# Our Relationship With the Stars and How We Came To Be:

From Rights to Responsibility

Thorough a series of explorations, students will examine our relationship with the celestial bodies and consider how these bodies have benefited humanity and influenced life on Earth. Students will compare traditional Creation stories with Western explanations regarding the origins of the universe and consider how other traditional stories about celestial bodies have informed our relationships with the land and environment. Subsequently, students will consider the night skies, light pollution and its consequences for life with a focus on taking responsibility for our interactions with the Earth by studying animals that are adversely affected by light pollution or that are culturally significant to Indigenous Peoples of Turtle Island. All life on Earth is affected by astronomical events (days/ nights, seasons, etc.) and human culture has been influenced by the stars since the dawn of time. By the end of the explorations, students should be able to answer the inquiry question: How do our values and beliefs affect our relationships with Earth and with space beyond Earth? This series of explorations is geared towards the Grade 6 units Space and Biodiversity and to the Grade 4 units, Habitats and Light (and Sound). Other expectations may be drawn from the Energy Conservation /Energy units in Grades 5 and 6, respectively.

## Guiding questions

- Where do our beliefs come from?
- Can space belong to us? Does space belong to us all? Or only to some?
- What are the consequences of light pollution?
- What are the differing perspectives about light pollution? Who benefits/ is harmed?
- What can we learn from nature about the importance of night relationships?
- How can we improve the night for nocturnal creatures? Why care?
- How can we take greater care of Mother Earth?

**Science and Technology Curriculum Expectations - Connections:**

### GRADE 4: UNDERSTANDING LIFE SYSTEMS HABITATS AND COMMUNITIES

| |
|---|
| ● analyse the effects of human activities on habitats and communities<br>● investigate the interdependence of plants and animals within specific habitats and communities |

### GRADE 4: UNDERSTANDING MATTER AND ENERGY LIGHT AND SOUND

| |
|---|
| ● assess the impact on society and the environment of technological innovations related to light<br>● investigate the characteristics and properties of light<br>● demonstrate an understanding of light as a form of energy that has specific characteristics and properties. |

GRADE 5:

| |
|---|
| ● analyse the immediate and long-term effects of energy and resource use on society and the environment, and evaluate options for conserving energy and resources<br>● investigate energy transformation and conservation |

GRADE 6: UNDERSTANDING LIFE SYSTEMS BIODIVERSITY

| |
|---|
| ● assess human impacts on biodiversity, and identify ways of preserving biodiversity<br>● investigate the characteristics of living things, and classify diverse organisms according to specific characteristics<br>● demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans. |

GRADE 6| UNDERSTANDING EARTH AND SPACE SYSTEMS SPACE

| |
|---|
| ● investigate characteristics of the systems of which the earth is a part and the relationship between the earth, the sun, and the moon<br>● demonstrate an understanding of components of the systems of which the earth is a part, and explain the phenomena that result from the movement of different bodies in space |

**EXPLORATION ONE**
**How Did Life Begin?**

**LEARNING GOAL**: Students will recognise at the end of this activity that there are many Creation Stories to explain how life began on Earth and that these exist in all cultures. Science explains the origins of the universe in what is known as the Big Bang Theory.

**MINDS ON:** Invite students to share their cultural stories about how life began (e.g. the Christian story begins with Adam and Eve). Allow several students to share, trying to listen to as many different stories as time permits.

**ACTIVITY:** Explain to students that humans have always had stories about how life began. On Turtle Island North America is known to the Indigenous Peoples who have lived here since time immemorial, Indigenous Peoples have also shared stories about their origins here. There are many different stories: today we will read two-three and think about how their stories are similar to each other and how the stories are similar to our own stories. We will also watch a video that gives a scientific explanation of how creation occurred. Teachers are encouraged to preview the stories to select those that are most appropriate for their students.

**Online stories:**

Oneida Indian Nation: Haudenosaunee creation story (Oneida). http://www.oneidaindiannation.com/the-haudenosaunee-creation-story/ Accessed July 22, 2018 (cut and paste URL if hyperlink does not work.). This written story includes death. It may be less suitable for Grade 4 students or may require advance discussion with students around idea that death is a natural part of the life cycle of all beings

MOHAWK (HAUDENOSAUNEE) TEACHING ELDER: TOM PORTER
http://www.fourdirectionsteachings.com/transcripts/mohawk.html Scroll down to find Creation Story titled, "*CREATION OF THE WORLD*" Accessed July 22, 2018 (cut and paste URL if hyperlink does not work.) This written story is short and briefly mentions that animals dies as the dove to find earth to help create Turtle Island.

https://www.youtube.com/watch?v=74Y38Oy4AM4 Raven Steals the Light. Accessed July 23, 2018. A nine minute video. Raven is a trickster manages to steal the light from a man (actually an eagle) who keeps it for himself.

https://www.eldrbarry.net/rabb/rvn/first.htm This Haida Creation story is very similar to the told by Bill Reid. The author, Barry McWilliams, appears to be a **settler**. Accessed July 22, 2018. This written story describes how the raven introduced boys and girls, who then had families.

http://www.muiniskw.org/pgCulture3a.htm MI'KMAW CREATION STORY. Accessed July 22, 2018. This written story is the longest and likely most suitable for older students. It is written is parts and provides many opportunities for class discussion.

**Book sources for stories include:**

*Raven Steals the Light*. pp 17-24 In: Raven Steals the Light by Bill Reid and Robert Bringhurst. 2013 Douglas & McIntyre, BC

*Raven and the First Men*. pp 31-31 In: Raven Steals the Light by Bill Reid and Robert Bringhurst. 2013 Douglas & McIntyre, BC

*The Coming of Gluscabi -Abenaki-Northwest Woodlands pp 2-4*- In: The Native Stories from Keepers of the Earth by Michael J. Caduto and Joseph Bruchac Fifth House Publishing Calgary, Alberta 1991

*The Earth on Turtle's Back* -Onondaga *Northwest Woodlands pp 5*-9 In: The Native Stories from Keepers of the Earth by Michael J. Caduto and Joseph Bruchac Fifth House Publishing Calgary, Alberta 1991

**Big Bang videos:**

https://www.youtube.com/watch?v=DmUiCweDic4 The beginning of the universe, for beginners - Tom Whyntie. Accessed July 24, 2018. A four minute TED ED video that is most suitable for junior grades.

**CONSOLIDATION:** As a class invite students to share how the stories are similar, which stories were new to them.

| EXIT CARD<br>One thing I am still wondering about is… |
|---|

**EXTENSION**: Have students find a Creation story from a different culture and share it with the class.

| Additional Big Bang Videos for Teacher Background |
|---|
| The Beginning of Everything -- The Big Bang https://www.youtube.com/watch?v=wNDGgL73ihY Accessed July 22, 2018. A six minute video. Kurzgesagt – In a Nutshell. Published on Mar 3, 2014. This video is detailed with extensive terminology.<br><br>Origins of the Universe 101 \| National Geographic https://www.youtube.com/watch?v=HdPzOWlLrbE National Geographic. Accessed July 22, 2018. A six minute video. National Geographic Published on Mar 1, 2018. Video connects Big Bang to present day chemistry ideas. |

**EXPLORATION 2**
**What Do I Know about Earth's Place in Space?**

**LEARNING GOAL**: Students will discuss in a non-threatening activity their ideas (and misconceptions) about the movement of Earth. The teacher will use this as an informal assessment for learning. Students will learn the planets' names in order and the relative positions of planets in the solar system.

**MATERIALS:**

- Globe(s) for students to locate Canada and Australia,
- Visuals for Four Corners Activity (see below)

**MINDS ON:**

Using the Four Corners strategy label the appropriate walls with signs labelled North, East, South, West. Divide students so that approximately the same number of students is at each label. At each label have the following questions posted. Allow students about 5 minutes to discuss their ideas about the questions.

- Does Earth travel around the Sun or does the sun travel around the Earth? Give a reason for your answer.
- Does the Earth move? If so explain how the Earth moves.
- Why is a day 24 hours long?
- Why is a year 365.5 days long?
- What causes winters in Canada to be cold and summers to be hot?
- What season is it in Australia in July? In December?
- Do we live in the Southern or Northern Hemisphere?
- What causes days to be longer in the summer and shorter in the winter?

After students have had the chance to discuss their ideas, regroup as a class. Ask volunteers to share some of their group's ideas. On chart paper, record students' ideas.

**ACTIVITY**:

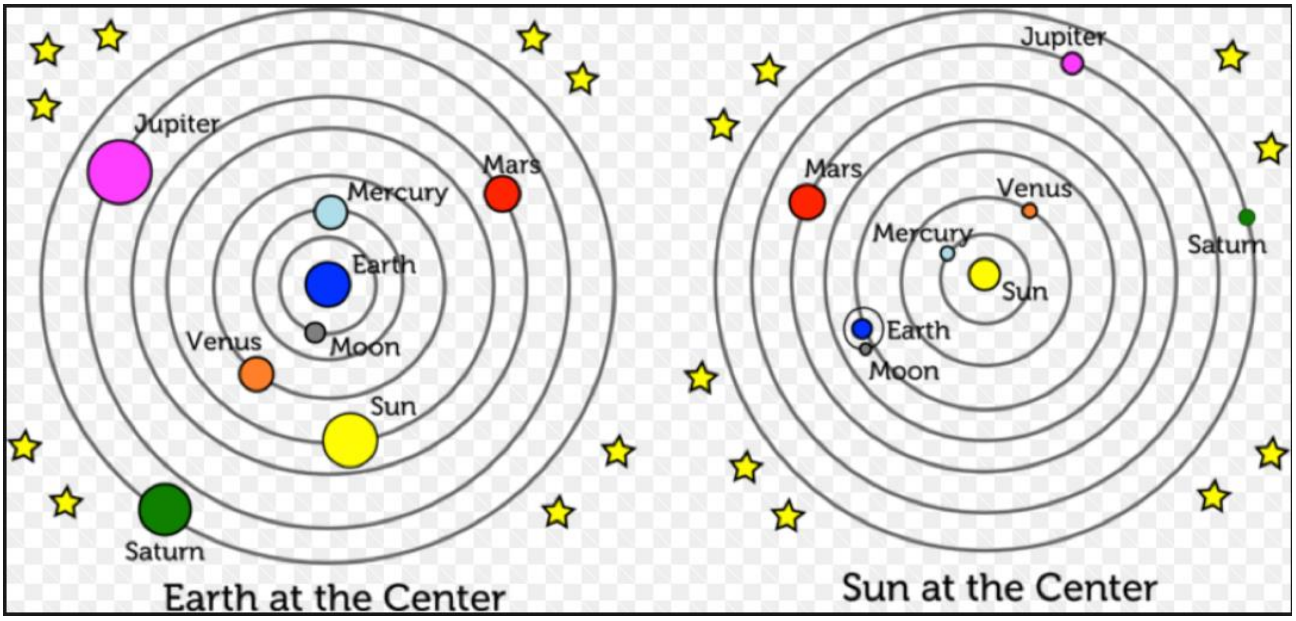
https://www.youtube.com/watch?v=UtOEnTiAZlU Geocentric to Heliocentric Video. Accessed July 19, 2018

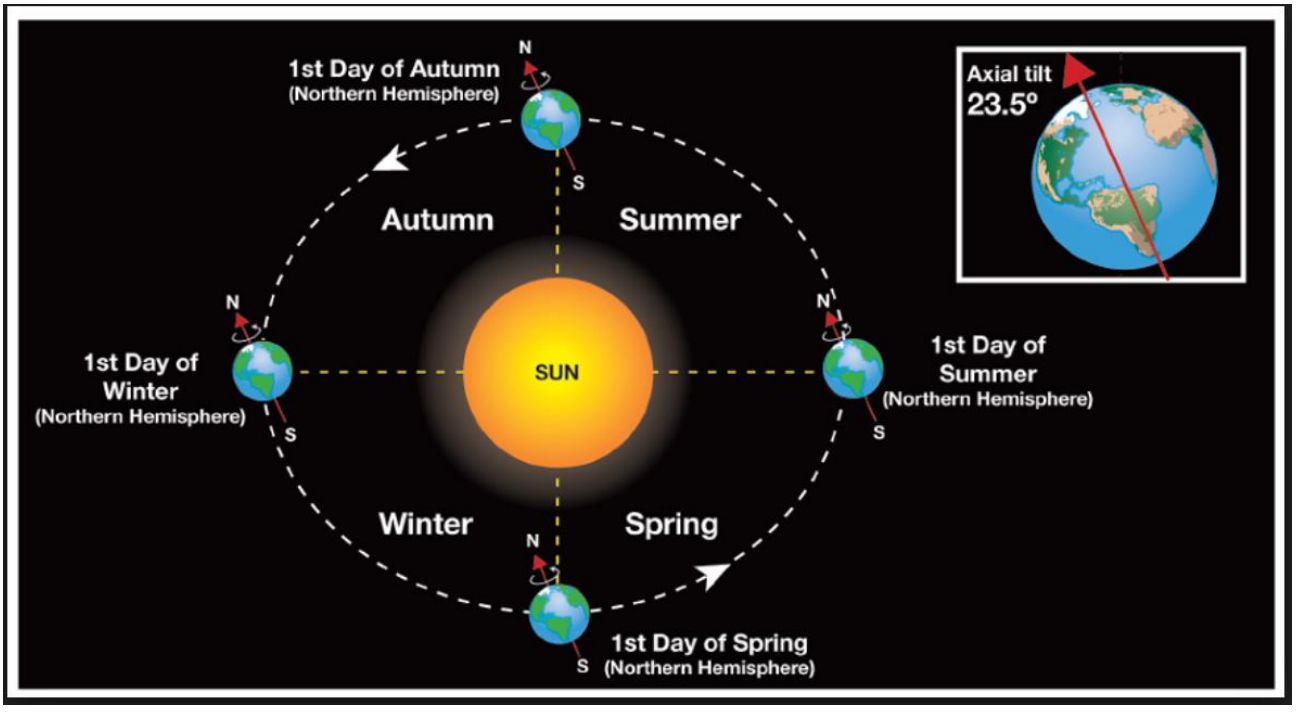
Copy and distribute the graphic organizer below, to students

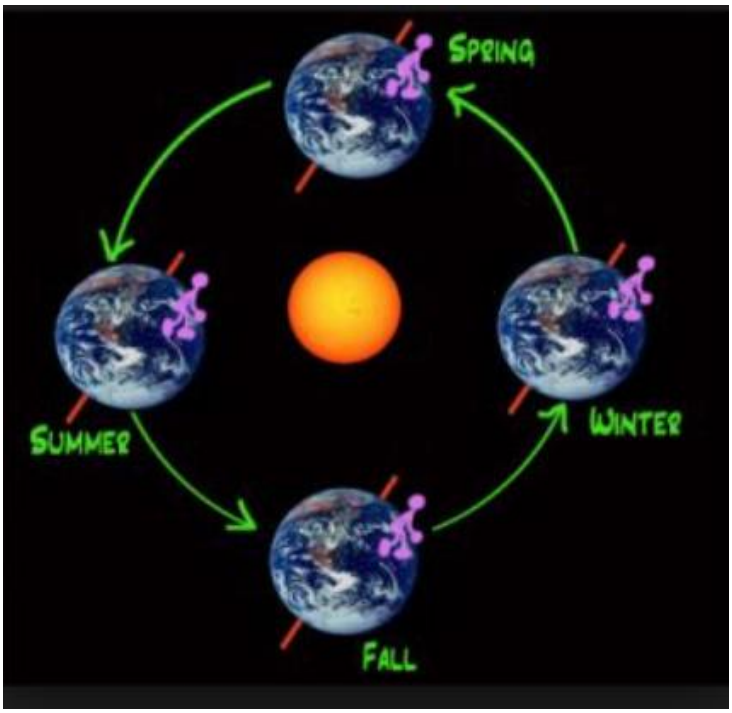
**CONSOLIDATION:**

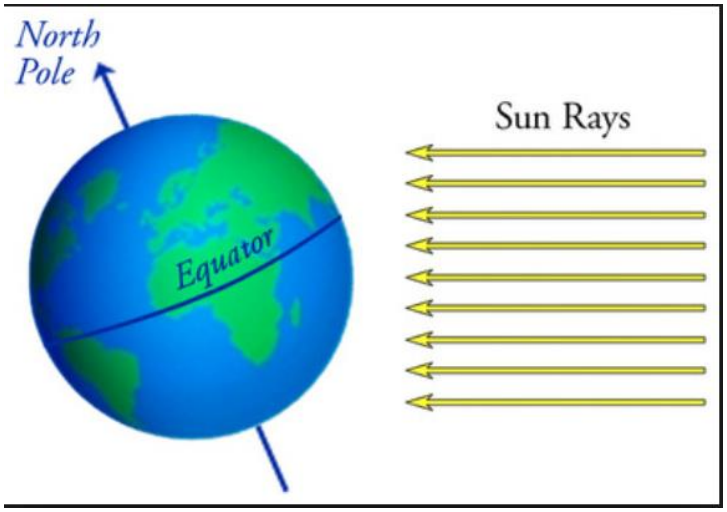
| **Comparing Heliocentric and Geocentric models of Earth's movement** | |
|---|---|
| **HELIOCENTRIC** | **GEOCENTRIC** |
| **What does heliocentric mean?** | **What does geocentric mean?** |
| **Who thought the heliocentric model was correct?** | **Who thought the geocentric model was correct?** |
| **What was their evidence?** | **What was their evidence?** |
| **Do we still believe in the heliocentric model today? Why/Why not?** | **Do we still believe in the geocentric model today? Why/Why not?** |

**VISUALS FOR FOUR CORNERS ACTIVITY**



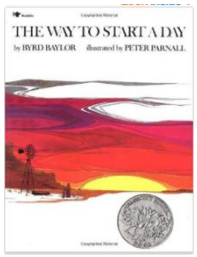

SPRING
SUMMER
WINTER
FALL


North Pole
Equator
Sun Rays

## EXPLORATION 3
### The Size of the Solar System

**LEARNING GOAL:** Students will go outside, weather permitting, for the entire lesson. If weather is inclement, the main activity part of the lesson can be done indoors and the observation of the skies (Minds On) can be postponed. In the Minds On part of the lesson, students find a sit spot and quietly observe the sky for any celestial bodies that are visible during daylight hours .In the Activity part of the lesson, students will model the relative distance between the planets. They will learn that the solar system has eight planets, four much smaller inner terrestrial planets and four outer giant planets, an asteroid belt, several dwarf planets, and numerous small bodies such as comets in orbit around the Sun. There are similarities and differences between the plants and the distances between plants are vast. Lastly, models can help us comprehend large-scale spatial relationships.

**MINDS ON:** Students will go outside with their teacher, and find a quiet place to sit alone to observe the sky. Students should taking a clip board, paper and pencil to jot down their observations. Regroup the class and ask students to share their observations of the objects they are able to identify. The website **https://spotthestation.nasa.gov/** provides worldwide times to sight the ISS. Depending on the region, teachers may have the opportunity to sight the ISS with students or alert students when to search the sky when they are not at school. Explicitly ask the students if anyone observed the moon in the sky. If not, as a class try to locate the moon and explain that it is often visible in the sky during the day (under clear skies).




In the book "*The Way to Start a Day*" by Byrd Baylor (Simon & Schuster 1998 NY), Baylor provides examples from ancient civilizations and Indigenous Peoples from different parts of the world showing how people throughout the ages have greeted the dawn. The book presents different worldviews regarding how to start a day and is a starting point to discuss how students start their day with how Indigenous Peoples traditionally begin their day. Read "*The Way to Start a Day*" to the class and ask them to think of one thing they are thankful for today. Ask them how people in the book greeted the day and how the solar system played into that thanks? Why was it important to greet the sun? What is important about the sun for us?

**ACTIVITY:** Solar System in My Neighborhood

**Overview**
In this 1-hour activity, students will "shrink" the scale of the vast solar system to the size of their neighborhood. They are challenged to consider not only the traditional "planets," but also some of the smaller

objects orbiting the Sun. Students compare the relative sizes of scale models of the planets, two dwarf planets, and a comet as represented by fruits and other foods. They determine the spacing between the scaled planets on a map of the neighborhood and relate those distances to familiar landmarks.

One of each of the following fruits and other foods* (listed from largest to smallest):
● (140cm–wide) giant pumpkin
● (140cm–wide) model pumpkin, made from
●1 Halloween orange pumpkin garbage bag, which is available from retailers (e.g. Amazon.com)
●Packing peanuts or pillows to fill the bag
● (14cm–wide) large mango or potato
● (11cm–wide) large orange or cantaloupe or coconut
● (5cm–wide) plum
● (5cm–wide) kiwi or lime
● (2-3cm–wide) small grape
● (2-3cm–wide) large blueberry
● (1cm–wide) pea or navy bean
● (1/2cm–long) uncooked orzo pasta
● (3/32"–wide) grain of uncooked rice
● (1/16"–wide) grain of uncooked rice
● (1/64"–wide) poppy seed

NOTE: it is suggested that the small items above be placed in plastic bags so that they are not lost outdoors and that a vertical flag or some type of marker be used so that the items are easy to locate.
●Measuring tape (to measure a distance of 6 metres)
●Coloring supplies, including markers and colored pencils
●1 neighborhood map, extending to 5 km from your geographic location, prepared as described under "Preparation" using either a photocopier and a detailed local map or mapping software and a printer
●11 (50cm) strings
●Ruler
●Tape
●11 coffee stirrers **or** 11 paint stirrers

**Use the site below for lesson directions.**
https://www.lpi.usra.edu/education/explore/solar_system/activities/familyOfPlanets/solarSystem/
In particular, the hyperlink for *Solar System in My Neighborhood: Planet Sizes and Distances* is especially useful to plan out the needed space in advance of taking students outside as is preparing the labels for the activity Cut out the *Planet Labels* and tape them to one end of each coffee stirrer or paint stirrer.

**CONSOLIDATION**: Invite the students to draw a map of their neighborhood and place the planets at their landmarks. Alternatively, the teacher may choose to reproduce a local map for students to place the planets at their landmarks.

Help the students visualize the vast scale of our solar system by comparing it to the fruit and its placement on your neighborhood map.

In our scale model of the solar system, how far away are the planets? What landmark did you identify for each one? E.g.: *At this scale, Mercury is an uncooked orzo pasta as far away as the end of the block, etc.*

Would you walk there or would you ride in a car or bus? E.g.: *Mercury is less than a block away; and even Venus, Earth, and Mars are within walking distance of the Sun at your location. Jupiter is about a 1/2 mile away, and Saturn nearly one mile away. Uranus, Neptune, and Pluto are all much further away. Comet Halley's orbit takes it almost to the orbit of Pluto.*

What do you notice about the distances from the Sun to the inner planets versus the distance to the outer planets? *Inner planets are closer together, relatively speaking, than the other planets.*

How long do you think it would it take a spacecraft to get to these other planets? E.g.: *Accept all answers before providing more information.* Part of this answer depends on the type of spacecraft and if it is doing other things like circling other planets. In general, if it was possible for a spacecraft to fly directly to Mercury, it would take it about 5 1/2 months to get there if it was going in a straight shot. The MESSENGER spacecraft, launched in 2004, arrived at Mercury in 2011; MESSENGER had several flybys of other planets to help it slow down so that it was able to go into orbit around Mercury. New Horizons, launched in 2006, is expected to reach the dwarf planet Pluto at the "other end" of our solar system in 2015! Due to a gravitational assist from Jupiter, New Horizon's trip has been shortened by three years. In 2016, the Juno spacecraft will arrive at Jupiter. Juno launched in 2011, and like MESSENGER, it will have a flyby that slings it past Earth (in 2013) on its way to the giant planet.

Are the planets in a straight line, like we sometimes see them presented in pictures? *No! T*he planets are in motion as they orbit the Sun. Only rarely do several planets "line up."

Other parts of this website can be used to assign reading, homework or projects.

NOTE TO TEACHER

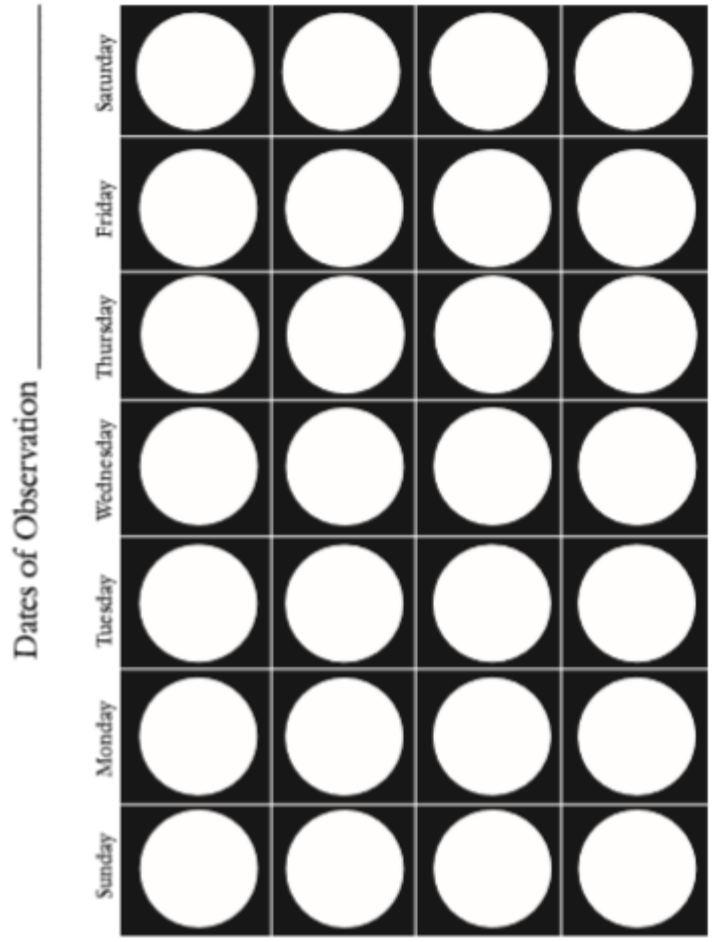
In anticipation of the next class, tell the class that as an assignment, they will begin to observe the moon after sunset, and continue to observe and record their observations on the chart that they are being given. If weather permits, model how to fill in the first day on the chart.

http://static.nsta.org/extras/nexttime/MoonJournal.pdf a 1 page phases of moon chart that students colour in to show phase of moon. The chart is reproduced below.

Name: _____

# Moon Journal

Dates of Observation _____



**EXPLORATION 4**

**How Do the Moons Make Up a Year?**

**DESCRIPTION:** In this lesson, students will learn about the moons that make up a year and develop an understanding of how Indigenous Peoples name moons. The significance of the turtle will also be explored and connected to the creation story of some First Nations people. The "calendar" is introduced as a story about the thirteen moons. Indigenous and Western European cultures have powerful stories to tell about the night sky. The stories from Western science are known as "astronomy."

Students are encouraged to meet Elders in their communities to learn about the moons and their names in their territory.

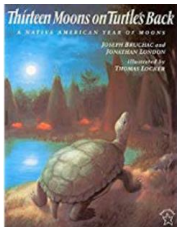
**LEARNING GOAL:** Students will be able to explain some of the reasoning used by Indigenous Peoples of Turtle Island for the naming of the months and understand that the moons are named based on the Peoples' keen observations of the land and the natural world. Students will learn the names of the 13 moons in Dëne and their English translation. They will learn about the Saanich's 13-moons and the significance of each.

Students will meet Elders (if possible) in their communities and develop respectful interviewing skills.

Students will present their learning to the class as a visual presentation, a dance, skit, or drama piece

**MINDS ON:**

Read the following book:



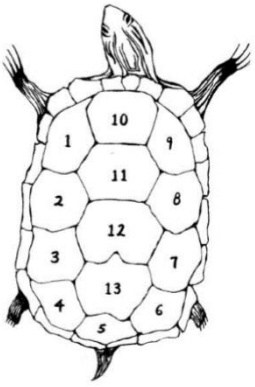

*"Thirteen Moons on Turtle's Back, A Native American Year of Moons*" by Joseph Bruchac and Jonathan London 1997 NY The Putnam and Grosset Group

Begin by reading *Thirteen Moons on Turtle's Back.* Notice that the names of the moons come from different First Nations. Be sure to read the nation names with the text. After reading the book prompt the students with the following questions:

How many months do Indigenous Peoples count? How are the months named? Are they named because of something happening in the environment? What reasons can you think of to explain why Indigenous Peoples would use this type of naming system? What do these words mean to you- "Potawatomi", "Anishinabe", "Huron", "Seneca"? Why do you think the author included these words (i.e. Potawatomi", "Anishinabe", "Huron", etc. (*They are the names of different First Nations*)) Remind the students that Indigenous Peoples live in relationships, especially in relationship to the land, and that the names of the month reflect these relationships. How many months do we count in our calendar? Do any of you practice traditions that use a different calendar? If so, what are these traditions

**ACTIVITY:**

**Students will need access to computers to access resource links.**




1. Ask students if they can remember the Creation stories they read, and what happened to Sky woman? What did she land on? How was she saved?
2. Introduce students to the thirteen sections on a turtle's back (see left). Hand out four copies per student of a turtle's back without the numbers. Have students number the moons and then fill in the 13 moons in Dëne on first figure, and in English translations on the second figure. Repeat using Saanich and English on the third and fourth figures, respectively.
3. Have a year calendar that shows when the 13 full moons appear in the current year. Locate the Dëne 13 moons on this calendar. Encourage students to relate what they know about seasonable events in their community that coincide with the 13 moons of the year of the Dëne and Saanich year.
4. Compare the Dëne moon calendar with a Saanich moon calendar.

**NOTE**: The 28 smaller sections on the outer edge of the turtle's shell correspond to the 28 days of the lunar month

RESOURCES FOR STUDENTS

THE 13 MOONS of the WSANEC (Saanich people) http://www.racerocks.com/racerock/firstnations/13moons/13moons.htm Includes names of moons and details about each moon. There is a link for an additional lesson on topic of First Nations and moons. Accessed October 16, 2018.

Thirteen Moons On Turtle's Back Instruction Guide http://www.nativereflections.com/instructions/ABB-02-Instructions.pdf Assessed October 16, 2018. Provides information about Ojibwe moons at the end of document. Very accessible for students.

OPHEA. Healthy Schools Healthy Communities Appendix 1: TRADITIONAL CALENDARS. https://teachingtools.ophea.net/sites/default/files/fn-dpa-appendices/en/11x8.5_ophea_fndpa_appendices_screen_i.pdf Assessed October 16, 2018. Provides Anishnaabe and some Cree, Haudenosaunee moon details.

**ADDITIONAL TEACHER RESOURCES FOR FIRST NATIONS:**

Tthën (Dëne), Acâhkosak (Cree) The Night Sky: A unit in the series: Rekindling Traditions: Cross-Cultural Science and Technology Units.http://creeliteracy.org/wp-content/uploads/2016/01/night_sky.pdf, Shaun Nagy, La Loche Community School La Loche, SK, Canada. Refer to Appendices A and B for details on Dëne and Cree moons. Accessed October 16, 2018.

Anishinaabe/Haudenosaunee Language Calendars Toronto Zoo Turtle Island Conservation http://www.torontozoo.com/pdfs/tic/13moons-overview.pdf Assessed August 26, 2018.

**BACKGROUND INFORMATION: CALENDARS AND LUNAR CYCLES**

There are several types of calendars in use today.

The first calendar used in the Western world was the Julian calendar named after Julius Caesar. Because of inaccuracies in that calendar, it was replaced by the calendar that we know today, the Gregorian calendar, named after Pope Gregory. Introduced in 1582, it is based on the 365 ¼ days it takes the Earth to travel around the sun, and is divided into 12 months. Every four years we have a leap year to account for the extra ¼ day. Despite its introduction in 1582, the Gregorian calendar was not universally adopted though out Europe. In Britain, it was adopted in 1752 while in Greece it was adopted in 1923. One of the biggest contributors for its adoption was the need to standardize train schedules in the mid-1800s.

The Jewish calendar is the lunisolar calendar. This calendar is used to determine days of significance. In this calendar, the length of time it takes the moon to be placed directly between the Earth makes a month. Like the Gregorian calendar there are twelve months annually, except for seven times every 19 years, when a thirteenth month is added. This adjustment is the reason some holidays occur at different times. There is also an Islamic calendar which is a lunar calendar that has a 30-year cycle with years having 12 lunar months, with leap years.

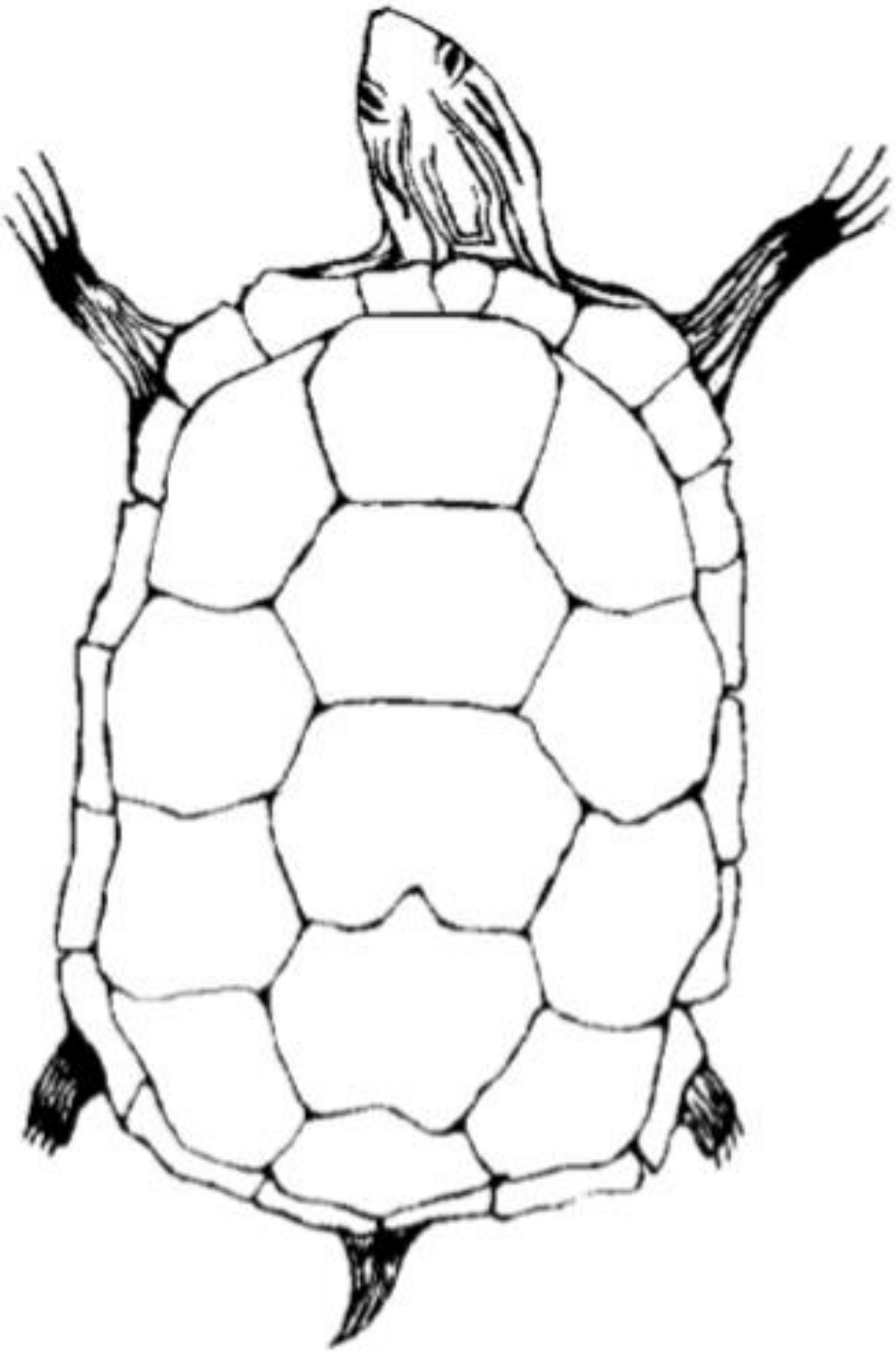
Many Indigenous People use a lunar cycle which is based on the time it takes the moon to rotate around Earth. In this system there are twelve or thirteen moons in a year. When does a moon begin? In Saskatchewan, for example, a moon begins with a full moon, but the answer varies with the culture. An Elder in your own community can give you the best answer for your area. Unlike Western calendars, these lunar cycles do not use the words “month” or “calendar” as these words reflect Western constructs and are colonialist. The lunar year does not correspond exactly to the Western year. The moons are markers of events that take place in nature. The moons have different names and different spellings, depending on location, and reflect what is locally important to the people in that area. Hunter-gathers will name moons differently than farmer-gathers. Lunar calendars are not precise in the way that Western calendars are. They are based on acute observations of nature and of natural events that do not require Western precision.

Background materials written with information accessed from:

https://www.sd71.bc.ca/School/abed/resources/teacher/Documents/The%20Saanich%20Year.pdf Accessed July 26, 2018

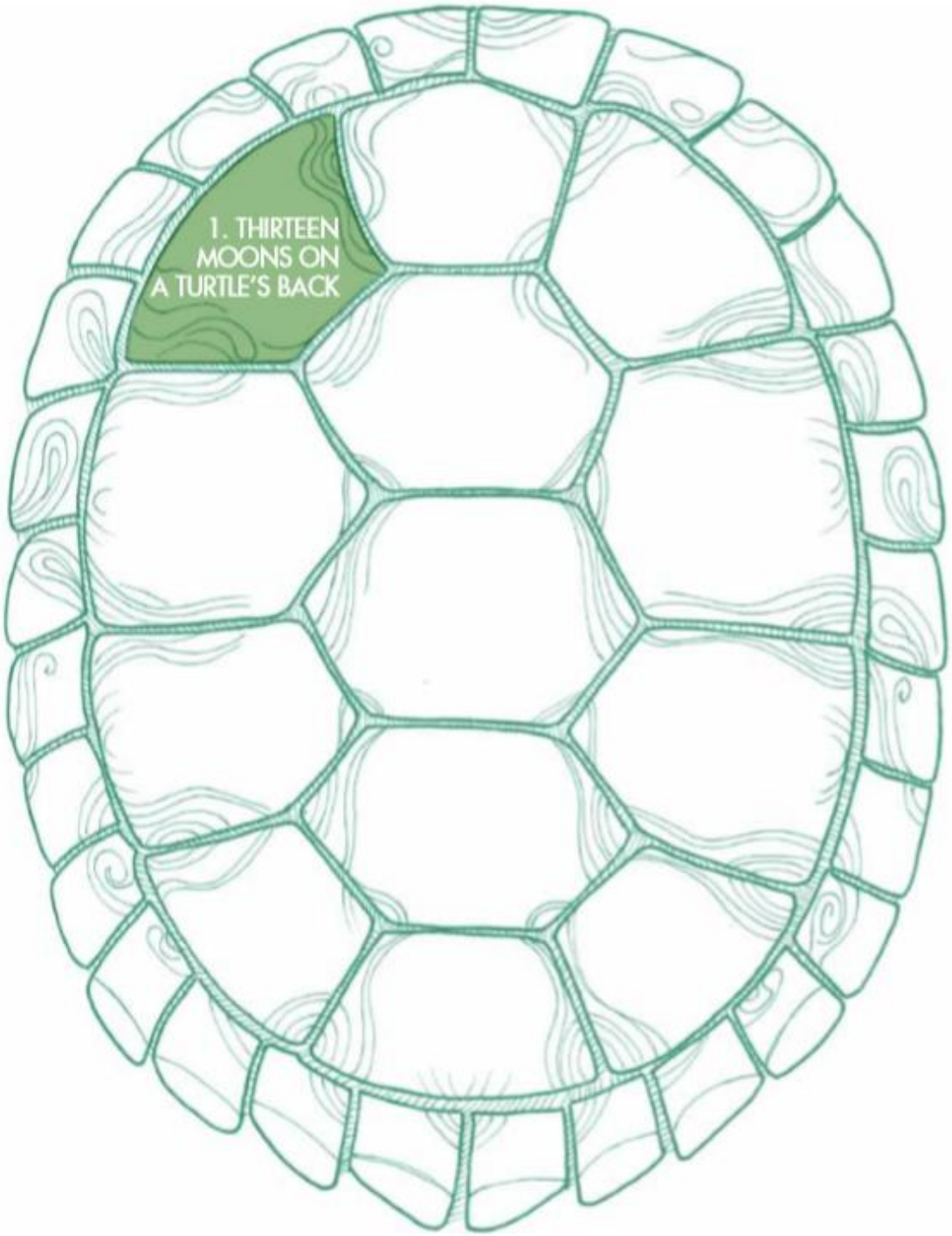
Tth’ën (Dëne) Acâhkosak (Cree) The Night Sky: A unit in the series: Rekindling Traditions: Cross-Cultural Science and Technology Units http://creeliteracy.org/wp-content/uploads/2016/01/night_sky.pdf Accessed October 16, 2018

**13 Moons on a Turtle's Back**



A similar image to the one shown above can be found on page 4 of *Thirteen Moons on Turtle's Back Instruction Guide* http://www.nativereflections.com/instructions/ABB-02-Instructions.pdf Accessed October 16, 2018

Tth'ën (Dëne) Acâhkosak (Cree) The Night Sky: A unit in the series: Rekindling Traditions: Cross-Cultural Science and Technology Units http://creeliteracy.org/wp-content/uploads/2016/01/night_sky.pdf Image above accessed October 16, 2018




**Accessed July 26, 2018 http://www.torontozoo.com/pdfs/tic/Walking_with_Miskwaadesi_22-53.pdf**

**FURTHER READING:** Identify and examine the thirteen names of the moon according to the Santee Dakotas: *The Oglala Lakota and The Western Abenaki* from *Keepers of the Night*, pg.72,(Caduto & Bruchac, 2001) and from *Keepers of Life* pg. 47, (Bruchac, Caduto, Fadden, & Fadden, 1995). What significance do the names of the moons have? What time of year do you suppose each moon relates to and why? How would using the moon as calendar work? Why do Indigenous Peoples of Turtle Island use the moon for their calendar? What types of ceremonies and practices would be implemented during these moon phases? Why do you suppose?

**EXPLORATION 5**

**What Causes the Phases of the Moon?**

**DESCRIPTION:** In this lesson, students will listen to a story about the phases of the moon and a Western explanation of the moon's phases.

**LEARNING GOAL:** Students will model the moon phases. At the end of the lesson, they should be able to explain, in their own words, why the moon looks different as the month progresses.

**MINDS ON:**

Read the following book:


*"The Next Time You See the Moon"* by Emily Morgan 2014, Arlington, NSTA Kids

Begin by reading, *The Next Time You See the Moon.* The writing in this book is structured to invite questioning. Stop during reading to invite students to share some of their responses to the questions that are posed in the text. After reading the book prompt the students with the following questions:

What happens to make the moon visible to us? *It reflects the Sun's light*. What is the special word for a growing moon? *A waxing moon*. What is the special word for a shrinking moon? *A Waning moon.* About how days does it take for the Moon to orbit the Earth? *About 29 days*. What do we call a period of about 29 days? *29 days is about one month.* Do you remember how many moons there were in the first book we read today? There were 13 moons in *Thirteen Moons on Turtle's Back*.

**ACTIVITY:**

http://static.nsta.org/extras/nexttime/MoonModeling.pdf moon modelling, modified below

https://www.youtube.com/watch?v=wz01pTvuMa0 Next Time You See the Moon. Video demonstration to accompany the book NSTA

Modeling can be the key to a better understanding of how the Moon's orbit around Earth causes changing shapes of the moon.

Materials (per group)

- Lamp with shade removed (one per class)
- Foam balls (1 per group)
- Pencil (1 per group)

Procedure:

This video provides an overview of the activity: https://www.youtube.com/watch?v=wz01pTvuMa0

Give each group the materials. In this model the lamp represents the Sun, the ball stuck into the foam ball represents the moon, and the head of the student who performing the modelling represents the Earth.

Guide students through the following activity to model how the Moon changes shape. First demonstrate the steps to the class:

1. With your face toward the lamp, hold the ball slightly above your head so that you have to look up a little to see the ball. In this position, point out to students that they cannot see the lighted side of the ball as it is facing way and the side facing the student is cast in shadow and is dark. This is called a new Moon.

2. Demonstrate turning your body slightly to the left while still looking at the ball and holding it a little above your head. Remind students they should turn until they see a tiny sliver of the lighted side—a crescent Moon.

3. Instruct the students to keep turning to the left and soon they will see more of the lighted half of the ball. This is called a quarter Moon.

4. Model turning a little more and almost all of the ball will be lit. This is called a gibbous Moon.

5. Model turning until you can see all the lighted half of the ball. This is a full Moon.

6. Continue to turn in the same direction, and point out that as they turn they will see less and less of the lighted part of the ball. First they will see a gibbous Moon, then a quarter Moon, then a thin crescent Moon, and finally they will be back to the new Moon.

Turn off all lights and make room as dark as possible. The darker, the better. Allow the students to work through the modelling in their groups and ensure that each group member takes a turn. Have students go through the orbit several times. Ask them to chorally respond with the name of each phase as it is modeled. Ask students to apply some of the vocabulary from the book to the model, such as waxing and waning (see pages 22 and 23).

Bring students' attention to notice that as they begin at new Moon and orbit the Moon to the left, they are seeing the waxing phases. Ask them on what side is the moon lighted? *The light is on the right*. One easy way to remember this is the following rhyme: If the light is on the right, the Moon is getting bright. Have them notice that the crescent is on the right side of the Moon, and that as they move the moon around they see more and more of the moon. Point out that once they continue past the full moon that they see less and less of the moon. The Moon is now said to be waning. First quarter Moon, which applies to the half of the lighted side they see after a new Moon. Third quarter Moon, which applies to the half of the lighted side they see after a full Moon. (The light is on the left.)

**CONSOLIDATION:**

Ask, "Where does the Moon's light come from?" (*The light is coming from the Sun and is reflected off the Moon*.) Some people think that the Moon phases are caused by the Earth's shadow. How does this model disprove that misconception? (*The shadow of my head, which represents the Earth, is nowhere near the Moon in this position. It is behind me.)*

Ask students what the shapes in the activity represent? (*The Moon phases*.) Point out that no matter where they are in the Moon's orbit, half of the Moon is always lighted by the Sun. Sometimes we see the whole lighted half from Earth (full Moon), sometimes we see almost all of the lighted half (Gibbous Moon), sometimes we see half of the lighted half (quarter Moon), sometimes we see only see a tiny sliver of the lighted side (crescent Moon), and sometimes we can't see any of the lighted half (new Moon). The portion we see from Earth depends on where the Moon is in its orbit around the Earth.

Assign students to visit http://www.moonconnection.com/moon_phases_calendar.phtml and view the Moon in the Southern Hemisphere compared to the Northern Hemisphere. Provide them with the questions below.

Visit http://www.moonconnection.com/moon_phases_calendar.phtml and view the Moon in the Southern Hemisphere compared to the Northern Hemisphere. You may use this site to do simulations of phases of the moon: http://astro.unl.edu/classaction/animations/lunarcycles/lunarapplet.html

Answer the questions below

Do you think the Moon would be appear differently in the Southern Hemisphere compared to the Northern Hemisphere?

Provide an explanation for your thinking? I.e. Why do you think this happens?

If we see a waning gibbous Moon in the Northern Hemisphere, what phase will people in the Southern Hemisphere see?

If we experience new Moon in the Northern Hemisphere, what phase do people in the Southern Hemisphere experience?

If we see a waxing gibbous Moon today in the Northern Hemisphere, we can expect to see more and more of the lighted side in the coming days until it is finally a full Moon. What will the Southern Hemisphere see in the coming days?

If we observe a full moon in the Northern Hemisphere what will the Southern Hemisphere see?

*The southern Hemisphere will observe the same phase as the Northern Hemisphere but the light will be on the opposite side. In the Northern and Southern Hemispheres, we are looking at the same Moon, but "upside down" from one another. Both hemispheres would see more of the lighted side of the Moon in

the coming days because it is waxing, but the light will appear on opposite sides. E.g. If we see a waning gibbous Moon in the Northern Hemisphere, what phase will people in the Southern Hemisphere see? (Waning gibbous Moon in the Northern Hemisphere is lighted on the right side but in the Southern Hemisphere the moon is lighted on the opposite side, i.e. the left side.

FOR TEACHERS: The Maori people of New Zealand had an intimate understanding of astronomy. The following websites provide additional background for down under.

https://www.sciencelearn.org.nz/resources/1274-revitalising-maori-astronomy

http://www.astronomynz.org/maori-astronomy-in-progress.html Phoenix Astronomical Society Tataai Arorangi (Maori Astronomy)

https://www.youtube.com/watch?v=iF8k9ibNKo8&feature=youtu.be Short video of phases of the moon from Discover the Universe.

**EXPLORATION 6**
**Celestial Bodies in the Night Sky**

**BACKGROUND**: The night sky and its constellations has been used by cultures since the dawn of civilization for various reasons. Early civilizations saw that the movement of the stars were predictable and cyclical. Each different culture developed their own interpretation. The earliest uses were probably religious. Different cultures developed stories about the constellations and gave stars names. Western names used today come down to us from the Greeks. More practical uses for constellations included agriculture. It was by looking to the heavens that farmers knew when to sow and harvest their crops. The constellations also helped with navigation. In particular, the position of the North Star, Polaris, was used to calculate latitude and lead Europeans to Turtle Island or North America. Modern astronomers use a common system of naming stars to facilitate communication about the ongoing discoveries in space.

Indigenous Peoples of Turtle Island also used the constellations to develop calendars and understand seasonal changes, and many continue to use these traditional ways in their daily lives to track the seasons, to anticipate when plants will be ready to harvest for food and medicines, to plan celebrations, to hunt, and in the past, to know when it was time to migrate. For example, the Skidi band of the Pawnee believed that a ring of stars in the sky represented their governance style of elders holding council to resolve important matters. Lastly, many stories have been created to help teach personal values, skills and ways of living and surviving in a good way.

From: Ask an Astronomer: http://curious.astro.cornell.edu/ask-a-question/117-the-universe/stars-and-star-clusters/constellations/375-what-are-constellations-used-for-intermediate Accessed July 25, 2018

From: Legends of America: Astronomy and Mythology in Native American Culture https://www.legendsofamerica.com/na-astronomyculture/ Accessed July 25, 2018

PREPARATION: Photocopy question sheet and name chart, below. Cut name chart into individual names and place cut names in envelopes (1 envelope per four students). Teachers may choose to print out the star finders for the students in advance of Part 2. Students can work in small groups to use the star finder to locate constellations.

**LEARNING GOAL**: Students will begin to learn Mi'kmaq and English names of constellations. They will learn the value of the night sky to Indigenous Peoples of Canada and for astronomical purposes.

**MINDS ON:** Ask the students what they know about constellations.

**ACTIVITY**: Have students Watch the introductory video explaining the background of the Mi'kmaq story Muin and the Seven Hunters.

PART 1:

https://ca.video.search.yahoo.com/yhs/search?fr=yhs-iry-fullyhosted_003&hsimp=yhs-fullyhosted_003&hspart=iry&p=Muin+and+the+seven+bird+hunters&guccounter=1#id=4&vid=13bd7d1a50e94c925b0b9371ee96db47&action=view

**nswer the following questions as you watch the video:**

1. The year, 2009, was the 400th anniversary of Galliano Galilei's invention of what instrument?

2. How many Eco zones are therein Canada?

3. What are the features or characteristics used to divide the eco zones?

4. Would people in different Eco zones see the same night sky? Explain why/why not?

5. What do the Mi'kmaq believe that the stars do for us?

6. Why does the story of Muin repeat?

7. What do Muin and the hunters represent?

8. Why do you think the Mi'kmaq used story to explain the movement of the stars they saw in the night sky? How do non-Indigenous People explain the movement of the stars?

Answer Key:

1. Invention of the telescope
2. 15
3. Types of trees, plants and animals
4. No, they would see different parts of the sky
5. The stars are the time givers and they are the calendar.
6. The story of Muin repeats because it is part of a repeating pattern.
7. They represent particular stars in constellations (Big Dipper, Bootes, Corona Borealis)
8. Story was used Indigenous People by as a way to explain natural phenomena. Western scientists use a science called astronomy.

AFTER WATCHING:

Divide students into groups of four. Pass one envelope to each group. You may choose to keep Arabic words or use them later. Have students consult their notes and group members to match the words. Practice saying the Mi'kmaq names.

| Mi’kmaq | Arabic | English |
|---|---|---|
| Muin | | Black Bear |
| Ntuksuinu’k | | The Hunters |
| Jipjawej | Alioth | Robin |
| Jiji’kes | Mizar | Chickadee |
| Wow | Alcor | Cooking Pot |
| Mikjaqoqwej | Alkaid | Grey Jay |
| Ples | Seginus | Passenger Pigeon |
| Tities | Izar | Blue Jay |
| Ku ku kwes | Arcturus | Barred Owl |
| Kupkwe’j | Mufrid | Saw-whet Owl |

**PART 2:**

Below is the story of *Muin and the Seven Bird Hunters*.

https://ca.video.search.yahoo.com/yhs/search?fr=yhs-iry-fullyhosted_003&hsimp=yhs-fullyhosted_003&hspart=iry&p=Muin+and+the+seven+bird+hunters&guccounter=1#id=1&vid=e8db82c7eb64a18d7a1fc6716ab89623&action=view

Pause the video at 1:27 to show the students the position of Muin and the Seven Bird Hunters. Continue to pause as each of the four seasons is shown and explain that as the seasons change so does the position of these stars. It is by observing these changes that the Mi'kmaq are able to track time.

**Students will need access to computers**.

After watching the video provide students with **physical** star finders from http://astro-canada.ca/le_cherche_etoile-star_finder-eng, below, and ask them what they notice.

1. Try to find the constellation described in the story, Muin and the Seven Bird Hunters, using the star finders.
2. Try to locate the Big Dipper, Bootes, and Corona Borealis.

http://astro-canada.ca/le_cherche_etoile-star_finder-eng Canada under the Stars. Star Finder. This site allows you to **print out a star finder** (also known as a planisphere) which is a circular map with an overlay that turns to show – through an opening in the overlay – the region of the sky that is visible for a specified time, date and location. It is an incredibly useful tool for orienting yourself in the night sky, for identifying constellations, and for planning your stargazing night. Students can change the date and see a virtual progression of the constellations through the night skies.

http://www.kidscosmos.org/cosmos/cosmos_star_maps.php Kids Cosmos Star Maps. This site provides pared down star maps for each month. A good place to start with younger students.

ADDITIONAL RESOURCES FOR TEACHERS:

Use the sites below to learn the location of various constellations and their names.
http://wildernessastronomy.com/resources/starchart-first-ever-overview-of-the-canadian-constellations/ Starchart: First EVER overview of the "Canadian" constellations. These are the constellations of the Ojibway, Cree, Blackfoot, and other First Nations of what is now known as Canada. Recommend using this chart in combination with other charts that have more constellations labelled. This site has links to a number of sites that provide Indigenous stories relating to the stars.

https://www.ontariosciencecentre.ca/Uploads/VirtualTour/documents/Star-Chart.pdf This star chart from the Ontario Science center shows Bootes and the Big Dipper
https://in-the-sky.org/skymap.php The In-The-Sky.org Planetarium. An online planetarium showing what stars and planets you'll be able to see in the night sky on any given day of the year. Interactive.

http://web.stcloudstate.edu/aslee/DAKOTAMAP/home.html provides names of constellations and an interpretive constellation map. Site also provides spoken names of constellations

http://www.ojibwe-dakota-in-mn.com/uploads/5/2/5/8/52587125/how_fisher_went_to_the_skyland.pdf Story of Dakota origin of the big Dipper. Accessed July 26, 2018

https://www.jpl.nasa.gov/video/details.php?id=1538 This site has monthly videos on the latest astronomical events.

https://spaceplace.nasa.gov/starfinder/en/ NASA Space Place Make a Star Finder

ADDITIONAL BACKGROUND INFORMATION FOR TEACHERS:
http://www.integrativescience.ca/uploads/articles/2010-CAPJournal-Mikmaq-Night-Sky-Stories-Harris-Bartlett-Marshall-aboriginal-astronomy-science.pdf Mi'kmaq Night Sky Stories; Patterns of Interconnectiveness, Vitality and Nourishment provides an explanation of the Muin story

***https://www.slideshare.net/jessidildy/122-aboriginal-astronomy slide show of first Nations astronomy

***http://mfnerc.org/wp-content/uploads/2016/03/Atchakosuk.pdf Slide show of indigenous connections to astronomy

**EXPLORATATION 7A**
**Light in the sky**

**LEARNING GOAL**:

In this lesson students will learn about natural sources of light (sun, moon, stars planets and the Aurora Borealis (Northern lights). They will demonstrate what makes a day, the difference between emitted and reflected light. They will explain their understanding of the Aurora Borealis from Indigenous and Western perspectives and describe how both perspectives beneficial.

**MINDS ON**: Ask students to answer the following questions as a Think, Pair, Share activity. The questions can be written on the board or handed out as a paper and pencil activity.

1. What are some natural sources of light?
2. Why do we have day and night?
3. Why are days in the summer in Ontario longer than days in the wintertime?

After discussing their answers as a class watch the following video:

https://www.youtube.com/watch?v=Wr-CRKsTYGs Day and Night video for kids.

**ACTIVITY: Part 1**: Group students into fours. Provide groups with the following materials.

Materials (per group)

- Lamp with shade removed (one per class)
- Foam balls (1 per group)
- Pencil (1 per group)
- One flashlight (1 per group)
- Mirror (1 per group)

Remind students that one ***revolution*** around the sun completes one year and that one ***rotation*** (one complete turn of the Earth on its axis) makes one night and day cycle. Have students model this cycle and Earth's axis with the lamp ball and pencil.

Light on Earth comes from the Sun (It takes 8 minutes for the Sun's light to reach us) and the light is ***emitted,*** whereas light from the Moon and the planets is ***reflected*** light (from the Sun). This distinction can be modelled using a mirror and a flashlight in a darkened classroom. First turn the flashlight on. The light that comes directly from the flashlight is emitted. Now shine the flashlight at the mirror. By angling the mirror the light can be "thrown" (reflected) to different places. The moon and planets act like mirrors in the night sky. Have students do this exploration. Ask the students which light, emitted of reflected, is brighter?

**PART 2:** Understanding the Aurora Borealis. Indigenous perspectives and Western science present different understandings and explanations for the Aurora Borealis.

**MINDS ON:** Use the Aurora Borealis video, Photographic footage of Aurora Borealis. https://www.youtube.com/watch?v=fVsONlc3OUY Scotland, August, 2015 to prompt students wondering about the Aurora Borealis.

*What do you think the video showed?*

*Have you heard of the Aurora Borealis? If so, what have you heard/read/learned about the Aurora Borealis?*

**ACTIVITY:** Below are two Indigenous stories about the Aurora Borealis. The first is Cree (from Manitoba) and the second one originates from Alaska. Depending on time constraints one or both stories could be viewed. The first story is available in print (details provided in the video). The printed version provides different opportunities for student thinking than the video version.

Cree Story of Aurora Borealis https://www.youtube.com/watch?v=fd18NxiH_BQ The Story of the Northern Lights - Wilfred Buck .The book, *Warren Whistles at the Sky* by: David A. Robertson is available here: https://mfnerc.org/product/warren-whistles-at-the-sky/ Accessed October 18, 2018

The Legend of the Northern Lights | Alaska Legend https://www.youtube.com/watch?v=ljLbeISADzo Accessed October 18, 2018

After watching the video(s) ask students the following:

*From whose perspective is /are the story(ies) told?*

*How are the stories different? Do you see any similarities between the two stories?*

*Based on the story (ies), what do you think the Aurora Borealis is?*

*Where/ when might someone see the Aurora Borealis?*

*Why would these stories be important for the people who told/ heard them?*

*What are some of your ideas about what makes an Aurora Borealis?*

Western Science explanations: Have students watch the following video:

All About Auroras: Aurora Borealis (Northern Lights) and Aurora Australis for Kids – Free School. https://www.youtube.com/watch?v=nHn5OO1t1yc Accessed October 18, 2018

After watching the video ask students to retell what was explained in the video. Record their thinking on chart paper.

*Why do you think Indigenous and Western science explanations about the Aurora Borealis are different?*

*How might both types of explanations be helpful to Indigenous and non-Indigenous People? (I.e. Indigenous stories provide lessons for living in an ethical way for the people listening, for example, staying safe, while Western explanations explain how things work (i.e. mechanist understanding))*

Assign the students the task of visiting the site, *Northern Lights Legends from Around the World* https://www.theaurorazone.com/about-the-aurora/aurora-legends to read different traditional stories to explain the Northern lights. They will write a response to the prompt "*The story I enjoyed the most was….because…*

**CONSOLIDATION:** Students share their responses about their favorite story/ legend and the understanding of what an Aurora Borealis is.

**EXTENSION:** Students visit the site, Aurora Borealis Explained University of Ohio, https://www.youtube.com/watch?v=1DXHE4kt3Fw. Using the information from this site as well as the information from the video they watched as a class, above, students will write their detailed understanding of what an Aurora Borealis is.

**ADDITIONAL TEACHER RESOURCES:**

https://www.youtube.com/watch?v=czMh3BnHFHQ . What is an aurora? - Michael Molina. TED Education

The Northern Lights https://www.nfb.ca/playlists/unikkausivut-sharing-our-stories/viewing/northern_lights/ this is an older (1992) NFB 47 minute documentary that includes traditional stories and western research about the Northern Lights. Western research to "validate" Indigenous explanation about the Aurora Borealis is described

See the Aurora http://seetheaurora.com/ This site provides details about the Aurora Borealis Northern Lights A to Z by Mindy Dwyer (2007) Sasquatch Books WA. Provides folklore and scientific information about the Aurora Borealis

**EXPLORATATION 7B**
**Light in the sky**

**LEARNING GOAL:** The purpose of this lesson is for students to acquire information about the electromagnetic spectrum and how its interpretation enables scientists to gather information about the universe. Students will use the website, *Electromagnetic spectrum/Light & color -Star Light, Star Bright* which provides students with an interactive and flexible learning environment that allows them to follow their curiosity and to learn at their own pace. Students will need computers for this activity. Students will create games based on the learning modules to challenge each other and to consolidate their understanding.

**MINDS ON**: Review with class what they have learned so far about where light comes from in the solar system.

**ACTIVITY:** Have students log into the website, *Electromagnetic spectrum/Light & color -Star Light, Star Bright*, at http://amazingspace.org/resource_page/233/electromagnetic/topic#resource_tab. The estimated time to complete all four modules if the activity is 140 minutes, so the lesson may need to be broken into smaller chunks. The three most important modules are “Catch the Waves", "Making Waves", and "Heating Up". Prisms, if they are available, would be useful to show students how light can be separated into different colours.

**CONSOLIDATION:** Divide students into groups of three to four students. Provide students access to questions from the teacher page of the web site, http://amazingspace.org/resources/explorations/light/star-light-plan.html by scrolling to the bottom of the page. Students will create a game (i.e. Jeopardy) based on one of the three activities (*Catch the Waves*, *Making Waves, and Heating Up*) that they will present to their classmates

**NOTE TO TEACHERS:** the home page for *Star Light, Star Bright* is http://amazingspace.org/resource/resource_index/electromagnetic/topic#online_exploration

**EXPLORATATION 8**
**Light Pollution**

**LEARNING GOAL**: The goal of this lesson is to learn that light pollution, in addition to interfering with astronomical research, also poses serious consequences for both animals and humans. Students will do a survey of their school and neighborhood to see if lighting is partially or fully shielded.

**MINDS ON:** Working in groups of four, have students jot down all the forms and sources of pollution they can think of.

Watch the You Tube video, *Losing the Dark,* https://www.youtube.com/watch?v=dd82jaztFIo&feature=youtu.be . After the video, ask the students to name some of the negative effects of light pollution. What are some of the solutions that are suggested to stop light pollution? Of these suggestions which would help astronomers who study the stars? Which solutions would help birds and migrating birds? (Fully shielded fixtures) Do you think that fully shielded fixtures would help to prevent turtles from swimming to land instead of to water?

**ACTIVITY:** Divide students into groups of three. In their groups they will do an audit of the school and school grounds to see what types of light fixtures are being used, if lights are on unnecessarily, and if outdoor fixtures are fully shielded. If feasible, take students on a community walk to extend the survey.

**CONSOLIDATION:** Students will share their results. When light fixtures were in place outside were they fully shielded or can light project upwards? Do you think having fewer lights on at home or in your community is a good idea? Why/why not? How can we balance our need for lighting, and safety with the needs of other organisms?

Using the websites below as a starting point, students will learn more about light pollution. Students will a) write an editorial style paragraph stating their opinion about whether light pollution is a problem or not and back their opinion with evidence **OR** b) create a PSA to inform the school community about the effects of light pollution on humans and non-human organisms.

NOTE: The teacher may wish to select one or two of the sites to explore first as a class before students undertake their own research.

Why we need darkness to survive | Diane Knutson | TEDx Rapid City Published on Aug 24, 2016 https://www.youtube.com/watch?v=C_9f7Qq4YZc Accessed October 22, 2018

Saving the night: Light pollution a serious concern for human health and wildlife Newspaper article 2013 https://globalnews.ca/news/748109/light-pollution-cause-for-concern/ Accessed October 17, 2018

http://astro-canada.ca/la_pollution_lumineuse-light_pollution-eng Canada under the Stars: Light Pollution

International dark sky protection http://darksky.org/light-pollution/ -Includes a short video of light pollution. Accessed October 17, 2018

TED Talk De-Light the Night (Light Pollution Solutions) | Diane Turnshek | TEDxPittsburgh https://www.youtube.com/watch?v=-xSv33prmGY Accessed October 17, 2018

Dark site finder http://darksitefinder.com/map/ Accessed October 17, 2018

Clear Sky Charts in Ontario http://www.cleardarksky.com/csk/prov/Ontario_map.html Shows amount of light pollution in Ontario. Accessed October 17, 2018

Light Pollution Map https://www.lightpollutionmap.info/#zoom=10&lat=5411236&lon=-8837146&layers=B0FFFFFFFTF Accessed October 17, 2018

The night sky in the World Satellite monitoring of the artificial night sky brightness and the stellar visibility http://www.inquinamentoluminoso.it/worldatlas/pages/fig1.htm Accessed October 17, 2018

**EXPLORATATION 9**
**Animals with Special Significance**

**LEARNING GOAL**: At this point in the explorations, students have learned about which celestial bodies emit and reflect light, some reasons we see more light at certain times of the lunar cycle, some properties and uses of light and natural light in our environment and some negative consequence of light pollution. Students will now consider those negative effects on animals, in particular, those animals that have special significance to Indigenous Peoples of Turtle Island.

**MINDS ON:** what are some of the animals that we have encountered that hold special significance e to First Nations, Metis and Inuit peoples? (Black Bear, Robin, Chickadee, Grey Jay, Passenger Pigeon (extinct), Blue Jay, Barred Owl, Saw-whet Owl and Turtle) Which animal do you think is the most special? The intent here is to coax the students into considering the animals that potentially are having the greatest difficulty with light pollution. Which of these animals do you think would /could be found close to where you live?

Share this quote, *"humankind must be especially grateful to the turtle as it has been given special responsibilities by the Creator to share Turtle Teachings. The turtle carries the earth on its back— the origins of Turtle Island discuss the great kindness and love expressed by the turtle in agreeing to carry the soil, plants, animals, and humans on its back, as shared in the Creation Story"*

*Turtle Island conservation, Miskwaadesi and A'nó:wara Curriculum-Based Activities Guide, page 11*

What does this quote suggest to you?

Show the one minute video "*What You Can Do*" http://darksky.org/light-pollution/wildlife/ International Dark-Sky Association Light Pollution Effects on Wildlife and Ecosystems.

**ACTIVITY:**
In group of 2-4, students will research some of the effects light pollution on animals (Migratory fish and birds, bats, insects, sea turtles, amphibians) or threats to Ontario turtles. They will then come up with an action plan (Video, PSA, letter to government, fund raise, build bat houses, etc.) of their choice to help that animal. Finished products will be published and put into action to take responsibility for the wellness of all beings. Below are some starting points for their research.

The *Curriculum-Based Activities Guide,* Toronto Zoo, Turtle Inland Conservation, pages 15-16 of the document, provides which turtle species are at risk in Ontario.
http://www.torontozoo.com/pdfs/tic/curriculum-final.pdf Information sheets for students may be found on pages 51-54 of the document (pages 28-29 of the PDF). Accessed July 27, 2018.

https://www.allaboutbirds.org/ Cornell lab of Ornithology All about Birds. This site has excellent information about birds of North America. Accessed July 27, 2018.

https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php US Fish and Wildlife Service Migratory Bird Program Threats to Birds. Accessed July 27, 2018.

https://abcbirds.org/article/up-to-one-billion-birds-may-be-killed-annually-in-building-collisions-new-study-says/ American Bird Conservancy. Accessed July 27, 2018.

https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/buildings-and-glass.php US Fish and Wildlife Service Migratory Bird Program, Buildings & Glass. Accessed July 27, 2018.

http://www.flap.org/index.php Fatal Light Awareness Program. Accessed July 27, 2018.

https://www.researchgate.net/publication/47634612_Light_Pollution_as_a_Biodiversity_Threat This article is appropriate for the teacher as background. Light Pollution as a Biodiversity Threat Article (PDF Available) in Trends in Ecology & Evolution 25(12):681-2 · October 2010. Accessed July 27, 2018.

http://darksky.org/light-pollution/wildlife/ International Dark-Sky Association Light Pollution Effects on Wildlife and Ecosystems. Accessed July 27, 2018.

**EXPLORATION 1: How Did Life Begin?**
**STUDENT SELF-ASSESSMENT**

| | I am having difficulty doing this | I sometimes need help | I can usually do this on my own and do it well | I can do this easily and seldom need help |
|---|---|---|---|---|
| I can share a creation story that is important to me and my family and explain why it is important to me. | | | | |
| I can retell one or more Creation stories from Indigenous Peoples and explain which community or nation the story comes from and why it is important to those people. | | | | |
| I can explain how scientists understand the Universe to have begun. | | | | |

**EXPLORATION 2**
**What Do I Know about Earth's Place in Space? Comparing Heliocentric and Geocentric models of Earth's movement**
**TEACHER ASSESSMENT**

| Student Name | Cannot yet explain what heliocentric and geocentric mean<br>DEVELOPING CAPABILITY | Can explain what heliocentric and geocentric mean<br><br>EMERGING CAPABILITY | Can explain what heliocentric and geocentric mean and is reasonably able to explain the evidence to support each idea<br>COMPETENT CAPABILITY |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**EXPLORATION 3**

**The Size of the Solar System**

**TEACHER ASSESSMENT**

| | Not yet-Needed ongoing help from teacher | Sometimes able to do independently or with some help | Able to do independently | Able to do independently and model/lead peers to succeed |
|---|---|---|---|---|
| Student was able to act appropriately to do task | | | | |
| Student was able to measure distance accurately | | | | |
| Student was able to locate sites used outdoors (to place the planets) on maps | | | | |
| Student showed understanding during class discussion about distances of planets and scale of solar system | | | | |

**EXPLORATION 4**

**How Do the Moons Make Up a Year?**

**SELF-ASSESSMENT (OR TEACHER ASSESSMENT)**

| | I am having difficulty doing this | I sometimes need help | I can usually do this on my own and do it well | I can do this easily and seldom need help |
|---|---|---|---|---|
| I can use information I have read, heard, or viewed in a variety of written or graphic forms, including charts | | | | |
| I can locate and interpret details in print and non-print media to gather information so I understand better | | | | |
| I was able to conduct an interview with an Elder of the Community and gather information about:<br>• The Elder's calendar and celebrations based on the calendar<br>• The history of this celebration<br>• The significance of each of the rituals involved in the celebration<br>• The importance of the celebration to the Elder's community | | | | |
| I can understand the importance of moons in First Nations culture and its relation to the environment | | | | |
| I can understand calendars of different cultures | | | | |
| I can identify the Gregorian calendar to which the chosen moon First Nation relates | | | | |

| | | | | |
|---|---|---|---|---|
| I can relate the moons to my own environment | | | | |

**EXPLORATION 6**
**Celestial Bodies in the Night Sky**

**TEACHER ASSESSMENT**

| | Not yet-Needed ongoing help from teacher | Sometimes able to do independently or with some help | Able to do independently | Able to do independently and model/lead peers to succeed |
|---|---|---|---|---|
| Student is able to answer questions about video, *Muin and the Seven Bird Hunters* | | | | |
| Student is able to identify and sort names for celestial bodies in Mi'kmaq, Arabic and English | | | | |
| Student is able to use a star finder (a planisphere) to locate the Big Dipper, Bootes, and Corona Borealis | | | | |
| | | | | |
| | | | | |
| | | | | |

**EXPLORATATION 7A**

**Light in the sky**

**STUDENT SELF-ASSESSMENT**

| | I am having difficulty doing this | I sometimes need help | I can usually do this on my own and do it well | I can do this easily and I help my classmates understand |
|---|---|---|---|---|
| I can give examples of natural light | | | | |
| I understand why we have day and night | | | | |
| I understand why days are longer in the summer | | | | |
| I can retell an Indigenous story about the Aurora Borealis | | | | |
| I can explain how Western scientist explain what causes the Aurora Borealis | | | | |

**EXPLORATATION 9**

**Animals with Special Significance**

| **Animals with Special Significance Graphic Organizer**<br>Names of group members:_____ |
|---|
| 1. Think back to some of the Indigenous Stories that you have heard in class. What animals were mentioned in the stories? |
| 2. How is this animal describe in stories? What does the animal do/ teach us? |
| 3. Chose one of the animals you recorded above. In what way(s) do you think this animal is important to Indigenous people? If you are able, speak to an Elder to learn more. |
| 4. In what geographic area does this animal live? Does the animal live in the same area as you live? Create a map to show the range where this animal lives and show where you live on the map. |

| |
|---|
| 5. Use one of the websites you have been introduced to (e.g. http://astro-canada.ca/la_pollution_lumineuse-light_pollution-eng Canada under the Stars: Light Pollution; Clear Sky Charts in Ontario http://www.cleardarksky.com/csk/prov/Ontario_map.html) and determine the amount of light pollution in the area where your animal is found. Create an overlay that can be placed over the map you drew for question #3 |
| 6. Do some research to learn about this animal's habitat and the animal's role in the ecosystem? Record your findings |
| 7. Is your animal nocturnal (is active during the night) or diurnal (is active during the day)? |
| 8. Is the animal you chose at risk? You may use this site to begin your research http://www.torontozoo.com/pdfs/tic/curriculum-final.pdf pages 15-16 provides which turtle species are at risk in Ontario. Information sheets for students may be found on pages 51-54 of the document (pages 28-29 of the PDF) |

| |
|---|
| 9. How might an Indigenous perspective and a Western perspective be similar to help species at risk? How might these two perspectives differ? If possible talk to an Elder to learn more. |
| 10. Conduct some research into how light pollution is harmful to animals. How might light pollution affect your animal if it is nocturnal? How might light pollution affect your animal if it is diurnal? |
| 11. Come up with an action plan (Video, PSA, letter to government, fund raise, build bat houses, etc.) of your choice to help your animal. For example, the Ontario Turtle Conservation Centre (https://ontarioturtle.ca/) operates a turtle hospital that treats, rehabilitates, and releases injured turtles, and does extensive research for conservation initiatives. The Canadian Wildlife Federation runs a program called *Help the Bats* (http://cwf-fcf.org/en/explore-our-work/endangered-species/help-the-bats/). There are many ways we can help make a difference to help animals in Ontario, Canada and internationally. |

OVERALL RUBRIC FOR EXPLORATATIONS

Culminating Activity: Animals with Special Significance

| KNOWLEDGE AND UNDERSTANDING | COMMUNICATION |
|---|---|
| **Student is able to show specific knowledge of content when he/ she is able to:**<br>●demonstrate considerable knowledge of science content across units including curriculum facts, terminology and definitions for the grade (i.e. size of solar system, explanations for night and day, rotation of the moon around Earth, ecosystems and biodiversity, sources of natural light on Earth, effects of light pollution on organisms, native animal species, etc.);<br>●knowledge of, and ability to model safe use of materials, tools and equipment appropriate for the units<br>**Student is able to show specific understanding of content when he/ she is able to:**<br>●demonstrate considerable understanding of concepts, ideas, theories, principles, procedures, processes for the unit/ grade (origins of the universe;<br>●demonstrate considerable understanding of Indigenous perspectives concerning months and seasons, and interrelationship between the seasons and patterns of natural events, importance of story to the understanding of natural phenomena (Traditional Ecological Knowledge) | **Student is able to show clear expression and organization of ideas and information when he/ she is able to:**<br>●use logical organization in oral, visual (diagrams, models) and/or written forms appropriate for the unit/ grade<br>●communicate respectfully with different people (teachers, Elders, parents, students) for different purposes in different forms<br>●use appropriate scientific conventions, vocabulary, and terminology of the for the unit in oral, visual, and/or written forms<br>●use correct words and language to describe and explain events from the perspective of Indigenous Peoples (i.e. learn Mi'kmaq names of constellations).<br>●develop and implement an action plan to conserve and protect an animal species that is native to Ontario/ Canada and accurately explain that animal's importance to Indigenous Peoples of Turtle Island |

| THINKING AND INVESTIGATION | APPLICATION |
| --- | --- |
| **Student is able to show specific use of critical and creative thinking skills and inquiry and problem solving skills and/or processes when he/ she is able to:**<br>Use initiating and planning skills and strategies to develop an action plan which includes:<br>●formulating questions for inquiry,<br>●identifying problems for inquiry,<br>●developing strategies for to learn how to formulate hypotheses,<br>●developing strategies to learn how to select strategies and resources<br>Use process skills and strategies to learn how to:<br>●perform and record inquiry activities,<br>●gather evidence and data,<br>●make observations,<br>●manipulate materials and use equipment safely,<br>Use critical/creative thinking processes, skills, and strategies to model how to learn to:<br>●analyse, interpret and evaluate evidence<br>●form and justify conclusions based on evidence | **Student is able to show specific application of knowledge and skills in familiar contexts when he/ she is able to:**<br>●use and model concepts and processes for the unit/ grade<br>●use equipment and technology safely for the unit/ grade,<br>●use investigation skills for the unit/ grade<br>●transfer knowledge and skills to unfamiliar contexts during action plan<br>●make connections between science, technology, society, and the environment for the unit / grade<br>●develop strategies to propose courses of practical action to deal with problems relating to science, technology, society, and the environment and to implement those actions |