

ADLC Digital Lesson: Sun Clock

http://www.youtube.com/watch?v=p0PUdIj0irI&feature=youtu.be

ADLC Digital Lesson: Moon Phases

http://www.youtube.com/watch?v=efDZ8coSz3o&feature=youtu.be

Moon Phases

http://www.brainpop.com/science/space/moonphases/preview.weml

Blue Moon – Moon Giant

http://www.moongiant.com/Blue_Moon_Calendar.php

What makes our solar system unique?

The Universe

http://www.kidsastronomy.com/universe.htm

Solar System – BrainPOP

BrainPOP | Science | Learn about Solar System

- **What is Earth's place in the universe?**

Earth's Place in the Universe

http://www.youtube.com/watch?v=BKT-Z6Dy6TU

The Scale of the Universe

http://htwins.net/scale/

How Big is Space?

http://www.kidsastronomy.com/space_size.htm

How Big is our Universe?

http://www.cfa.harvard.edu/seuforum/howfar/howfar.html

How Big is the Solar System? – Astronomy for Kids

http://www.dustbunny.com/afk/planets/howbig.html

Cosmology

http://encyclopedia.kids.net.au/page/co/Cosmology

ADLC Digital Lesson: Solar System Scale

http://www.youtube.com/watch?v=BkLBysV3aR4&feature=youtu.be

- **How do other planets compare to Earth?**

Space School Musical – Discovery

http://discovery.nasa.gov/musical/planetary.cfml

Mercury – BrainPOP

http://www.brainpop.com/science/space/mercury/preview.weml

Venus – BrainPOP

http://www.brainpop.com/science/space/venus/preview.weml

Mars – BrainPOP

http://www.brainpop.com/science/space/mars/

Jupiter – BrainPOP

http://www.brainpop.com/science/space/jupiter/preview.weml

Saturn –BrainPOP

http://www.brainpop.com/science/space/saturn/preview.weml

Uranus – BrainPOP

http://www.brainpop.com/science/space/uranus/preview.weml

Neptune – BrainPOP

http://www.brainpop.com/science/space/neptune/preview.weml

Pluto – BrainPOP

http://www.brainpop.com/science/space/pluto/preview.weml

Solar System Gizmo

http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=636

Explore the Solar System

http://spaceplace.nasa.gov/solar-system-explorer/en/

Moons of the Solar System

http://www.kidsastronomy.com/other_worlds.htm

Moons in the Solar System

http://www.windows2universe.org/our_solar_system/moons_table.html