UNDERSTANDING EARTH AND SPACE SYSTEMS: SPACE

Grade 6 Ontario

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UNDERSTANDING EARTH AND SPACE SYSTEMS: SPACE

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INTRODUCTION

space

Dear Teacher,

This unit has a lot of hands on experiments that will keep students excited and engaged while learning about space. Wherever possible, I have tried to ensure that all of the experiments use common and safe materials to accomplish the learning goals. However, an important aspect of these experiments is the ability for students to reflect on their learning because some of the concepts are theoretical and some students may struggle with making these connections without your guidance. This is especially true with the study of the solar system and space exploration; dealing with sizes and distances that are so immense we have a hard time visualizing them. Considering the advanced science required to study our universe and abstract concepts such as the Earth's axis, it is easy to understand why students may struggle to grasp them fully.

I also highly recommend that this not be your first unit of the year. There are many skills that students will require, such as independent work skills and a knowledge of inquiry and the inquiry process. These are skills that have to be explicitly taught, modelled, and rehearsed. It can be done in this unit, but would require additional lessons to teach these skills.

This unit can be used by teachers at any stage of their inquiry journey. Learning how to use an inquiry approach in your classroom is a valuable and instruction-changing experience. As you begin, I cannot promise you that it will all be smooth sailing because inquiry can be messy and uncomfortable as the teacher lets go of some control over student learning and the students begin to learn to take a more active role in their own learning. Understanding that this process is a journey and that this unit will help you to begin, continue, or support you on that journey is paramount. If you are new to inquiry and would like more support, please check out my video inquiry series on my website at http://bit.ly/ML-inquiry to learn about how I implement inquiry in my classroom with my split grade classroom.

As always, if you have any questions, concerns, or comments you would like to share with me, I am always available to support you. Send me an email and I will get back to you promptly. I appreciate when buyers contact me directly about any issue prior to leaving feedback.

Enjoy the unit!

Sincerely,

Patti

@MadlyLearning

EMAIL : info@MadlyLearning.com

FOCUS ON inquiry

Inquiry is an approach to teaching that takes the teacher out of the role of lecturer and transitions the teacher into the guide on the side. By implementing an inquiry approach, you are giving up some of the control in your classroom and over the learning.

Getting Started:
Start your unit getting to know how much your students know and what they are interested in. This is the goal of lesson one. They will review the images of the Wonder Wall to activate prior knowledge and inspire thinking. Their thinking will elicit questions that will serve to guide your exploration through the remaining components of the unit. Capture student questions and post them on a chart as they share their ideas with the class.

At this point, students will ask questions—but don't give them answers; just write the questions down and ask a question back that makes them think more deeply about the topic they are curious about. Get an idea about what they are interested in and what they know. Once you have captured their questions, look at their list and group their questions into topics.

The photos were designed to foster student thinking related to the content of the curriculum. These will serve as questions that will lead into your lessons.

Make a list of themes that students want to know more about. These will generally follow the lessons as they are planned out in this unit, except now you have let them choose why they are learning about them.

FOCUS ON inquiry

The Lessons:

The lessons in this resource reflect the typical goals of an initial student inquiry.

You will work through these lessons by always referring to these as being a part of the student goals. They do not have to be done in exactly this order, and you can add in other information based on student interest. You will notice that many of the pages either activate prior knowledge or are a reflection about a hands-on learning activity to ensure that students are learning what they are supposed to learn from the activities. This is where your guidance becomes an important part of the learning process.

You are no longer just giving information. You are leading discussions through questioning techniques that help students to draw conclusions.

Conferencing and knowledge-building circles will be important activities for this to occur. Assess who is doing most of the talking? It should be the students doing the talking about their learning, not just listening.

This is the goal for learning. However this may be new to many of them as they learn to listen to each other instead of just you. So train them, train them, train them by gradually releasing the control of the conversation away from you and more to them.

Final Inquiry Project:

This is the application piece of all of their learning and should take up the most of your teaching and learning time. During this time, you are not teaching and lecturing. Instead, you are supporting, questioning, and conferencing with students.

FOCUS ON inquiry

If this is one of your first inquiry units, you can consider a guided inquiry approach where you walk them through each step and limit their choices. Alternatively, you can allow students to work as a group based on interest and use a guided reading for science model to help guide them through their inquiry.

Assessment

Assessment has three elements along the journey.

Diagnostic - *Assess students about their initial knowledge. This is not a formal assessment but will give you a baseline of student understanding. Quickly level student knowledge based on three levels of understanding: limited, developing, and good.*

Formative Assessment - *Through each lesson, there are guides for how to collect formative assessment of your students. Gather information for your assessment from a balance of your conversations, observations, and the products produced by students.*

Summative - *At the end of the unit, students will participate in a culminating activity of the inquiry project. This project will have them apply their learning from the smaller parts of the unit to complete this inquiry project. Allow for an open-ended approach to how students present their information. Your assessment will be of the knowledge and skills demonstrated, not on specific methods of how this is demonstrated.*

Inquiry is a journey, and wherever you are on your inquiry journey as a teacher is an okay place to be. Start with one inquiry task and with every new experience release a bit more control to students letting them lead. This happens over time, not overnight.

SCIENCE BACKGROUND

teacher support

This unit begins with looking at the bodies in our solar system and how they are interrelated. This does **not** include bodies beyond our system that are part of the galaxy (stars other than the sun, constellations, black holes, etc.). This is how the students discover that the only object in our solar system that emits light is the sun, which is a star. The lessons give the opportunity for students to explore the size, movements, and interactions of the different bodies in the solar system. The intent is not to have the students memorize detailed facts about the planets and other bodies, but have a general understanding of the role they play. Particular attention is given to the natural phenomenon of day/night, the seasons, tides, and eclipse that we experience here on Earth. Students come to understand that it is the relationship and movements of the moon, Earth, and sun that produce these natural occurrences.

A second focus is the technology that humans have created to view and explore space. Space science is ever evolving as our curiosity pushes us to find out more about our universe and beyond. Much of this technology has improved our daily lives of Earth, with advances in health care, scientific knowledge, communications, and human safety. Some question the cost, considering the billions of dollars spent on space exploration, the risks involved, and the pollution it adds to our environment. It is important that students become aware that there are costs and benefits to space exploration.

There are extensive resources about the topics studied in this space unit. There are many reference books written specifically for this age group. The Canadian Space Agency and NASA both have excellent sites that are updated daily. They produce materials for students, including videos, simulations, space camps, and activities. Other renowned sites such as National Geographic for Kids, The Smithsonian, and PBS (just to name a few) have wonderful support material. Visual materials play an important role in allowing students to see and understand what they cannot see with the naked eye. All of these resources are useful for teachers as well, especially for those of us who do not have a science background.

CROSS CURRICULAR
connections

There are many other opportunities to connect this unit with other subjects that you teach. Here are some ideas about how you can connect the learning in this unit with other subject areas.

OTHER SCIENCE	• flight • rocks and minerals • states of matter • making a rocket • creating models (solar system, day/night, etc.)
SOCIAL STUDIES	• ancient people's view of Earth and space
MATH	• circle - diameter, area • measurement - distances, converting units, space units
LANGUAGE	• research skills (synthesizing information taking notes) • myths and folklore about beginning of universe
ARTS	• suggestions in optional lessons
PHYS ED	• personal training - building cardio, strong muscles, and stamina like astronauts do to prepare for space and in space to work against the effects of gravity

GRADE 6 SPACE
table of contents

ONTARIO

LESSON	DESCRIPTION	PAGE #
1	Space - Asking Questions	14-27
2	The Solar System: Space Hunt	28-48
3	The Solar System Simulation	49-52
4	Comets, Meteors, Asteroids and Satellites	53-62
5	Sun: King of the Universe	63-71
6	The Moon and Earth Working Together (phases, tides and eclipses)	72-91
7	Can We Live Here? - Human Needs in Space	92-100
8	The International Space Station	101-109
9	Using Space Technology on Earth	110-116
10	Canada in Space	117-127
11	Putting it All Together : Our Interrelated System	128-133
12	Independent Inquiry	134-151

GRADE 6 - SPACE

unit checklist

Checklist of curriculum expectations covered by lesson

Curriculum Expectations	1	2	3	4	5	6	7	8	9	10	11	12
1.1 assess the contributions of Canadians to the exploration and scientific understanding of space										X		X
1.2 evaluate the social and environmental costs and benefits of space exploration, taking different points of view into account								X	X	X		X
2.1 follow established safety procedures for handling tools and materials and observing the sun			X		X							
2.2 use technological problem-solving skills to design, build, and test devices (sundial)					X							
2.3 use scientific inquiry/research skills to investigate scientific and techno- logical advances that allow humans to adapt to life in		X			X	X	X	X		X		X
2.4 use appropriate science and technology vocabulary,		X	X	X	X	X	X	X	X	X	X	X
2.5 use a variety of forms (*e.g., oral, written, graphic, multimedia)* to communicate		X	X	X	X	X	X	X	X	X	X	X
3.1 identify components of the solar system, including the sun, the earth, and other planets, natural satellites, comets, asteroids, and meteors, and describe their physical characteristics		X	X	X	X	X						
3.2 identify the bodies in space that emit light and those that reflect light		X	X	X	X	X						
3.3 explain how humans meet their basic biological needs in space							X	X	X			
3.4 identify the technological tools and devices needed for space exploration							X	X	X			
3.5 describe the effects of the relative positions and motions of the earth, moon, and sun					X	X						

grade 6 space

LEARNING GOAL SUMMARY

Student Name: ______________________________

Lesson	Learning Goal	1	2	3	4
1	Students will recognize their background knowledge about the topic. They will formulate specific questions to answer during the study of space.				
2	Students will identify components of the solar system, including the sun, Earth and other planets, natural satellites, comets, asteroids, and meteoroids.				
3	Students will simulate a scale model of the solar system.				
4	Students will identify and describe natural satellites, comets, asteroids, and meteoroids.				
5	Students will describe the effects of the positions and motions of the Earth and the sun with a focus on night/day and the seasons.				
6	Students will describe the effects of the positions and motions of the earth and the moon with a focus on the phases of the moon and the creation of tides. Students will describe the positions and motions of the Earth, moon, and sun during lunar and solar eclipses.				
7	Students will identify scientific and technological advances that allow humans to adapt to life in space.				

grade 6 space

LEARNING GOAL SUMMARY

CONTINUED

Student Name: ______________________________

Lesson	Learning Goal	1	2	3	4
8	Students will identify scientific and technological advances that allow humans to adapt to life in space.				
9	Students will investigate scientific and technological advances that allow humans to adapt to life in space and how these inventions have benefitted our daily lives on Earth.				
10	Students will investigate Canada's contributions to space exploration.				
11	Students will demonstrate their understanding of the interrelated nature of our universe and how the technological and scientific advances that enable humans to study space affect our lives.				
12	Students will design and carry out a research and design project.				

NOTES:

LESSON ONE

Space - Asking Questions

6 L1

All pages through this resource are marked similar to above to show the Grade (6) and Lesson number (L1).

grade six

LESSON ONE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will recognize their background knowledge about the topic.
They will formulate specific questions to answer during the study of space.

Preparation

- Wonder Wall Images
- Copies of Space by Images: Know, Observe, Wonder graphic organizer - 1 per student
- Chart paper, document, or board to record class notes

Lesson Part A	Lesson Part B
• Students will begin by looking at the images posted on the wonder wall. • Have students inspect the images carefully. • Ask them to complete the Space by Images: Know, Observe, Wonder organizer independently.	• Have students share information from the Organizer one column at a time recording some common points. • These can be transferred to a bulletin board for reference. • Inform students that we will be using their Wonderings to learn about space and they will have an opportunity later to do a personal investigation.

Assessment

The students' notes on the organizer will give you insight into background knowledge and which lessons you might want to spend more time, noted by the interest in different pictures.

NOTES

The photos were chosen to elicit questions that align with the lessons. It is important to record students' ideas, even if they may be incorrect, in order to track student learning throughout the unit. You may wish to record the questions from the wonder column on cards to post with the images on a bulletin board.


1


2


3


4

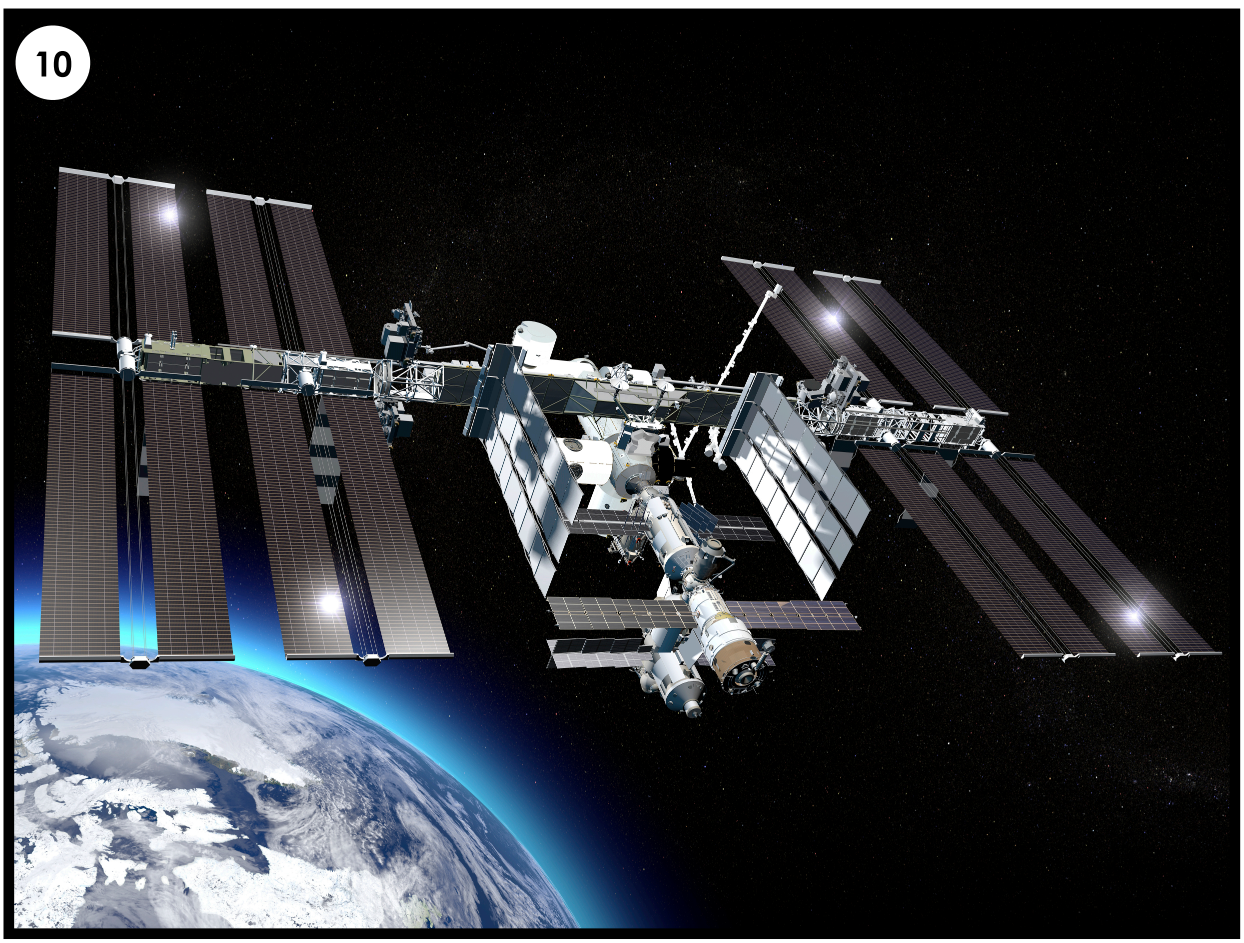

5
METEOR RAIN


6

7

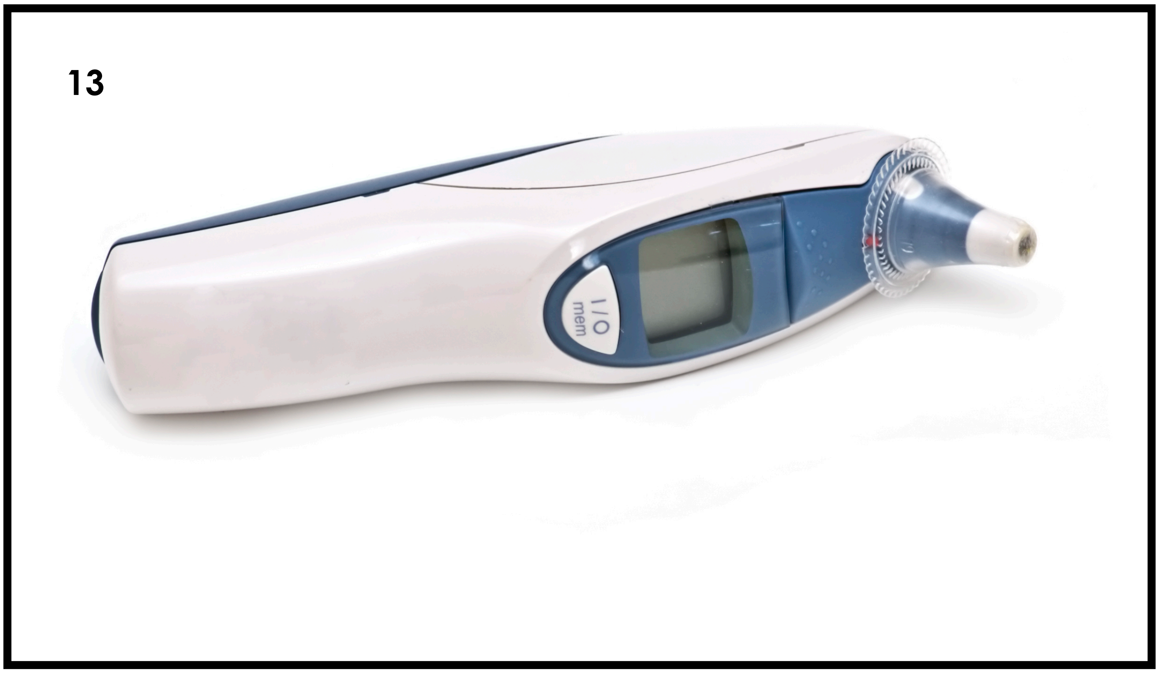
8


9


10


11


12
CHEESE SPREAD
Creamed Spinach
50 mL hot water, 5-10 min
Shortbread Cookies
Candy Coated Peanuts
Crackers
Beef Steak
4127303142


13
I/O
mem


14


15


16
JULIE PAYETTE
NASA

Answer Key

WONDER WALL ANSWERS

1. solar system
2. Milky Way galaxy
3. sun, moon, Earth aligned
4. solar eclipse
5. meteor shower
6. asteroid
7. ocean/ tide coming in
8. seasons
9. astronauts' view from space
10. International Space Station (ISS)
11. astronaut sleeping aboard the ISS
12. space food
13. ear thermometer
14. CT (CAT) scan machine
15. Chris Hadfield
16. Julie Payette

SPACE BY IMAGES

KNOW	OBSERVE	WONDER

WE WONDER

WE WONDER

LESSON TWO

The Solar System

grade six
LESSON TWO

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will identify components of the solar system, including the sun, Earth and other planets, natural satellites, comets, asteroids, and meteoroids.

Preparation

- Print sets of **Space Hunt Cards**
- Devices with link to **site**
- Books from library about the solar system and universe
- Several copies of article as a resource
- Copies of article **Our Universe** for student notebook

Lesson Part A	Lesson Part B
• Set out research resources and decide how to give your students access to them. • **Space Hunt** activity—follow instructions page. • During the first part of the lesson, the students will collect the information.	• Now that students have collected the information, follow the activity instructions steps 4-6. • Once students have the article **Our Universe**, instruct them to highlight a memorable piece of information about each component of the universe.

Assessment

This lesson will allow you to assess the background knowledge of your students as well as judge interest in the topic.

NOTES

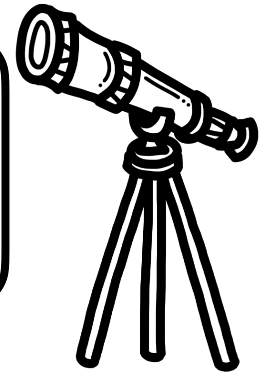
The intent of the lesson is to introduce information about the parts of the solar system to the students. The Ontario curriculum does not require memorization of numerous detailed facts about the bodies in the solar system, but rather a qualitative understanding, like Jupiter is a large planet far from the sun so it is very cold. The details on the cards are to help them identify the body using resources.

Much of the information is based on the following websites, as well as the article provided with the unit.

https://pbslm-contrib.s3.amazonaws.com/WGBH/buac18/buac18-int-toursolarsystem/index.html

http://www.skyscience.ca/solar-system.html

SPACE HUNT



1. Explain to the class that they will be going on a space hunt. Some of the information they may be will familiar with while some will be new.

2. Give each student one **Information Card**. They are to use the resources to find out which part of the universe (planet, star, comet, etc.) they have. Read all of the information about their part of the solar system. They are not to share their findings with other classmates.

3. Set a time limit for the search, depending on your class needs—10-20 minutes.

4. Once the class is back together, tell them that they have only part of the information about their part of the universe and that another person has the other part.

5. Allow them to compare cards until they find their partner.

6. Have partners post their cards together on the **Space Hunt Chart** or a bulletin board.

7. Give each student a copy of the **Our Universe** article for their notebook.

8. An **Answer Key** has been provided.

✳ planet
✳ gas giant
✳ has rings

✳ hottest planet
✳ over 1000 volcanoes
✳ spins in opposite direction than other planets

✳ dwarf planet
✳ surface is water ice, nitrogen, and methane
✳ one year is 248 Earth years

✳ ice giant planet
✳ made of helium, hydrogen, methane
✳ appears blue due to methane
✳

✳ largest object in asteroid belt
✳ rocky crust with ice water
✳ smaller than Earth (.00015 Earth's mass)

* a star
* largest object in our solar system
* ball of gases

* closest planet to sun
* has no moons
* similar in size to Earth's moon

* located past Neptune
* made up of over a trillion comets
* also made up of icy objects, including Pluto

* region between Mars and Jupiter
* made up of asteroids
* does not emit light

* planet
* 62 moons
* does not emit light

- ✳ holds planets in place with gravitational pull
- ✳ emits light
- ✳ will continue for 5 billion more years

- ✳ one year is only 0.24 of a year on Earth, or 88 days
- ✳ very thin atmosphere
- ✳ does not emit light

- ✳ farthest planet from sun
- ✳ one year on this planet is almost 165 Earth years
- ✳ appears blue

- ✳ neighbour to Earth
- ✳ has largest volcano
- ✳ one year is almost 2 years on Earth

- ✳ known as Earth’s twin
- ✳ does not emit light
- ✳ has a volcano with two craters

✳ known as a shooting star
✳ can also be part of a group and appear as a shower
✳ reflects light

✳ fifth largest planet
✳ has one moon
✳ year is 365 days

✳ usually comes from afar, at the edge of our solar system
✳ orbits the sun
✳ also known as a dirty snowball

✳ a gas giant made up of mainly helium and hydrogen
✳ has a giant red spot
✳ has a storm which has lasted over 100 years

✳ made up of millions of objects
✳ size of objects in this area range from pebbles to dwarf planets
✳ most well known body is Ceres

✳ 27 moons
✳ larger than Earth (14.5x)
✳ rotates opposite direction
✳ does not emit light

✳ largest planet
✳ does not emit light
✳ one year is equal to almost 12 Earth years

✳ planet appears red from minerals on its surface
✳ has ice and snow
✳ has 2 moons

✳ an ice giant planet
✳ does not emit light
✳ has 14 moons

✳ is doughnut shaped
✳ similar to an asteroid belt
✳ does not emit light

✳ a spiral shaped galaxy
✳ made up of about 100 million stars
✳ contains our solar system

✳ at one time had status as a planet
✳ does not emit light
✳ largest body in Kuiper Belt

✳ has a bright tail
✳ Halley's is a famous example which passes Earth about every 76 years

✳ a space body that enters Earth's atmosphere and lands on our planet
✳ has three stages ending in -or, -ite, and -oid

✳ third planet from Sun
✳ only inhabited planet
✳ does not emit light

- ✳ planet
- ✳ gas giant
- ✳ has rings

- ✳ hottest planet
- ✳ over 1000 volcanoes
- ✳ spins in opposite direction than other planets

- ✳ dwarf planet
- ✳ surface is water ice, nitrogen, and methane
- ✳ one year i s 248 Earth years

- ✳ ice giant planet
- ✳ made of helium, hydrogen, methane
- ✳ appears blue due to methane

- ✳ a collection of stars, dust and gas held together as a group by gravity
- ✳ our galaxy

- ✳ a star
- ✳ largest object in our solar system
- ✳ ball of gases

- ✳ closest planet to sun
- ✳ has no moons
- ✳ similar size to Earth's moon

- ✳ located past Neptune
- ✳ made up of over a trillion comets
- ✳ also made up of icy objects including Pluto

- ✳ region between Mars and Jupiter
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- ✳ planet
- ✳ 62 moons
- ✳ does not emit light

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- emits light
- will continue for 5 billion more years

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- very thin atmosphere
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- has largest volcano
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- does not emit light
- has a volcano with two craters

- known as a shooting star
- can also be part of a group and appear as a shower
- reflect light

- fifth largest planet
- has one moon
- year is 365 days

- usually come from afar, at the edge of our solar system
- orbit the sun
- also known as a dirty snowball

- a gas giant made up of mainly helium and hydrogen
- has a giant red spot
- the spot is a storm which has lasted over 100 years

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- ✳ rotates opposite direction
- ✳ does not emit light

- ✳ largest planet
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- ✳ one year is equal to almost 12 Earth years

- ✳ planet appears red from minerals on its surface
- ✳ has ice and snow
- ✳ has 2 moons

- ✳ an ice giant planet
- ✳ does not emit light
- ✳ has 14 moons

- ✳ is doughnut shaped
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- ✳ has three stages ending in -or, -ite, and -oid

- ✳ third planet from Sun
- ✳ only inhabited planet we know of
- ✳ does not emit light

SPACE HUNT

THE SUN	MERCURY
NEPTUNE	VENUS
JUPITER	SATURN

SPACE HUNT

MERCURY	URANUS
MARS	KUIPER BELT
ASTEROID BELT	PLUTO

SPACE HUNT

EARTH	THE MILKY WAY
METEORS	COMETS

Answers to Space Hunt:

pg. 30	pg. 31	pg. 32	pg. 33	pg. 34	pg. 35
Saturn	Sun	Uranus	Milky Way	Sun	Meteor
Venus	Mercury	Jupiter	Pluto	Mercury	Earth
Pluto	Kuiper Belt	Mars	Comet	Neptune	Comet
Uranus	asteroid belt	Neptune	Meteor	Mars	Jupiter
Milky Way	Saturn	Kuiper Belt	Earth	Venus	asteroid belt

Space Hunt Cards - alternate activity
A second set of smaller cards are provided if you wish to assign this as an individual activity. There is an accompanying chart onto which the students can cut and paste the cards.

pg. 36	
Saturn	Venus
Pluto	Uranus
Milky Way	Sun
Mercury	Kuiper Belt
asteroid belt	Saturn

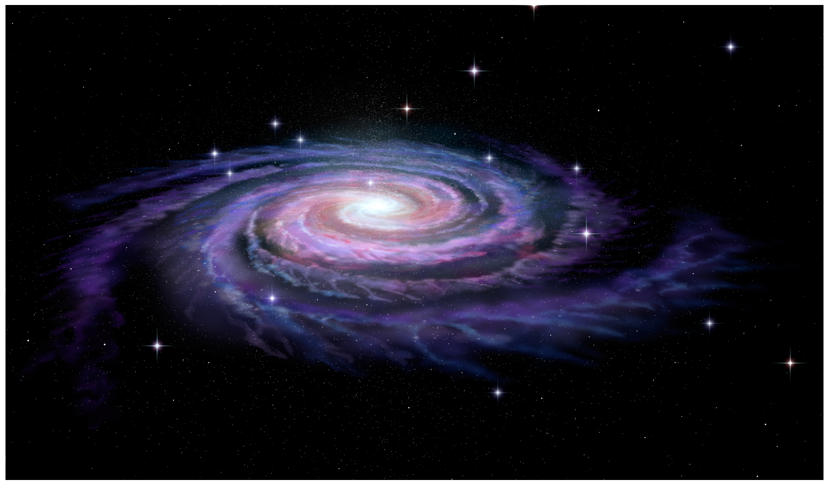
pg. 37	
Uranus	Jupiter
Mars	Neptune
Kuiper Belt	Milky Way
Pluto	Comet
Meteor	Earth

pg. 38	
Sun	Mercury
Neptune	Mars
Venus	Meteor
Earth	Comet
Jupiter	asteroid belt

OUR UNIVERSE

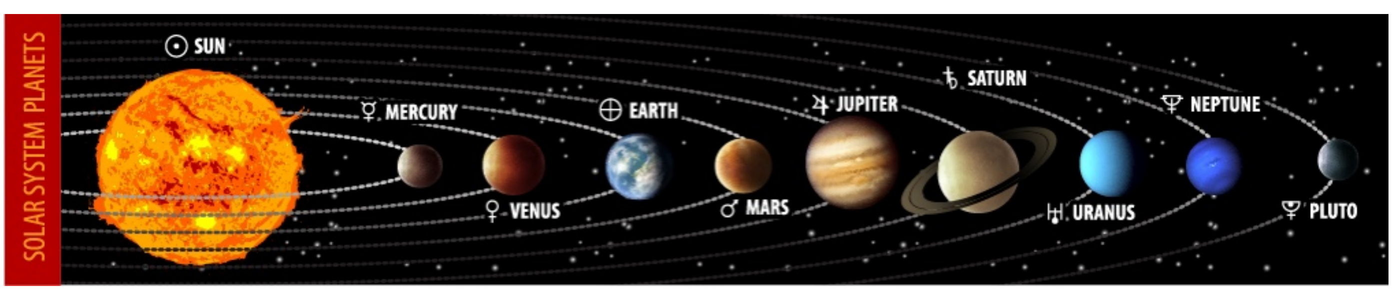
The Milky Way

A galaxy is a huge cluster of stars. Our galaxy, the Milky Way is made up of billions of stars. At the centre of our galaxy is a black hole, named Sagittarius A by scientists. The Milky Way is a spiral galaxy in shape. Our solar system is located on one of the arms.



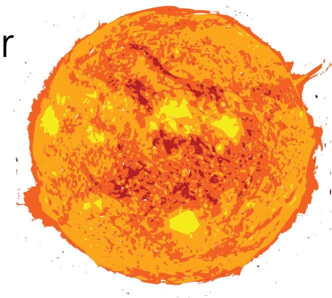
Our Solar System

Our solar system is just one of many in the Milky Way. It consists of the sun, eight planets, an asteroid belt, the Kuiper Belt, the Oort cloud, and millions of asteroids, comets, and meteors. These bodies are held together by the gravity from the sun. The sun is so massive it makes up ninety percent of the mass in our solar system. In our early history, people thought that the Earth was the centre of the solar system and the other planets revolved around it. By the 15th Century, astronomers were discovering that this was not true and Earth, as well as the other objects, all revolved around the sun.



The Sun

The sun is a star, similar to the other sparkling lights we see in the sky at night. It is the only star in our solar system. It provides heat and light. The sun is made up of plasma, or intensely hot gases. The sun is made up of three layers: the photosphere, the chromosphere, and the corona (inner to outer). It takes eight minutes for the light and heat from the sun to reach Earth. Because the sun is the largest body in our solar system, its pull holds all the other planets, asteroids, etc. in gravitational orbits. Some scientists have predicted that the sun will live for about five billion more years.

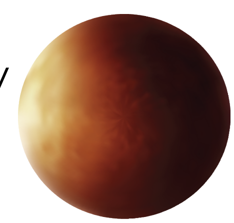


Mercury

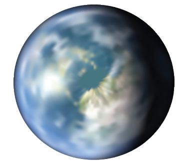
Mercury is one of the rocky planets located closes to the sun, also known as the inner planets. It is the fastest planet—it takes only eighty-eight Earth days to complete its rotation around the sun. It is also the hottest planet due to it s proximity to the sun. The surface of Mercury is covered in craters and it is thought that there might be ice, and therefore water, located in the craters at the polar regions. It has no moons.

Venus

Venus is sometimes called Earth's twin because it is relatively the same size. Several space probes have provided us information about Venus. There is a cloud that surround the planet making it difficult to see. The space probe Magellan discovered a large volcano with two craters, one of many volcanoes on the planet. Most of the surface of Venus is covered in solid lava. Venus rotates very slowly on its axis. It completes its revolution around the sun (224 days) before it complete one rotation (1 day = 243 Earth days).

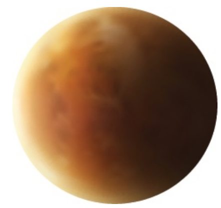


Earth



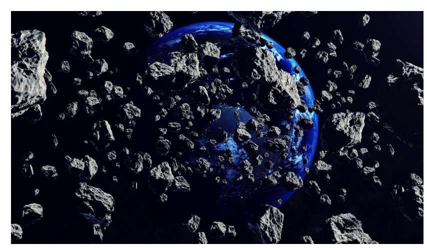
Our home planet is third from the sun; it's one of the inner rocky planets. It is the only inhabitable planet we know of. Its surface is seventy percent water with an atmosphere made up of mainly nitrogen and oxygen. Earth is the fifth largest planet and has only one moon.

Mars



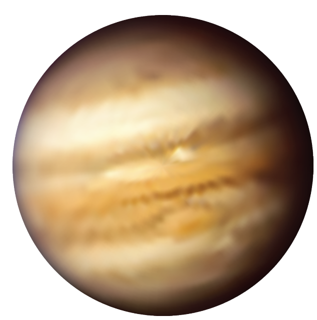
This final inner planet is known as the red planet because the surface contains a large quantity of iron and appears red. The surface is a combination of plains, canyons, and volcanic peaks. The largest canyon on Mars has walls measuring 10km high, which makes the Grand Canyon seem small. A day on Mars is very close to an Earth day, 24.5 hours, but a year on Mars is close to double, 687 Earth days. Mars has two moons named Phobos and Deimos.

The Asteroid Belt



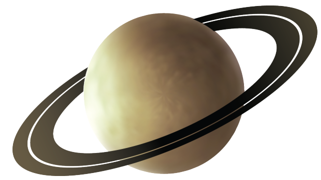
This belt fills a gap between the inner, or rocky, planets and the outer, or gas, planets. This ring is made up of about 50,000 asteroids. Asteroids are thought to be the left overs from when the planets were formed. They are a combination of rocks and metals. We use some of these same metals here on Earth to make microchips and batteries. The asteroids vary in size from that of a baby elephant to the size of a country. The most famous asteroid is actually a dwarf planet named Ceres.

Jupiter



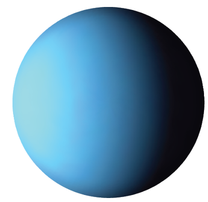
Jupiter is the first of the gas giants. It is the largest of the planets, eleven times the size of Earth. A day on Jupiter is only ten hours on our planet. It has seventy-nine known moons. Jupiter's atmosphere is made up of hydrogen, helium, and methane. Jupiter is known for a giant red spot which is actually storm that has lasted for over 100 years.

Saturn



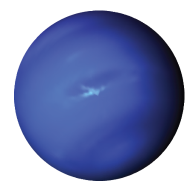
Saturn is best known for its rings—we can see seven. The rings are made up of billions of pieces of ice. Other planets have rings but Saturn has the biggest and brightest rings. This gas giant, second in size to Jupiter, has eighty-two moons. Its largest moon is named Titan. Like the other gas planets, it is made up mainly of hydrogen and helium.

Uranus



Uranus is different from other planets. Its axis is tilted so that it rotates around the sun on its side. It is know as an ice giant because it is so cold that it is composed of ice, liquid, and extremely cold gases. The Voyager 2 space probe discovered thirteen very large rings around Uranus during the 1980s.

Neptune



Neptune is the furthest planet from the sun, about 4.5 billion km away. It takes 164 Earth years for it to revolve around the sun. Neptune appears blue and is made up of mostly slushy ice gases. It is a very stormy planet with winds that are up to twenty times stronger than Earth's strongest hurricanes. It has fourteen moons and a ring system.

The Kuiper Belt

This ring region lies beyond Neptune. We do not know a lot about this area yet due to its distance. Up until recently, scientists could only view it through the most powerful telescopes. A probe, New Horizons, travelled years to begin exploration. The Kuiper Belt is made up of small frozen objects thought to be remnants from the beginning of the solar system. The Kuiper Belt contains at least four dwarf planets.

Pluto

Prior to 2006, Pluto was considered the ninth planet. Astronomers decided it is actually a dwarf planet as its gravity is not strong enough to keep other objects out of its path. Pluto is located in the Kuiper Belt. A day on Pluto is equal to six Earth days, and one year on Pluto is 248 years on Earth. This is because of Pluto's extreme distance from the sun.

Comets

A comet is a body that orbits the Earth. It is made up of two parts. The head of a comet, the nucleus, is made up of rock, ice, and dust. When a comet gets close to the sun, it gets hotter and starts to glow. Dust breaks from the nucleus, creating a glowing tail. Astronomers often refer to comets as dirty snowballs. A well known comet is Halley's comet which is named after the astronomer who recognized the pattern of its appearance every seventy six years.

Meteors

We often see meteors here on Earth but we think of them as shooting stars. At times, they even appear as a shower. A meteor can be called by three different names depending on where it is in relation to the Earth. The three forms are: meteoroid, meteor, and meteorite. It is similar to an asteroid in that it is made of rocks and dust, but much smaller. We find meteorites here on Earth after they come through our atmosphere.

LESSON THREE

The Solar System - A Simulation

grade six

LESSON THREE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

The students will simulate a scale model of the solar system.

Preparation

- Video link - The Solar System for Kids - Generation Genius - I
- Simulation instructions for students
- Large area for students to recreate the solar system - ie: School gym, outdoors
- Meter sticks or trundle wheels
- Print one Solar System Simulation Learning Reflections for each student

Lesson Part A	Lesson Part B
• Students will view the video which is a demonstration of creating a scale model of the solar system. The running time is just under 20 minutes.	• Divide students into groups of 8-10. • Provide the group with Solar System Simlulation instsructions and meter sticks or trundle wheels. • Students, in groups, will work together to simulate the position and speed of movement of the planets. • Students fill out Solar System Simulation Learning Reflections independently.

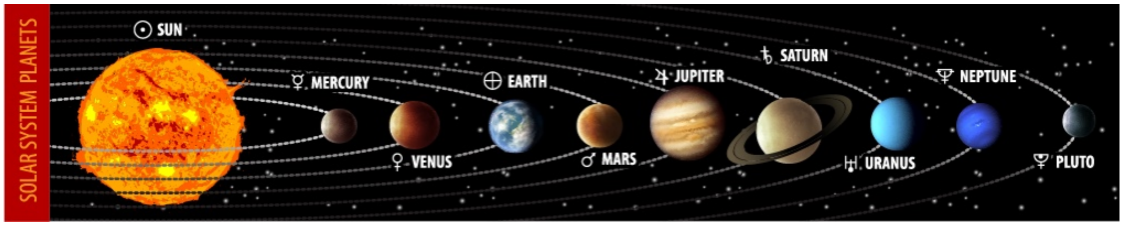
Assessment

You may wish to record the simulations to check for understanding. The Learning Reflection will also allow you to see.

NOTES

An alternative to the simulation would be to have students draw a scale model of the solar system. You may wish to have them do this with a partner.

SOLAR SYSTEM SIMULATION



Your group will create a simulation of the solar system. Each person in the group will represent a component of the system. Start with the sun and planets. Depending on the size of your group, you may then add the asteroid belt and/or moons. Use the information below to help set up the simulation. Once the planets are in place you can start rotating around the sun.

STEP 1

Choose a spot for the sun. Measure ten metres from this spot and mark it. Use the measurements below to have a person stand in the place of a planet. We will not be using Pluto because it is too far to show in this demonstration.

distance from the sun in meters and centimetres

Mercury - 13 centimetres
Venus - 24 centimetres
Earth - 53 centimetres
Mars- 56 centimetres
asteroid belt
Jupiter - 1 metre 7 centimetres
Saturn - 3 metres 20 centimetres
Uranus - 6 metres 40 centimetres
Neptune - 10 metres

STEP 2

Once the sun and all planets are in place, begin rotating around the sun using the details below. Watch the planet that is close to you in speed to adjust your speed. The speeds are rounded to the nearest day or year.

length of rotation based on Earth days

Mercury - 88 days
Venus - 225 days
Earth - 365 days
Mars- 2 years
Asteroid Belt
Jupiter - 12 years
Saturn - 30 years
Uranus - 84 years
Neptune - 165 years

SOLAR SYSTEM SIMULATION LEARNING REFLECTION

Name: ____

Facts I knew about the solar system before the video and simulation were:

____

____

____

____

____

The most important fact(s) I learned :

____

____

____

____

____

The information that surprised me the most is :

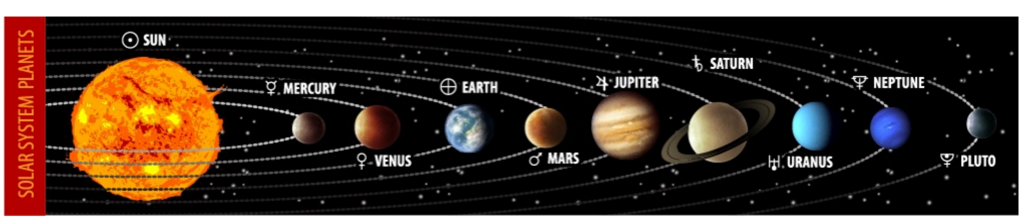
____

____

____

____

____



LESSON FOUR

Satellites, Comets, Asteroids, and Meteors

grade six

LESSON FOUR

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will identify and describe natural satellites, comets, asteroids, and meteoroids.

Preparation

- Copies of reading **Spectacular Celestial Bodies**
- Copies of graphic organizer
- **Space Helmet** - game instructions - 1 for each group
- Preassemble the **Space Helmet Cards** - make 3 copies of each card per group
- Copies of **Exit Ticket**

Lesson Part A	Lesson Part B
• Ask students - *We have looked at the planets in our solar system. What are some other objects in the system?* • Students will read the article **Spectacular Celestial Bodies**. Ask them to highlight key words and phrases that describe each phenomena. • After reading, students will use the graphic organizer **Meteor, Comets and Asteroids, Oh My!** to classify the information. General information is written in the rectangles. Ask students to note any similarities between the bodies in the ovals.	• Put students in groups of 4 to 5. • Play the **Space Helmets** game following the instructions. • Provide each group with **Space Helmet Cards** (preassembled) and **Instruction Page**. • Students play game. • Exit ticket - **Identify the Space Rock**.

Assessment

Graphic Organizer - Gives an insight into note taking skills (Scientific Inquiry/ Research skills). Noting similarities between space bodies shows ability to see relationships.
Exit ticket - **Identify the Space Rock** - students demonstrate knowledge of content.

NOTES

SPECTACULAR CELESTIAL BODIES

Outer space contains many objects—stars, planets, moons, and a long list of others. Anything in space, except Earth, is called a celestial body. This includes satellites, asteroids, comets, and meteors—all of which are unique celestial bodies with fascinating features.

Satellites

Natural satellites are objects in space that orbit planets and asteroids. You probably know them better as moons. Some moons formed from the gas and dust circling around planets. Others got pulled into the orbits of other celestial bodies. There are more than 200 natural satellites in the solar system, and one of them orbits around Earth. That satellite is our moon.

Jupiter and Saturn both have a lot more than one moon. They are giant planets and have multiple celestial bodies in their orbits. Jupiter has almost eighty natural satellites, and Saturn has more than fifty. Some of Saturn's moons travel in the orbit that make up the planet's rings. Mercury and Venus are the only planets that don't have moons, in fact. Asteroids and even some dwarf planets, like Pluto, have small satellites.

Asteroids

The chunks of rock left over from the formation of our solar system are called asteroids. They orbit around the sun, mostly in the asteroid belt which is between Mars and Jupiter. Another name for an asteroid is "small planet" or "minor planet." They range in size, from over 300 miles to just thirty feet across. Most asteroids have odd shapes, but some are more round. All of them have pits and craters, like our moon. However, if you took all of the asteroids that we have discovered and put them together, they would still be smaller than the moon.

There are currently over 1,000 asteroids that have been discovered and divided into three types. The most common and oldest asteroids are made of rock and clay. These are classified as C-types. S-type asteroids consist of silicate rock and nickel-iron. The last type are called M-types. These asteroids are made of metallic materials. None of them have any air.

Comets

Like asteroids, comets are remains from when our solar system was formed billions of years ago. There are more than three times as many comets as asteroids that are known. They also differ from asteroids in that they contain frozen gases surrounded by other materials. Most comets are made of dust, rock, and ice and range from a few miles to tens of miles in diameter. Sometimes, they are called "dirty snowballs."

Before scientists and astronomers identified what comets were, people were amazed by them. That's because they'd often see flaming balls of fire moving across the sky, with long tails behind them. These are actually comets that came too close to the sun during their orbit. They heat up, and the dust and gases from the melting comet stretch out behind their big, glowing heads. These fiery tails can stretch millions of miles from the sun.

Meteors

Another kind of celestial body that travels across the sky is a meteor, which at times, is also a meteoroid or meteorite. These bodies start out as meteoroids, which can be as tiny as a grain of dust to as big as a small asteroid. When a meteoroid travels at a high speed and enters a planet's atmosphere, it burns up and becomes a meteor. When it's Earth's atmosphere, people sometimes see the meteors streaking through the sky and often call them "shooting stars." If a meteor makes it all the way through the atmosphere and comes into contact with the ground of a planet, that is when it's called a meteorite.

COMETS, METEORS, AND ASTEROIDS OH MY!

Comets

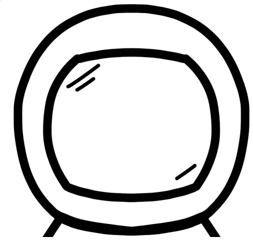
Meteors

Asteroids

Natural Satellites

SPACE HELMETS

(GAME)



1. Put the cards face down in the middle of your group.
2. Decide who is going to choose the first card.
3. The first person picks up the card keeping it faced away from them, so they can not see the word.They hold it against their forehead so the rest of the group can see the word.
4. The person then begins asking yes or no questions and uses the graphic organizer to determine if the card says satellite, meteor, comet, or asteroid. e.g., Does it have a tail?
5. The other group members respond with yes or no.
6. After each question, the 'it' person guesses which space body is on their card, until they are correct.
7. Continue until all members have had a chance to be 'it'.

Cut out the cards and glue them onto a dark piece of construction paper. Alternatively, you can use the following pages and fold the card back and glue the two sides together, which prevents students from seeing through the cards.

COMET

METEOR

ASTEROID

SATELLITE

COMET

[redacted]

METEOR

[redacted]

ASTEROID

[redacted]

SATELLITE

[redacted]

METEOR, COMET, ASTEROID OR SATELLITE?

- leftover materials from formation of planets
- made of rock or metals
- do not have a standard shape

What is it? ______________________________

- also know as a shooting star
- size can range from tiny pieces of space dust to small asteroids
- orbit the sun

What is it? ______________________________

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- made of ice and dust
- develops a tail when it comes close to the sun
- travels close to the Earth only a few times each century

What is it? ______________________________

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- also known as a moon
- orbits another body
- some planets have these; Jupiter has more than sixty, but others have none

What is it? ______________________________

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LESSON FIVE

The Earth and Sun Working Together
Day/Night and the Seasons
(2 lessons)

grade six

LESSON FIVE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will describe the effects of the positions and motions of the Earth and the sun with a focus on night/day and the seasons.

Preparation

- Earth's Rotation and Revolution: A Crash Course- **video**
- **Anticipation Guide** - copies
- **Sun and Earth Working Together** - notes - copies
- **Experiment - Making a Sun Dial** - copies (3 pages)
- Gather material for sundial (paper plates or cardboard circles, plasticine, straws or sticks)

Lesson Part A

- Have students complete the **Anticipation Guide**.
- Students will view **video** - Earth's Rotation and Revolution: A Crash Course
- Revisit the **Anticipation Guide** to ensure or correct responses.
- Review **The Sun and Earth Working Together** with students, ensuring you show them the pictures.

Lesson Part B

- **Making a Sundial** (2 classes).
- Revisit diagram for day/night and fact that earth rotates on axis.
- Divide students into groups of 2-3.
- Distribute **Instructions** and materials for construction to make a sundial.
- This is a problem-solving activity.
- Conducting the shadow experiment may have to take place on a different day, depending on the time of your class.
- Set a time for each hour and students can mark their hours.
- After the experiment is complete, students will **record** their observations.

Assessment

The **Anticipation Guide** gives insight into the students' background knowledge and their understanding of the concepts.

Sundial Design/Experiment:
You can assess your students, even a small group, through observation if time permits. The **Our Sundial** report helps the students outline their design experiment and reflect on their learning. A **Rubric** has been provided to help guide your assessment. Modify as needed.

grade six

LESSON FIVE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

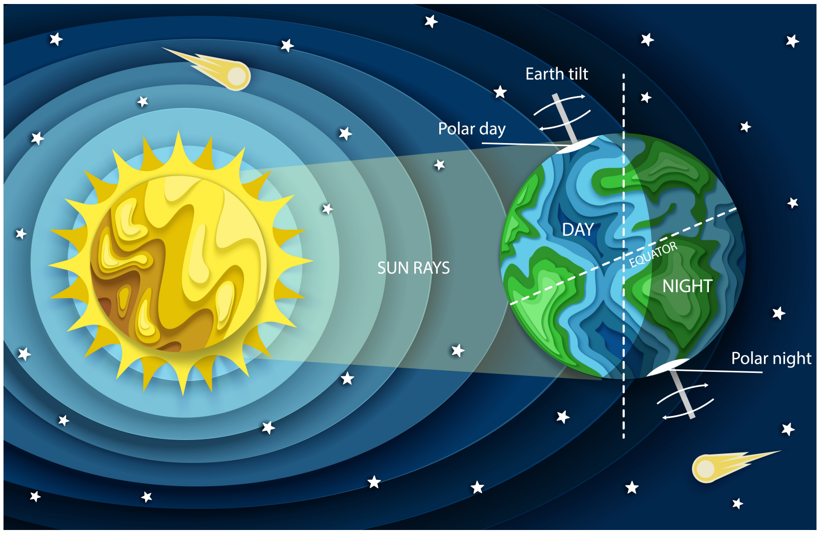
NOTES
Video Link: Another option is **Bill Nye-Seasons - Season 1 Episode 15**. It is a longer video (over 20 minutes), but if students watch up to 10:50, they get the key points. **https://www.youtube.com/watch?v=a9z-aGB3atg** Notes to consider when making sundials: 1. It is best to put the sundials out early in the day to track as much time as possible. 2. Starting early in the day will create longer shadows which get shorter as the day goes on. After mid day, the shadows will start to get longer again. 3. The shadow will move in a clockwise direction. 4. Earth's rotation isn't perpendicular and the Earth isn't perfectly round. The accuracy of a sundial is affected by these facts. 5. If you are in the northern hemisphere, the sundials should be placed facing north to begin tracking time. The opposite is needed for measuring time in the southern hemisphere. Use a compass if you are unsure of your position.

SUN: KING OF OUR UNIVERSE ANTICIPATION GUIDE

Read the following statements and check whether you agree or disagree.

Before Viewing			After Viewing	
agree	disagree		agree	disagree
		The sun is the largest body in our solar system.		
		The sun orbits around the Earth.		
		The rotation of the Earth causes night and day.		
		The sun is the only star in our solar system.		
		The Earth is tilted.		
		There is a real line running through the Earth called the axis.		
		The revolution of the Earth around the sun creates the seasons.		
		It is summer in your part of the world when the Earth is pointed away from the sun.		
		In the winter, we get the sun's rays on an angle.		

SUN AND EARTH WORKING TOGETHER

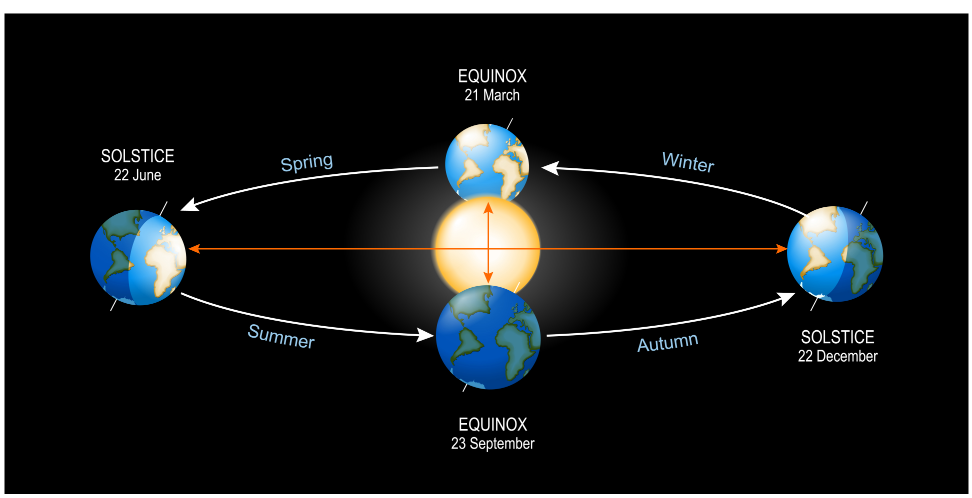


Day and Night

As the Earth spins on its tilted *axis*, different parts of the world experience not only day and night, but different times. While you are experiencing day facing the sun, on the other side of the world it is night. As the Earth *rotates*, each tiny movement marks the passage of seconds, minutes, and hours. The total time for the Earth to complete a rotation is twenty-four hours.

The Seasons

As the Earth *revolves* around the sun in its *elliptical orbit,* the different hemispheres are either *tilting* towards or away from the sun. This creates the seasons. The tilt of the Earth allows different parts of the planet to get different amounts of light and heat from the sun. When the northern hemisphere is leaning towards the sun, it is summer. At this same time, the southern hemisphere is tilting away from the sun and it is winter. During spring and autumn, the sun shines almost equally on the two hemispheres as the the sun's rays hit the Earth at close to a perpendicular angle. One revolution of the Earth around the sun takes 365 days, or one year.



MAKING A SUNDIAL

Materials

- paper plate or cardboard circle
- small lump of plasticine
- drinking straw or straight stick of similar size
- scissors or tool for cutting hole (if they wish)
- ruler
- pencil/marker
- compass or device to find North
- sunglasses

Using the above materials, construct a sundial that you think will track the hours of the day using the sun. You and your group will create your own design that can accurately mark the hours. Think about the following:

1. Where will you place the gnomon (piece that measures the hours)?
2. Consider that the Earth is tilted on an axis (23.5 degrees).
3. Which direction will you point the gnomon to start?
4. We live in the northern hemisphere.
5. How will you mark the hours?

Place your sun dial in the sun at the start of an hour. Return every hour to mark the new time. It is best to start early in the day.

OUR SUNDIAL

Process

Sketch of our design.

Explain how you are going to measure and mark time when you test your sundial. Where are you going to place it? Is there a specific direction you in which you will set it?

OUR SUNDIAL

Results

Describe your results. Were you able to mark the hours? Was there any interference in the experiment? Were all the hours equal distance apart (use a protractor)?

Conclusion

Is your sundial a success? Is it able to tell time? Is there anything you would change about your sundial?

CREATING A SUNDIAL RUBRIC

This rubric is designed to evaluate skills associated with the design, building, and testing of a sundial.

	Level 2	Level 3	Level 4
Experiment Safety	Handles materials and tools safely some of the time.	Handles materials and tools safely most of times.	Handles materials and tools safely at all times.
Procedural Design	Creates a procedure that lacks some steps or is missing concepts associated with a sundial.	Creates a clear procedure that takes possible problems into account.	Creates a detailed procedure that takes possible problems into account.
Collecting Data	Makes some observations; missing details.	Makes appropriate observations that are clear and logical.	Makes in-depth observations using previous knowledge and learning from unit.
Forming Conclusions	Partial conclusion is stated based on some of the observed results.	Conclusions are logical using information from the observed results. Student can evaluate design and experiment with some effectiveness.	Conclusions are logical using information from the observed results. Student can evaluate effectiveness of design and experiment.
Communication	Uses scientific vocabulary to communicate some of the time.	Uses scientific vocabulary to communicate most of the time.	Uses scientific vocabulary to communicate effectively.

LESSON SIX

The Moon and Earth Centres
(2 lessons)

grade six

LESSON SIX

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will describe the effects of the positions and motions of the earth and the moon with a focus on the phases of the moon and the creation of tides.

Students will describe the positions and motions of the earth, moon, and sun during lunar and solar eclipses.

Preparation

- Video - Phases of the Moon - Astronomy and Space for Kids - Free-School -(5:41 minutes)
- Video - Ocean's Tides Explained - Atomic School (5:11 minutes)
- Video - Solar Eclipses 101 - National Geographic (4:57 minutes)
- Video - Lunar Eclipses 101 National Geographic (2.50 minutes)
- Activity Sheets - **Phases of the Moon**, **Tides**, **Eclipses**
- Optional Activity - **Flipbook - Phases of the Moon**

Lesson Part A

Moon and Earth Centres - Introduction

- This lesson will span **two periods** with two optional activities for a third period.
- Introduce each centre (**Phases**, **Tides**, and **Eclipses**) to the students—ensure that materials are at each station or stored in a container.
- Divide students into groups and set up a rotation schedule for the periods, allowing about 20 minutes per rotation.

Lesson Part B

Moon and Earth Centres

- Review groups and assign to the first rotation.
- To reduce the amount of marking, you may wish to provide an **Answer Key** at the end of each centre time.
- You may also wish to collect one or all of the tasks for formative evaluation.
- Use the next class time for the second and third rotations.
- Hands-on optional activities have been included if you wish to extend the learning.

Assessment

The centre activities were designed as a way for the students to collect information. The answers show a basic understanding of the concepts shown in the videos. You may wish to use them as a form of assessment or, depending on your time and situation, you may wish to provide the students with answer sheets for them to check their own while you observe them as they work.

NOTES

PHASES OF THE MOON

1. Talk to a partner: Describe the appearance of moon. Why do you think the moon's appearance changes?

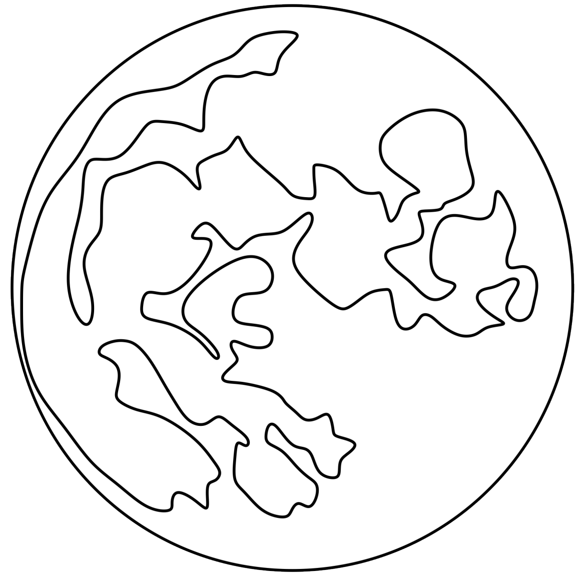
2. Watch video - *Phases of the Moon - Astronomy and Space for Kids.*

3. Read the matching activity, **Phases of the Moon**. Watch the video again—stopping it to match the word with the definition.

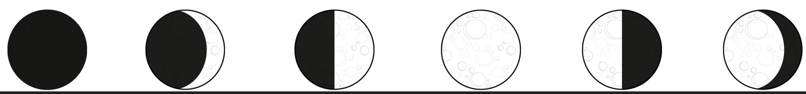
4. Label the different phases of the moon on the diagram.

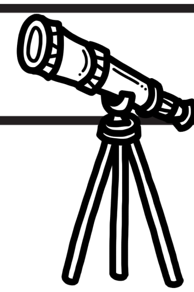
Labels for diagram

- new moon
- half moon (third quarter)
- waxing crescent
- half moon (first quarter)
- waxing gibbous
- full moon
- waning gibbous
- waning crescent
- full moon



PHASES OF THE MOON

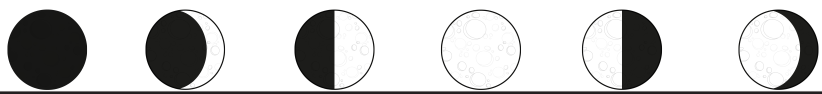


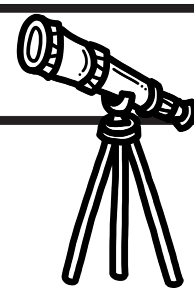


Match the word with its meaning.

orbit	getting larger; growing
terminator	to produce - moon does **not** emit light, but reflects light from sun
emit	moon's path around Earth - takes 29.5 days or a month
waxing	dividing line between day and night

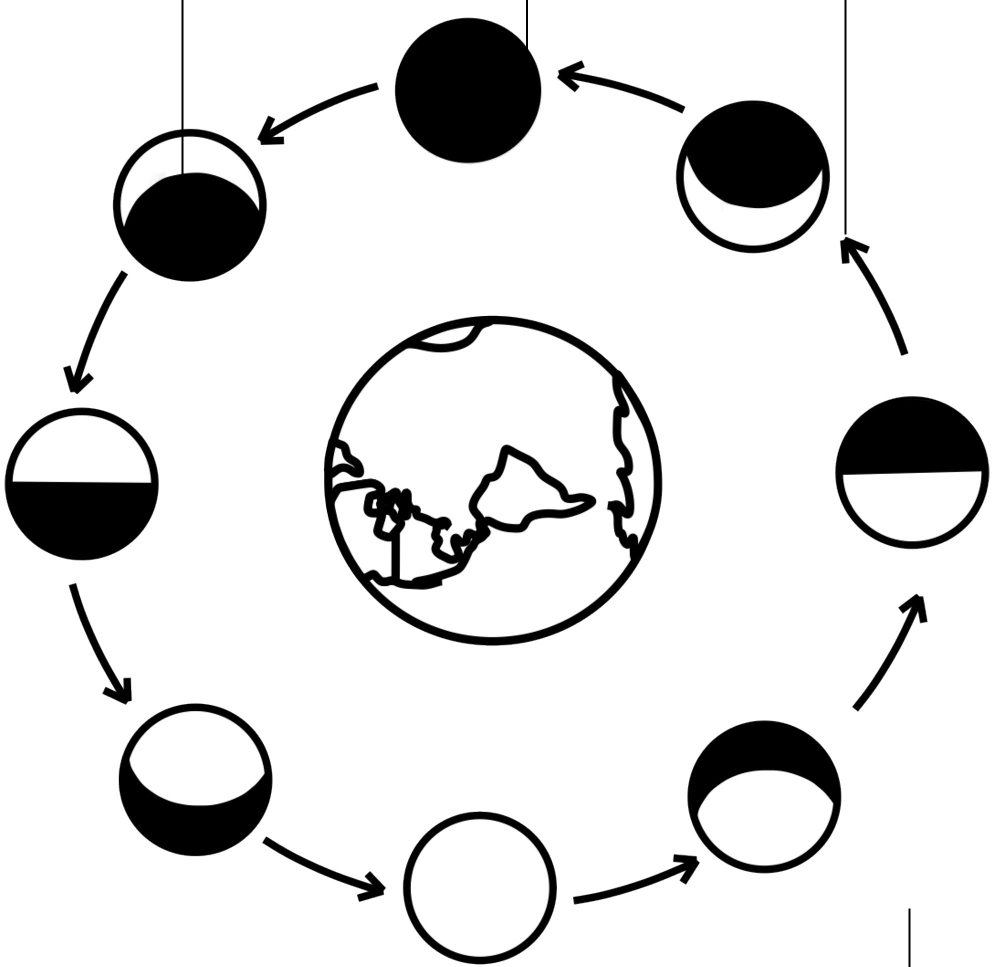
PHASES OF THE MOON





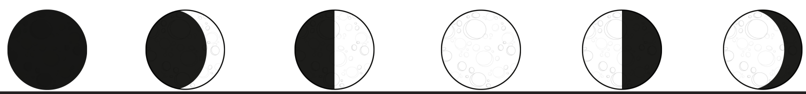
waning	more than half of moon showing
first /third quarter	getting smaller; diminishing
crescent	half of moon showing; one or three quarters through rotation.
gibbous	less than half of moon showing

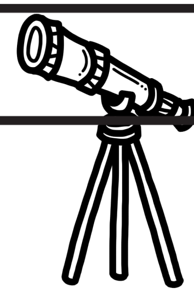
PHASES OF THE MOON



Answer Key

PHASES OF THE MOON

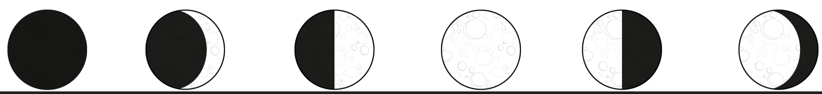


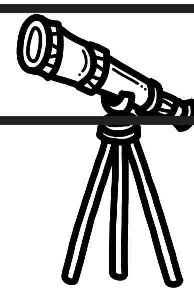


orbit	getting larger; growing
terminator	to produce - moon does **not** emit light, but reflects light from sun
emit	moon's path around Earth - takes 29.5 days or a month
waxing	dividing line between day and night

Answer Key

PHASES OF THE MOON

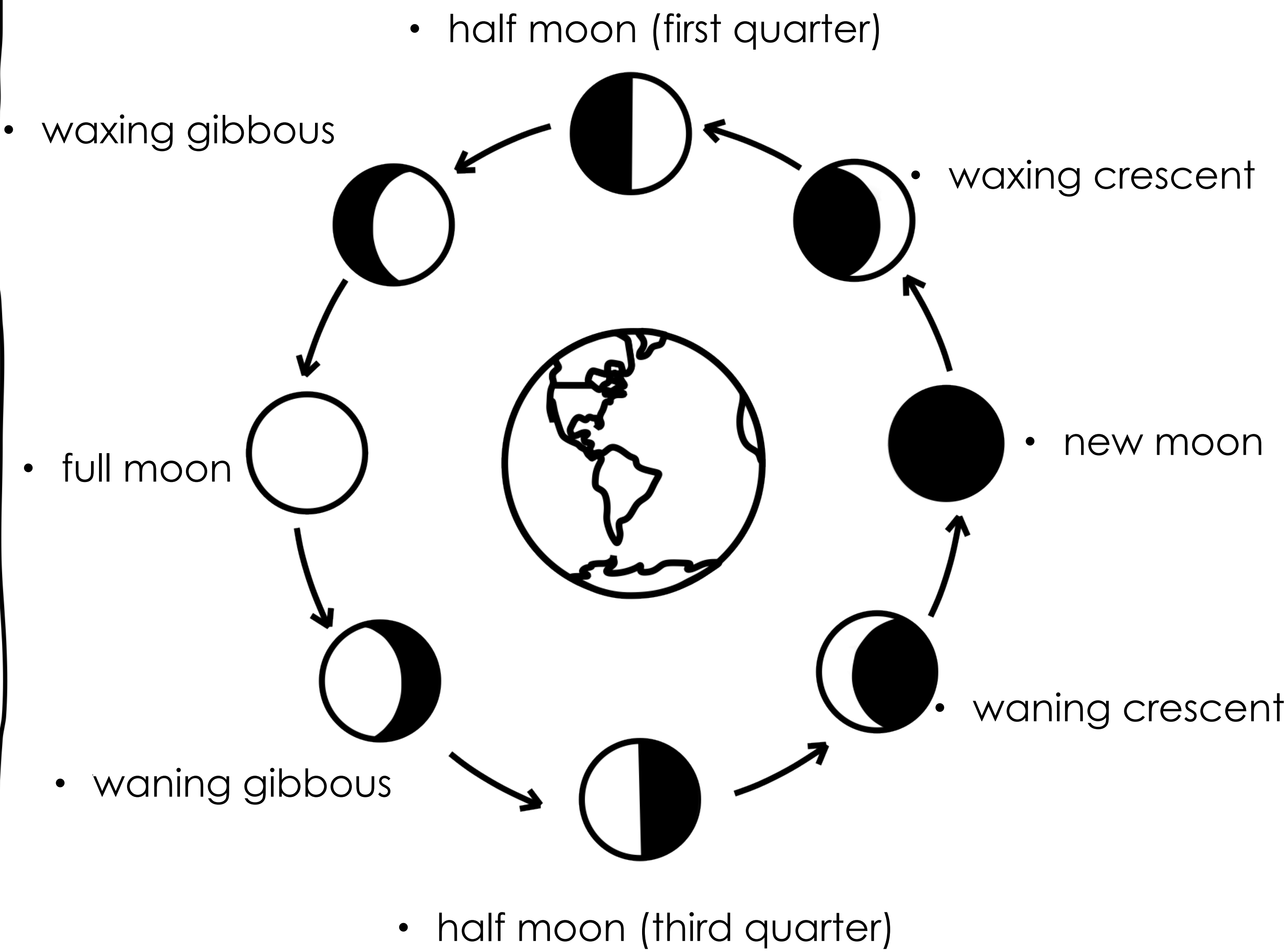




waning	getting smaller; diminishing
first /third quarter	half of moon showing; one or three quarters through rotation.
crescent	less than half of moon showing
gibbous	more than half of moon showing

Answer Key

PHASES OF THE MOON



TIDES

THE MOON CONTROLS AN ASPECT OF OUR OCEANS, RIVERS, AND LAKES.

1. Talk to a partner: What effect do you think the moon has on the bodies of water on the Earth? Why do you you think this happens?

2. View the video - **Ocean's Tides Explained**.

3. Read the Frequently Asked Questions on **The Moon and Tides** activity page.

4. Rewatch the video, this time stopping to answer the questions.

5. Complete the diagram following the instructions.

6. Read the information on **TIDES FYI** and follow the instructions to complete the diagram.

THE MOON AND TIDES

Frequently Asked Questions

What is the force that acts between the Earth and moon?

Describe the Earth's rotation.

What is high tide?

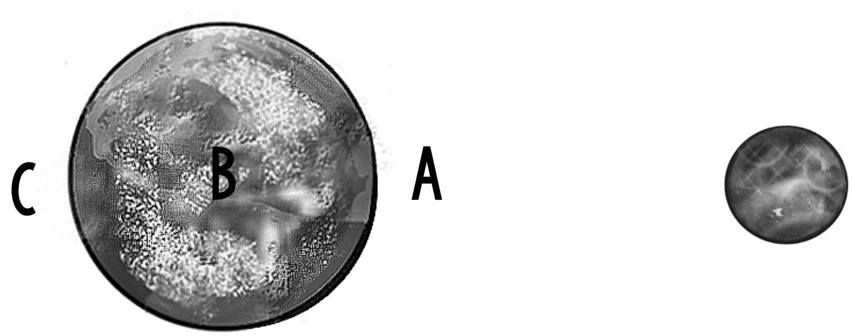
What is low tide?

How many high tides are there everyday?

Where is the pull of gravity the strongest on the Earth?

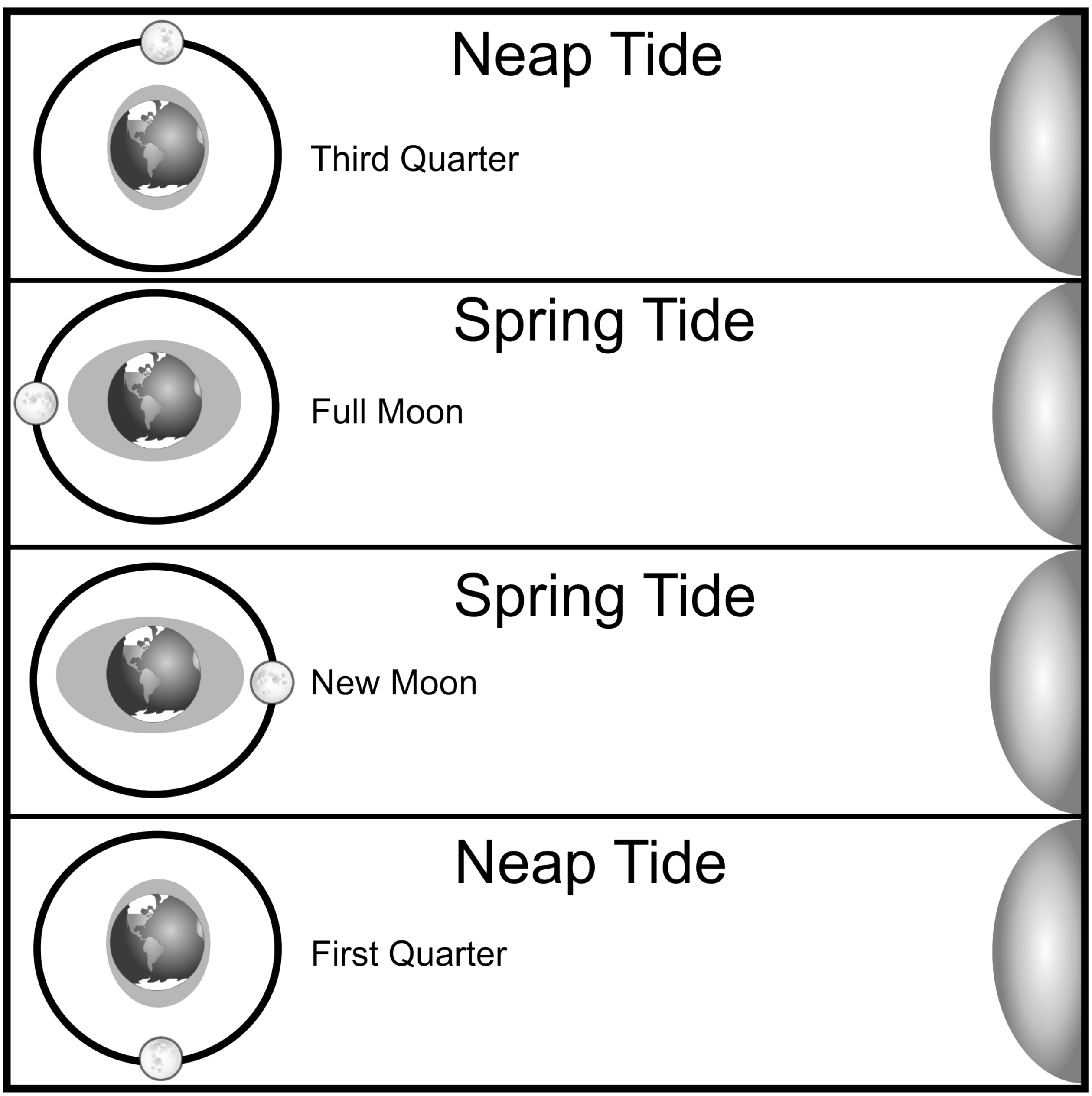
How much later are the tides each day as the moon rotates around the earth.

Add arrows showing the gravitational pull. Then, add the layer of ocean around the Earth showing the high and low tides. Label them.



TIDES FYI

The diagram below shows how the location of high and low tides change as the moon revolves around the earth during its phases. Notice that both *quarter phases* are referred to as **neap tides** and the *whole moon phases* are called **spring tides**. Colour in the ocean layer to make it more visible.



Answer Key

THE MOON AND TIDES

Frequently Asked Questions

What is the force that acts between the Earth and Moon?
Gravity. Gravitational pull between the Earth and moon is equal.
Describe the Earth's rotation.
The Earth rotates on its axis, taking 24 hours for a complete rotation.
What is high tide?
High tide occurs when oceans closest to moon 'bulge' due to the pull of gravity.
What is low tide?
Low tide occurs where gravity does not pull on the oceans so they don't 'bulge".
How many high tides are there everyday?
There are 2 high tides per day.
Where is the pull of the moon's gravity the strongest on the Earth?
At the part closest to the moon.
How much later are the tides each day as the moon rotates around the ea
About 50 minutes later each day due to the rotation of the moon,

Add arrows showing the gravitational pull. Then, add the layer of ocean around the Earth showing the high and low tides. Label them.

ECLIPSES

Solar Eclipse

Watch the video - **Solar Eclipses 101** and answer the following questions.

1. What is a solar eclipse?

____

____

____

2. Explain the four types of solar eclipses

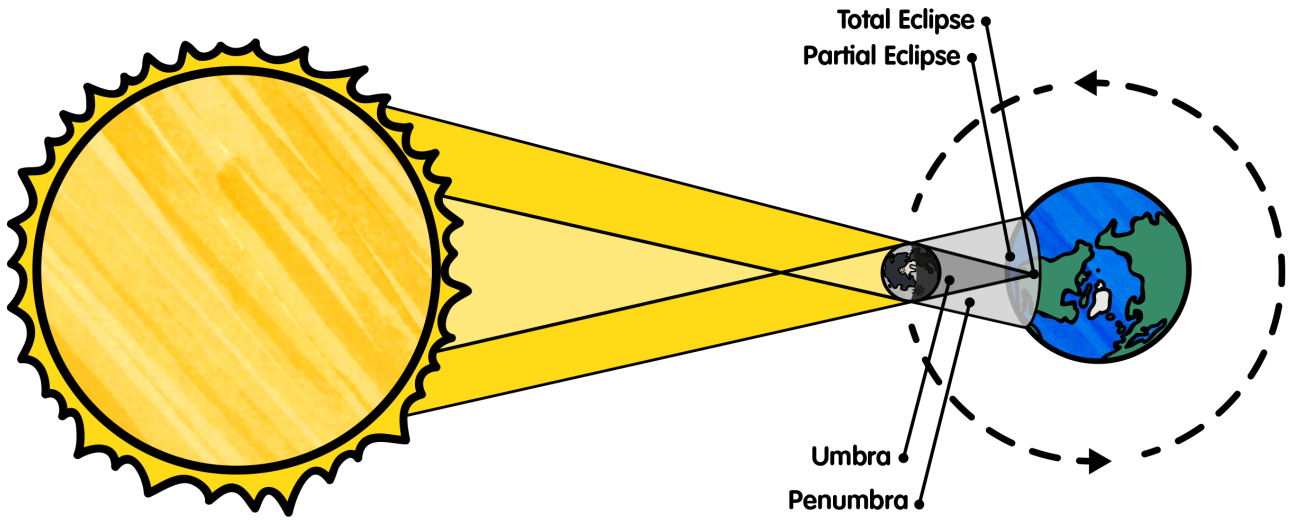
total eclipse	
partial eclipse	
annular eclipse	
hybrid eclipse	

3. How can we safely watch a solar eclipse?
   a. ______________________________
   b. ______________________________

4. An interesting fact about a solar eclipse: ______________________

ECLIPSES

4. An interesting fact about a solar eclipse:



Lunar Eclipse

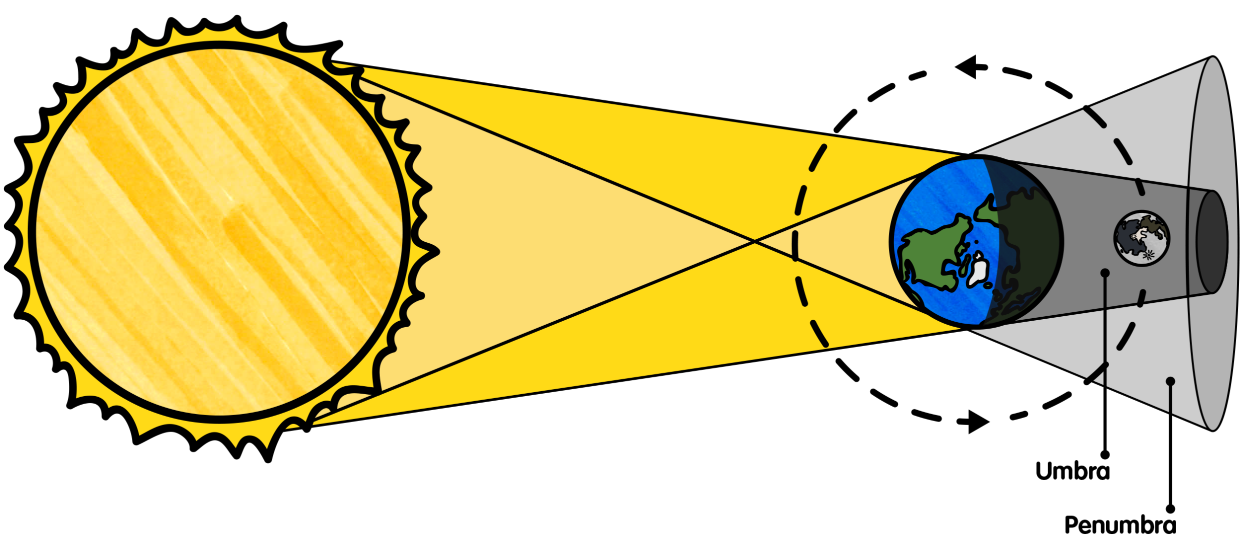
View the video **Lunar Eclipses 101** and answer the following questions.

1. What is a lunar eclipse?

2. Describe the three types of lunar eclipses.

total eclipse	
partial eclipse	
penumbral eclipse	

4. An interesting fact about a lunar eclipse:



Answer Key

ECLIPSES

Solar Eclipse

Watch the video - **Solar Eclipses 101** and answer the following questions.

1. What is a solar eclipse?
A solar eclipse happens when a new moon moves between the Earth and the sun, blocking all or some of the sun's rays.

2. Explain the four types of solar eclipses

total eclipse	*moon passes in front of the sun totally covering the surface so that no part is visible*
partial eclipse	*moon passes in front of the sun off centre so that part of the sun is still visible*
annular eclipse	*moon passes in front of the sun but appears smaller than the sun so does not fully cover the sun*
hybrid eclipse	a combination of a total and annular eclipse

3. How can we watch an eclipse safely?
   a. special eclipse glasses
   b. pinhole camera

4. An interesting fact about a solar eclipse: *(answers will vary)*

Answer Key

ECLIPSES

Lunar Eclipses

5. What is a lunar eclipse?
A lunar eclipse happens when moon moves into the Earth's shadow, or umbra. This can only happen when the Earth, moon, and sun are aligned or almost aligned.

total eclipse	*moon appears red because Earth is totally blocking the sun's rays from the moon*
partial eclipse	*part of the moon stays out of the Earth's shadow—moon does not appear red because some sunlight is hitting it*
penumbral eclipse	*when the Moon passes through Earth's penumbra, or shadow—the penumbra causes a subtle dimming of the moon's surface*

6. An interesting fact about a lunar eclipse: *(answers will vary)*

OPTIONAL ACTIVITIES
THE EARTH, MOON, AND SUN

Making a Flip Book of the Moon's Phases

1. Watch the video - How to MAKE A FLIPBOOK.
2. Use the precut paper to begin your illustrations.
3. Build a book that simulates the phases of the moon, carefully shading each moon slightly more or less (waxing and waning) than the previous moon.

Eclipse Chalk or Pastel Art

1. Have students view the final image.
2. Identify as a class:
   a. What kind of eclipse is shown?
   b. Why are the colours brighter on the left and darker as you move towards the right side?
   c. Where is Earth positioned?

MAKING A FLIP BOOK

1. Start with a stack of small lightweight paper (3X5 inches or 8 X12cm). The stack can be stapled or paper clipped together. A pad of sticky notes also works.
2. Draw an image, in this case a **full moon,** on the very last (bottom) sheet of paper. This picture is the starting point. Draw it near the right hand corner. Use pencil so it is easy to erase mistakes.
3. On the next page forward, draw the same moon in the same place but add a bit of a shadow to show it moving towards being a **waning gibbous**. For the next few pages (5-8) continue to draw the same moon, in the same place—each time adding a bit more shadow until you create a **waning gibbous moon**.
4. For the next section of 5-8 pages, continue to add shadowing to the **waning gibbous moon** until it is a **half moon.**
5. Continue this process until you have moved from:
   * *half moon to waning crescent moon*
   * *waning crescent to new moon*
   * *new moon to waxing crescent*
   * *waxing crescent to half moon*
   * *half moon to waxing crescent*
   * *waxing crescent to full moon*

6. Once you have finished drawing the moons, flip through the book to make sure you are happy with the animation.
7. You can then go over the pencil in marker, add colour, add a sky background, etc.

The following link on YouTube is a useful video if you are having difficulty.
https://www.youtube.com/watch?v=Un-BdBSOGKY&t=2s

LESSON SEVEN

Living in Space

grade six

LESSON SEVEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Identify scientific and technological advances that allow humans to adapt to life in space.

Preparation

- **Can We Live Here Organizer?** - copies
- **Can we Live Here? Pros and Cons** chart - copies
- **Surviving in Space** - copies
- **Surviving in Space Organizer** - copies

Lesson Part A

- Discuss: *What are human's basic needs? What do we need to live?*
- Point out that this is why Earth is the perfect place for humans. We have adapted to our planet.
- Discuss: *Why do we explore space?* (see **Notes**)
- Break students up into 8 groups. Assign each group one of the planets or moons listed on the activity sheet **Can We Live Here? Organizer**. Students will use their notes from previous lessons to briefly describe why their planet/moon is appropriate or not appropriate for human habitation.
- Distribute a copy of the **Can we Live Here? Pros and Cons** organizer to each group.
- Groups confirm their information and add any new details.

Lesson Part B

- Gallery walk - post charts from previous lesson around the room as groups rotate.
- Class discussion: *Which options look best for humans to colonize?*
- Brainstorm: *If humans are to live in space, what types of materials and technology will we need to take with us? How are we going to meet our needs?*
- Introduce article: **Surviving in Space**. Show students how to take jot notes (using your own words) using third paragraph.
- Students choose 2 subtopics and make jot notes for those sections on the **Surviving in Space Organizer**.

Assessment

Can We Live Here? **- Organizer**
The responses in this activity can be used to assess each student's ability to use notes to apply knowledge to a new situation.

Surviving in Space **- jot notes**
You can assess each student's ablility to take notes in preparation for the Inquiry section of the unit.

NOTES

Human's Basic Needs
- breathable air
- water
- shelter
- food
- sleep

Additional Needs in Space
- source of energy to provide light and heat
- protections from sun's damaging rays (atmosphere)
- artificial gravity

Why do we explore space?

1. Curiosity - In history, humans have always explored beyond their borders to see what was beyond. Sometimes explorers found riches, like gold, diamonds, and fur. What might we find in space? Perhaps we will discover a mineral for fuel or an unknown compound that can cure disease.
2. Overpopulation - As our population continues to grow, humans are searching for new environments for our species to live.
3. Safety - Studying the sun, asteroids, and other space bodies to learn more about them helps us plan for unknown situations, such as an asteroid hitting Earth.
4. Understanding our own planet - The satellites that we launch into space allow us to study weather, natural disasters, melting icecaps, and our atmosphere.
5. Inventions - Many inventions originally developed for space travel and exploration have improved our life here on Earth.

CAN WE LIVE HERE?

The Moon	Mercury
Venus	Mars
Jupiter	Saturn
Uranus	Neptune
Suggestion	Suggestion

COULD WE LIVE HERE?

PROS	CONS
The Moon	
✦ has water in its soil ✦ gravity is weak, but might be enough for humans ✦ temperature is bearable with technological assistance	✦ atmosphere is thin ✦ would not protect us from sun's high-energy radiation bursts ✦ violent storms
Mercury	
✦ ice, so water might be found at the poles	✦ weak gravity ✦ no atmosphere ✦ too hot - twenty-eight times hotter than Earth
Venus	
✦ gravity is similar to Earth's	✦ hottest planet ✦ atmosphere is made of poisonous gases
Mars	
✦ has water in its soil ✦ gravity is weak, but might be enough for humans ✦ temperature is bearable with technological assistance	✦ atmosphere is thin ✦ would not protect us from sun's high-energy radiation bursts ✦ violent storms

PROS CONS

Jupiter	
✦ part of our solar system	✦ atmosphere changes frequently ✦ storms constantly ✦ one storm has been going on for more than 100 years

Saturn	
✦ part of our solar system	✦ storms - winds up to four times the strength of our most powerful hurricanes on Earth ✦ lightning bolts 1000 times more forceful

Uranus	
✦ part of our solar system	✦ cold too extreme ✦ seasons last 20 years ✦ winter would be twenty years in the dark

Neptune	
✦ part of our solar system	✦ too far to travel (12 years) ✦ atmospheric pressure too great for humans

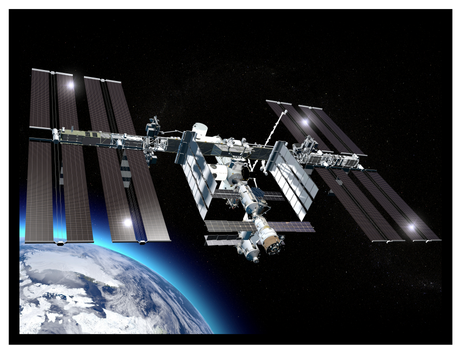
SURVIVING IN SPACE

For a long time, people traveling to and being able to survive in space was only the stuff of science fiction. However, human beings developed inventions and advancements in technology. This enabled some things in fiction to become reality. But just how do people survive up in space?

It's much different than living on Earth, that's for sure. There's no breathable air or water in space. However, people have lived inside the International Space Station for over twenty years. They have had to bring the air and water from Earth.

Breathing in Space

Small spacecraft bring air, water, and other supplies to the International Space Station regularly, but astronauts and cosmonauts are also trained to recycle as much as they can. For instance, they can make oxygen through a process called electrolysis. This involves running electricity through some water. You might wonder where they get electricity. The outside of the International Space Station has large solar panels that convert energy from the sun into power.



Water in Space

How do they recycle water, then? Well, there is an ingenious water recycling system on the International Space Station. Clean, pure drinking water is produced from waste, urine, and sweat. It goes through a process of filtration to be available for thirsty space residents to drink again.

Food

Water is essential for survival, of course, and so is food. Astronauts and cosmonauts eat similar types of food that we do on Earth, but there are some limits. They have an oven to heat up some of their meals, but there are no refrigerators, so they can't keep foods cold. Space food comes in special packages. Some of it, like fruits and nuts can be eaten right away, but others need to have water added to them or warmed up in the oven.

Exercise

Everyday, the people in space eat three meals and exercise for two hours. Exercising is very different in space than it is here on Earth. The gravity in space is far less than it is on Earth; it's called microgravity. Due to microgravity, people float around rather than walk on the floor. They can also move extremely heavy objects easily. Because of this, their bones and muscles can weaken. Special exercise machines have been designed for astronauts and cosmonauts and put on the International Space Station. These machines give the residents the right amount of exercise to keep them strong and healthy.

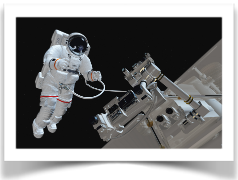
Toilets

Special toilets were also designed for when space travellers need to use the bathroom. These bathrooms have straps that the men and women can use so they don't float off the toilet. There are vacuums inside the toilets that suck up the waste.

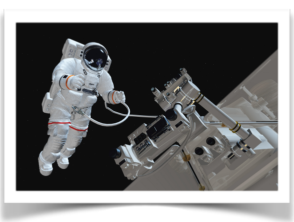
Sleeping

After long days of keeping themselves and the space station in tip-top shape, astronauts and cosmonauts need get a good amount of sleep. That's a little tricky to do because they are weightless in space and they float around. Therefore, they usually sleep inside of special sleeping bags that can be found in small, one-person cabins.

SURVIVING IN SPACE



Subtopic:______________________________



Subtopic:______________________________

LESSON EIGHT

The International Space Station

grade six
LESSON EIGHT

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will investigate scientific and technological advances that allow humans live on the ISS.

Preparation

- Copies of article - The International Space Station
- Instructions for follow-up activity - ISS is True or False?
- Copies of Inventions That Allow Us to Live in Space - Note-taking Organizer
- Copies of exit ticket - Reflection
- Access to sites and books about the ISS (several books can be found on EPIC)

Lesson Part A

- Invite students to share their previous knowledge about the ISS.
- Ask students what they think would be challenging about living aboard the ISS.
- Ask students to read the article The International Space Station.
- Follow up activity - ISS it True or False?
- Revisit the Wonder Wall questions related to living in space. Choose 4-6 questions based on the number of students you will put in a group.
- Divide students into JIg Saw groups. Each student in each group will choose a question to answer for their group.

Lesson Part B

Jig Saw Activity

- Expert groups (students from each group answering the same question) meet to take notes using websites and books. They can record information using the Inventions That Allow Us to Live in Space Organizer.
- Members return to original group and share findings.
- Have students complete the exit ticket - Reflection - Would You Want to Stay on the ISS?

Assessment

ISS It True or False - comprehension activity - Teacher can make observations while reading questions to the class. It could be used as a more formal assessment if you wish to have students record their answers.

Reflection -Would You Want to Live on the ISS?
An overall level (1-4) can be assigned based on the following:
- student considers several to many factors when making decision
- student uses information from different sources
- student uses scientific vocabulary to communicate

NOTES

Answers to the ISS it True or False
1. T 2. F 3. F 4. T 5. T 6. T 7. T 8. T 9. T 10. F

Jigsaw Method
1. Put students into home groups of 4.
2. Each member of the home group selects one of the questions to research and answer for their group.
3. Students leave their home group to sit with students who are researching the same question. These are called the expert groups.
4. The expert groups share resources and findings to record in the top part of the organizers. Have specific resources ready for each group to make the research time short.
5. Students return to their home groups to share their findings. Members can make brief notes about the findings of their home group members in the bottom part of the organizer.

Resources
Both the Canadian Space Agency and NASA sites have a plethora of information about the ISS, including recordings of live feeds from the astronauts, with the most up to date information. It is a good idea to explore these sites in order to best direct your students. These videos would also be a great resource for students when they have finished other tasks.

EPIC Books has a number of resources at varying levels for your students to access.

THE INTERNATIONAL SPACE STATION

The International Space Station (ISS) is more than just a spacecraft. It's also a home for astronauts, a research lab, a classroom, and a satellite. Scientists use the ISS to learn more about space and how life on Earth can improve.

The ISS began as a project between the United States, Canada, Russia, Japan, and Europe. They wanted to create a space station where astronauts from around the world could live and work together. The project began in 1993 and the first section was launched in 1998. After that, forty-two space flights delivered more pieces of the ISS. It is now 109 meters long and weighs over 417,000 kilograms.

Different astronauts have lived on the ISS full-time since 2000. A crew of six astronauts stay together on the ISS for different research missions. The living and working areas are very big, around the size of a six-bedroom home. Each astronaut gets his or her own bedroom. They share two bathrooms and a gym. The gym is more than a fun luxury. Astronauts can lose muscle tone when they are in space for a long period of time. They must exercise for two hours each day to make sure their muscles stay healthy.

The research that astronauts conduct on the ISS is very important. They perform many experiments on human health. Astronauts look closely at how cells and tissues grow in space compared to how they develop on Earth. They also observe how fluids, metals, and other materials respond to a lack of gravity. The ISS astronauts hope this research will lead to new treatments for diseases like cancer.

Astronauts also use the ISS as a large classroom. They give students back on Earth opportunities to learn about space, science, and technology. ISS astronauts provide videos showing different parts of the spacecraft, experiments on scientific laws, and even astronaut workout videos. There is also a live video feed of the ISS that can be viewed at any time. ISS astronauts enjoy providing educational content. They want students to become interested in space and careers in science.

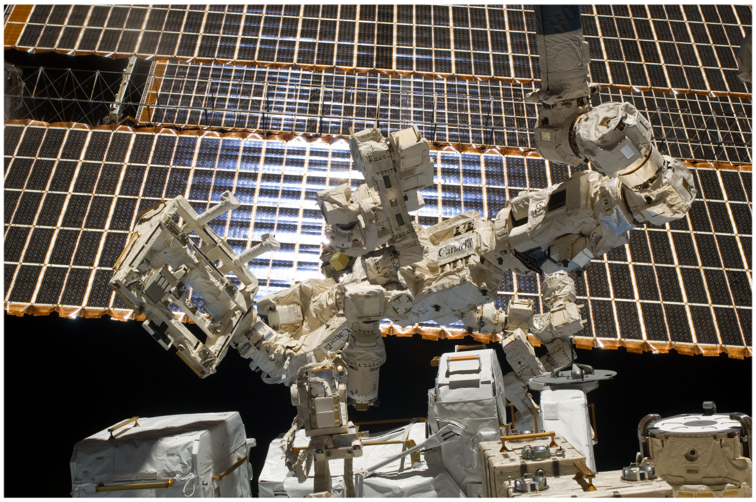
While research and education are taking place inside the ISS, the station is circling Earth as a satellite. The International Space Station travels at a speed of 5 miles per second and orbits the planet every 90 minutes. As it circles, it takes millions of photos of Earth below. These images are used for many purposes. Photos from the ISS have been used to identify bad weather, to spot changes at sea, and to make maps.

Several Canadian astronauts have served aboard the ISS. They include:

Julie Payette docked onto the ISS from the Space Shuttle Discovery in 1999. This was the first time another spacecraft was able to connect to the International Space Station. This made Payette the first Canadian to participate in an ISS mission.

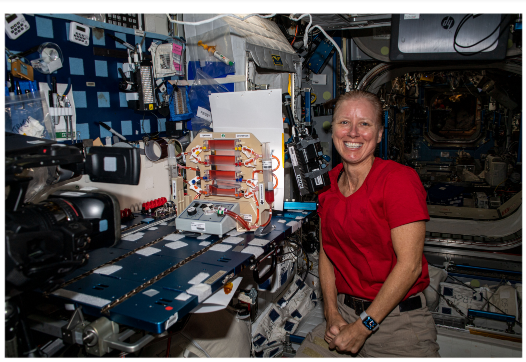
Robert Thirsk was the first Canadian astronaut to go on a long-term ISS mission in 2009. Thirsk conducted experiments, researched robotics, and completed repair work on the station's technology systems.

Chris Hadfield became the second Canadian astronaut to participate in a long-term ISS mission in 2012-2013. During the second half of this mission, Hadfield became the first Canadian Commander of the International Space Station.

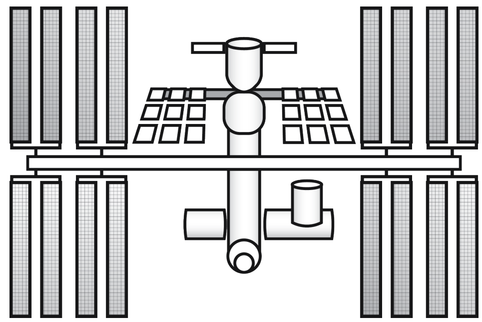


Canadians have also contributed technology to the ISS. The station utilizes a Canadian robot called Dextre. Dextre was built by an aerospace company in Ontario and was installed aboard the ISS in 2008. The robot has two hands that work like multi-use pocket tools. The hands have retractable wrenches, cameras, and power connectors. These tools are used to install equipment, fix electrical components, and test new materials. Dextre is special because it can complete these tasks with a delicate touch. The robot can handle both fragile and bulky equipment with precision. It is an essential piece of technology because it helps astronauts fix signs of damage on the ISS as soon as possible.

It is amazing to imagine the impressive work that is taking place above Earth on the International Space Station. But you don't just have to imagine it. The ISS can actually be seen in the night sky when it is 400 kilometers from Earth. To the naked eye, it looks like a large white dot, moving much faster than an airplane. It is also the brightest object in the sky and can even be seen in big cities with lots of artificial light. If you see it, remember all of the remarkable work the ISS astronauts are doing onboard to make life on Earth even better.



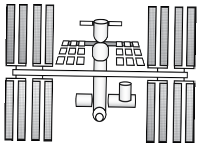
ISS IT TRUE OR FALSE?



Read the following questions to the class. You can have them indicate their response with a thumbs up or thumbs down, a 2 side colour card, or even jotting their answers down. The intent of this activity is to ensure that some key points from the article are shared.

1. The ISS began as a project between the United States, Canada, Russia, Japan, and Europe.
2. The ISS was completely assembled on Earth and then launched into space.
3. A crew of twenty astronauts live on the ISS at one time.
4. Astronauts can lose muscle tone when they are in space for a long period of time.
5. The scientists aboard the ISS conduct experiments about gravity.
6. There is also a live video feed of the ISS that can be viewed at any time.
7. Photos from the ISS have been used to identify bad weather, to spot changes at sea, and to make maps.
8. Astronaut Julie Payette was the first Canadian to participate in an ISS mission.
9. Dextre is a robot with two arms with different tools as hands which can install and fix components on the station.
10. You can not see the ISS from Earth.

INVENTIONS THAT ALLOW US TO LIVE IN SPACE



Invention: ______________________________

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Invention Information From My Group Members

Invention: ______________________________

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Invention: ______________________________

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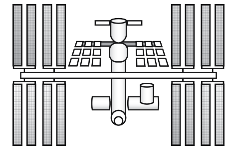
Name: ____

REFLECTION



WOULD YOU WANT TO STAY ON THE INTERNATIONAL SPACE STATION?

Reflect on the information you learned today. In your answer, refer to specific facts that influenced your decision.

Name: ________________________________

LESSON NINE

Space Inventions

grade six

LESSON NINE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will investigate scientific and technological advances that allow humans to adapt to life in space and how these inventions have benefitted our daily lives on Earth.

Preparation

- Text - **Top10 Interesting Space Inventions** - copies
- **Graphic Organizer - Top Ten Space Inventions** - copies
- **Graphic Organizer - Top Three Space Inventions** - copies
- Chart paper, board, etc. to record voting criteria

Lesson Part A

- Pose question: *What are some of the benefits of space exploration?*
- Inform students they will be reading an article about some inventions originally created for space exploration, but for which scientists have found ways to improve our lives here on Earth.
- Ask students to make predictions. Tell them the article is only about 10 inventions; there are obviously many more.
- Have them scan the **Top10 Interesting Things** to confirm any predictions. They can investigate other predictions later.
- Students read the article. Ask them to highlight any information they find important or interesting.
- Introduce task: **Rank** the ten inventions in order of importance in their opinion. They will work with a group and compare their rankings next class.

Lesson Part B

- Remind students that today they will be comparing their rankings with a group.
- Ask: *How did you make decisions about your ranking?*
- Discuss: *In order to come to agreement we need to establish criteria to make decisions e.g., Who do the inventions help? Can they be used across the world? etc.*
- Once criteria has been established, put students in small groups of 4-5 and have them choose the top 3 inventions and be able to support their opinion with the criteria. They will complete the **Top 3 Inventions** graphic organizer to record their ideas.

Assessment

- The rankings and communication of the thinking process demonstrate a student's ability to assess the impact of space exploration on society. Other creative and critical thinking processes involved are evaluating and justifying.
- When reading student responses, you can evaluate the depth of the responses looking at how students justify and support their thinking (insightful, adequate, general). Arguments should be logical and communicated clearly.

NOTES

TOP 10 TEN INTERESTING

SPACE INVENTIONS USED IN EVERY DAY LIFE

The human desire to explore beyond our own planet has motivated us to create new technologies not only to observe our universe, but to travel in space. We have built equipment that allows us survive in an environment where there is no gravity, no air we can breathe, and no way to communicate. These advances have also benefitted our lives here on Earth. Below is a small list of some of the items that we use which were originally made for the space industry.

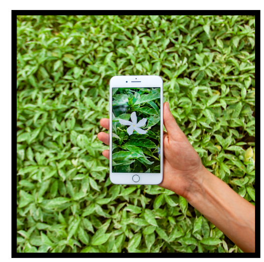
1. **Insulin Pump -** Millions of people around the world live with diabetes, a disease which requires constant monitoring and daily injections. The Goodard Space Center invented a system that was originally designed to record body readings of astronauts, but now is being used as a monitoring system. What a person with diabetes needs insulin, the pump immediately provides it. This invention has saved the lives of uncountable people with diabetes.

2. **Firefighting Equipment -** The material used to make space suits is now used to create suits for firefighters which are heat resistant and flame retardant. They have also incorporated a circulating cooling system which keeps firefighters from becoming overheated. They also have an advanced breathing apparatus. Both of which allow them to fight fires for a longer period of time.

3. **Improved Solar Cells -** These were developed when NASA was attempting to invent a remotely-piloted plane which could fly for days. It needed a solar source that was light weight. Now, single crystal silicon solar cells are widely available at a reasonable price.

4. Wireless Headsets - This technology was originally designed for communication between astronauts and Earth. NASA improved on the design—making a light, hands-free system that has been in use since the Mercury and Apollo missions in the 1960s and 1970s. Neil Armstrong spoke the very first words in space using a wireless headset.

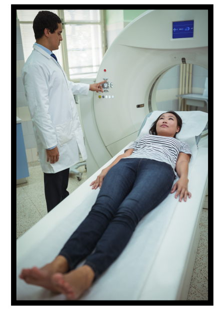
5. **Freeze Dried Foods** - Freeze dried foods are perfect for space flights because they take up very little room and are also very nutritious once they have been reconstituted with water. They are actually tastier than earlier meals which were packed in squeeze tubes. These foods are important as they are used for disaster relief programs and soldiers, but also enjoyed by campers and backpackers.



6. **Camera Phones** - The technology that we use in cell phones and computer cameras was originally designed in 1990. NASA needed a system to take high-quality photographs from space. The findings by NASA scientist Eric Fossum has changed the digital imaging industry.

7. Ear Thermometers - The technology for ear thermometers was first developed to measure the temperatures of distant planets and stars. These thermometers can rapidly detect temperature in under two seconds using infrared sensors.

8. **Artificial Limbs/Prosthetics** - Modern prosthetics, which now include artificial muscle systems and sensors, exist in part due to NASA's research. Their improvements of shock absorption and development of memory foam have helped make artificial limbs more comfortable, reducing the friction between the patient's skin and the artificial limb.



9. CAT Scans - CAT scans were originally designed to help find imperfections in aerospace structures during the Apollo missions. It is now used daily in the medical field as a diagnostic tool. It takes multiple x-rays of the body and allows doctors to see inside the body without surgery. It is a vital tool in detecting diseases such as cancer, cystic fibrosis, and heart problems—as well as for finding injuries to the lungs, heart and vessels, liver, spleen, kidneys, bowel, or other internal organs in cases of trauma.

10. Artificial Satellites - The first satellite sent into space was by the Russians in 1957; it was called Sputnik. The largest satellite orbiting the Earth today is the International Space Station. After the launch of the first few satellites for political purposes in the space race, other countries began to send satellites which were used for benefits here on Earth. With satellites, we now have the ability to forecast weather more accurately, predict natural disasters, and have television and radio from around the world. Other devices we use daily which rely on satellites are GPS, bank machines, and broadband Internet services. Our lives would be very different without the satellites that circle our planet.

There are people who would argue that the money spent on our space program would be better spent in other areas. The advances made in health care, scientific knowledge, communications, and human safety, in addition to job creation and being a partner in the international community, have proven time and time again the benefits of space exploration.

TOP 10 TEN INTERESTING space inventions RANKINGS

My Rankings

10.______________________
9.______________________
8.______________________
7.______________________
6.______________________
5.______________________
4.______________________
3.______________________
2.______________________
1.______________________

MY THINKING

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TOP 3 THREE INTERESTING space inventions RANKINGS

Criteria

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GROUP DECISION - TOP THREE INVENTIONS

1. ____
2. ____
3. ____

MY FINAL THOUGHTS

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LESSON TEN

Canada in Space

grade six

LESSON TEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will investigate the contributions of Canada to space exploration.

Preparation

- Canada Space History Cards
- Timeline drawn on mural paper or board
- Tape or other fixative
- Access to Internet
- Canada Space Agency - Key Ideas Organizer - copies

Lesson Part A

Canada Space Agency - Key Ideas Organizer

- Display a set of the Timeline Cards and inform students that they are just a small sampling of Canada's space history.
- Ask students if they are aware of contributions that Canada has made to space exploration. As they suggest events or people, pull the card out.
- Distribute 1 card to each student. Ask class to cooperatively put themselves in order by date.
- Once students are in a line, have them read out their cards one at a time.
- If time permits, you may wish to have students add an additional piece of information or image to the card.
- Have 2-3 students at a time stick their card to the remade timeline on a board or mural paper.

Lesson Part B

- Show the students the Canada Space Agency website.
- Choose 1 or 2 sections to briefly view as a class.
- Students will work with a partner to choose one section to explore. Using the Canada Space Agency organizer, record three key ideas to share.
- Again, depending on the length of your classes, you can have the students share these in a knowledge-building circle or have them post them as a gallery walk or on a bulletin board to view.

Assessment

- The timeline activity allows you to observe learning skills of cooperation and collaboration. You can also see who steps in as leaders. The discussion prior to the activity can be used to determine those who have background knowledge about the topic.
- The website exploration will give you insight on the comfort level of using technology and ability to take notes.

NOTES

It will help the students if you briefly explore the Canadian Space Agency site together. The site is full of information. Students are not always as 'tech savvy' as we may think, especially when it comes to navigating websites. The best sections for them will probably the sections geared towards kids.

To save time, if your periods are short, you may wish to preselect some areas to assign or have students choose from. They can then go back on their own to explore another time.

Providing them with a short time frame to read a brief section and jot down the key notes is best. This is not intended as a time for extended research, but as an introduction to the site and contributions of Canada.

CANADA IN SPACE

1839

The first magnetic observatory was created at the University of Toronto by Edward Sabine. Its purpose was to study the idea that the northern lights were formed due to Earth's magnetic field. He was the first scientist to affirm that sunspots were related to magnetic disturbances across the world.

1932

Canada, as part of the group for the International Polar Year, built stations to measure meteorological, magnetic, and auroral phenomena beyond the Arctic Circle. They employed new technology which involved using radio-equipped balloons and kites to extend measurements high above the Earth's surface.

1957-1958

Canada and the US partnered together to build the Churchill Research Range in Manitoba. At this facility, they launched probes into the upper atmosphere of Earth to gather information. Over the history of the facility, over 3500 probes were launched. It closed in 1989.

1962

With the design and launch of the Alouette 1, Canada was the third nation (after Russian and US) to do so. Its purpose was to study the ionosphere (the upper atmosphere of Earth) which can affect long distance radio transmissions.

CANADA IN SPACE

1974

The Canada Arm was invented when NASA asked our country to design a shuttle remote manipulator system. It was a 15 metre robotic arm. The project cost $100 million and was the first part of the space shuttle program.

1976

The most powerful satellite at the time, The Hermes, was launched by Canada. It was a communications satellite which explored new ways of using satellites. Future direct broadcast satellites were based on the work done by the Hermes.

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1980

Canada became part of the European Space Agency. Our role was to supply solar panels, amplifiers, hyperfrequency components, and support assembly, integration, and testing to the Olympus, a $1 billion spacecraft and communications satellite.

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1982

The year the Canadian astronaut program began. NASA asked Canada to join them in space.

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CANADA IN SPACE

1983

Canada choose its first astronauts:

Roberta Bondar, Marc Garneau, Steve MacLean, Ken Money, Robert Thirsk, and Bjarni Tryggvason.

1984

Marc Garneau became the first Canadian in space on a mission aboard Challenger. He conducted experiments, CANEX-1, designed by Canadian scientists. The Canada Arm was used for the ninth time on a space shuttle flight.

1986

Canada was a full partner of the International Space Station program after signing an agreement.

1990

The High Flux Telescope was launched. It was another first for Canada, having an instrument launched beyond Earth's orbit. It was part of the Ulysses mission which studied the poles of the sun.

CANADA IN SPACE

1992

Roberta Bondar was the first Canadian woman in space. She was part of the crew aboard the Space Shuttle Discovery.

1995

Canada sent its first Earth observation satellite into orbit, RADARSAT. It provided information in many areas such as disaster management, agriculture, cartography, forestry, and oceanography

1996

Robert Thirsk completed the longest mission by a Canadian, 17 days. Julie Payette and Steven McLean began training as mission specialists.

2001

Astronaut Chris Hadfield, was part of the crew of the Space Shuttle Endeavour to deliver Canadarm2 to the International Space Station. He was the first Canadian to perform an extra-vehicular activity, or spacewalk.

CANADA IN SPACE

2006

Astronaut Steve MacLean travelled aboard the Space Shuttle Atlantis. He worked with the other astronauts to finish the assembly of the International Space Station. They installed new solar arrays which doubled the power of the station. Steve also completed his first space walk.

2008

A piece of Canadian technology made it to Mars. **Canada's meteorological station** travelled aboard the NASA vessel Phoenix to the Arctic region of Mars. Its mission was to find data about the history of water on Mars and whether or not the soil could grow vegetation.

2011

Astronaut David Saint-Jacques took part in NASA Undersea Mission. The purpose of the mission, NEEMO 15 was to discover the conditions for visiting an asteroid. The one-seater submarines named The DeepWorker were built and developed by Canada.

2012

Astronaut **Chris Hadfield** became the first Canadian Commander of the International Space Station during his third visit there.

CANADA IN SPACE

2013

Canada's satellite, CASSIOPE, was launched to collect vital information about space weather. It contained two new pieces of technology: a SmallSats spacecraft, Fun; and Cascade, a communications demonstrator.

2014

The Canadian Space Agency was partnering with the National Aeronautics and Space Administration (NASA) on OSIRIS-REx, the first US-led mission to return a sample from an asteroid to Earth. Canada provided a high-tech laser for the mission.

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2015

The Tomatosphere™ educational project was launched into space. Over 600,000 tomato seeds were be used on the ISS for the experiments led by the the University of Guelph. Also aboard were new instruments for the Osteo-4 experiments where Canadian scientists were looking to find treatment for osteoporosis.

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2016

The Canadarm2 completed another first. It was used to attach the Bigelow Expandable Activity Module(BEAM) to the ISS. It will be used in the future as a living space on the moon or Mars. These modules will reduce the costs of future missions.

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CANADA IN SPACE

2017

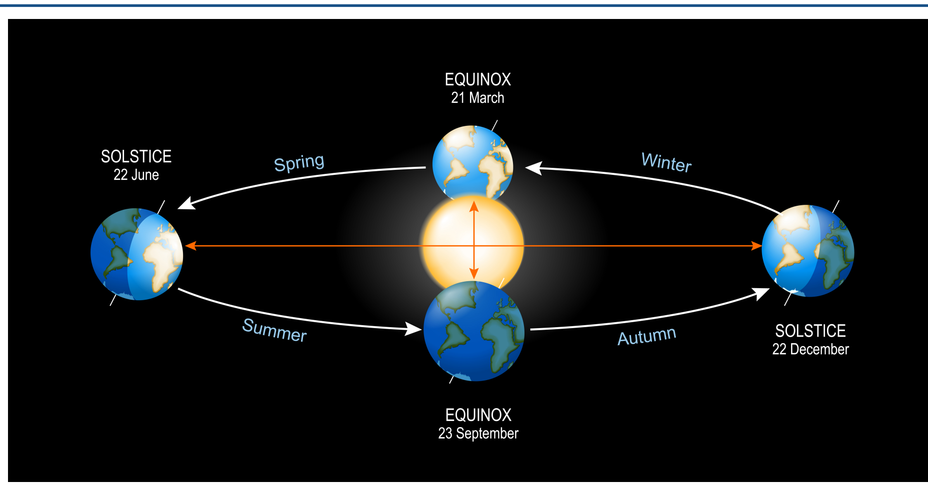
Two new astronaurts were selected to train for space missions. This was the first time since 2009 that new recruits joined the team. L. Col. Joshua Kutryk, an Air Force pilot and Dr. Jennifer Sidey-Gibbons, an assistant professor at the University of Cambridge were the lucky candidates. They headed to NASA for two years of training.

2019

Canada'space robot Dextre was being used to show how robots can refuel spacecraft while in orbit. This allowed humans to conduct longer missions deeper into space. Previous to this, Dextre had been used to install, replace, and repair equipment outside of the space station. It was a vital member of the crew.

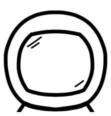
2021

Canada contributed two key pieces of technology to the most powerful telescope yet, the James Webb Space Telescope. The first is the Fine Guidance Sensor which allowed us to see newborn stars, merging galaxies, and other bodies which we have not been able to see yet. The second is the NIRISS which collected data that will recognize life on other celestial bodies.



CANADA SPACE AGENCY

Topic: ______________________________



Key Sharing Point #1

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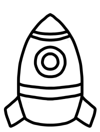

Key Sharing Point #2

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Key Sharing Point #3

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LESSON ELEVEN

Putting it All Together : Our Interrelated System

grade six

LESSON ELEVEN

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will demonstrate their understanding of the interrelated nature of our universe and how the technological and scientific advances that enable humans to study space affect our lives.

Preparation

Lesson Part A

- Give students a set time (about 5 minutes) to flip through their notebook to observe the learning that has taken place.
- Ask them to find the fluency list they did the first day of the unit. Have them close their notebooks. Give them an assigned amount of time to add to the list (2-3 minutes). Compare the new list with the original. Could they double their list? Triple?
- Using their notes have students create KAHOOT-style questions using the **KAHOOT Template**.
- Collect the questions. You can play low tech, reading the questions aloud and using a paper **KAHOOT Card** or create a game using the website.

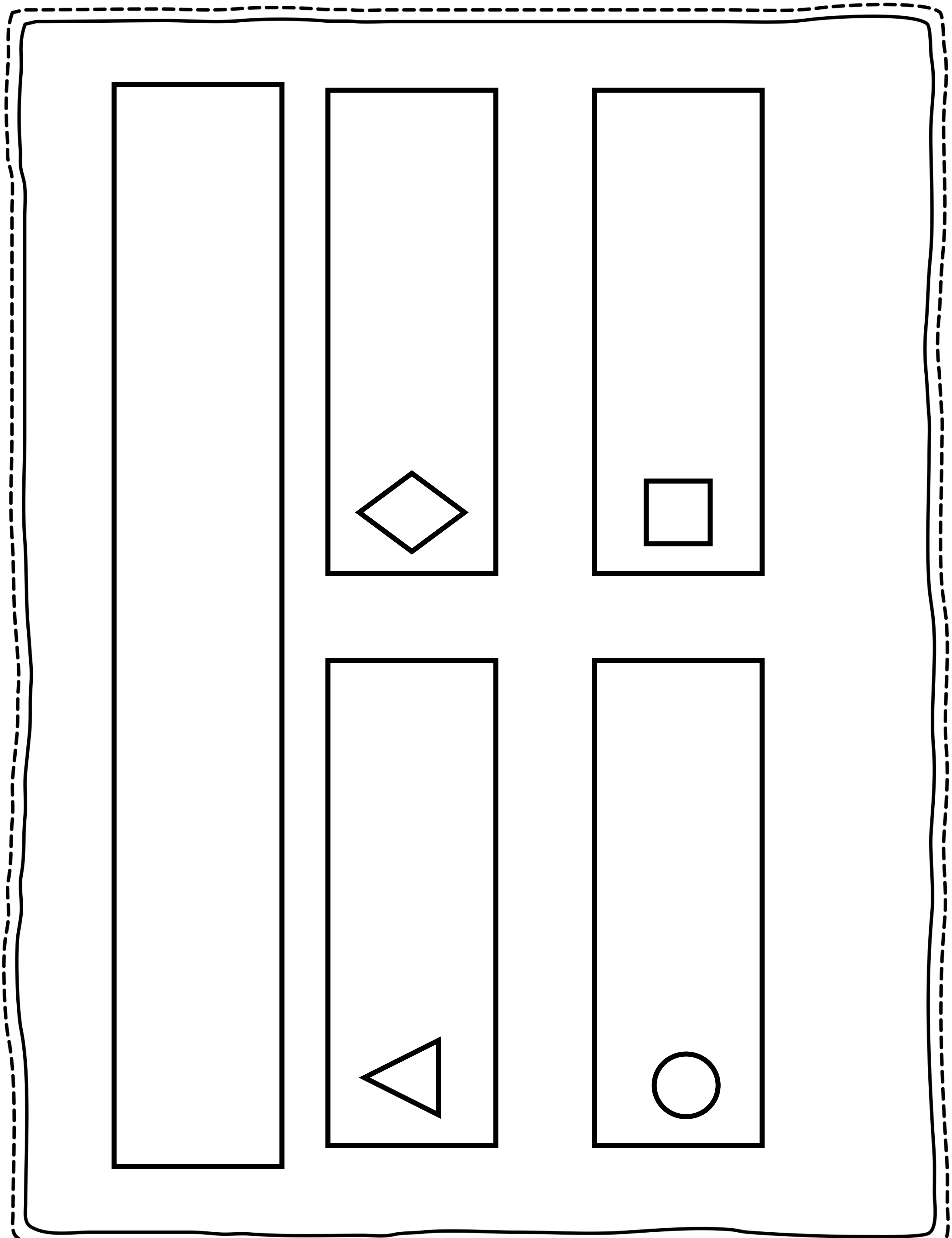
Lesson Part B

- Note for students: *All of the words on your fluency list are connected in some way because Earth is part of an interrelated system.*
- Demonstrate **Our Interconnected Universe - Vocabulary** for the students or use the model provided.
- Give the students a blank sheet of paper. Have students choose 3 words. Using words, images, and lines, students are to show how the words are interconnected.

Assessment

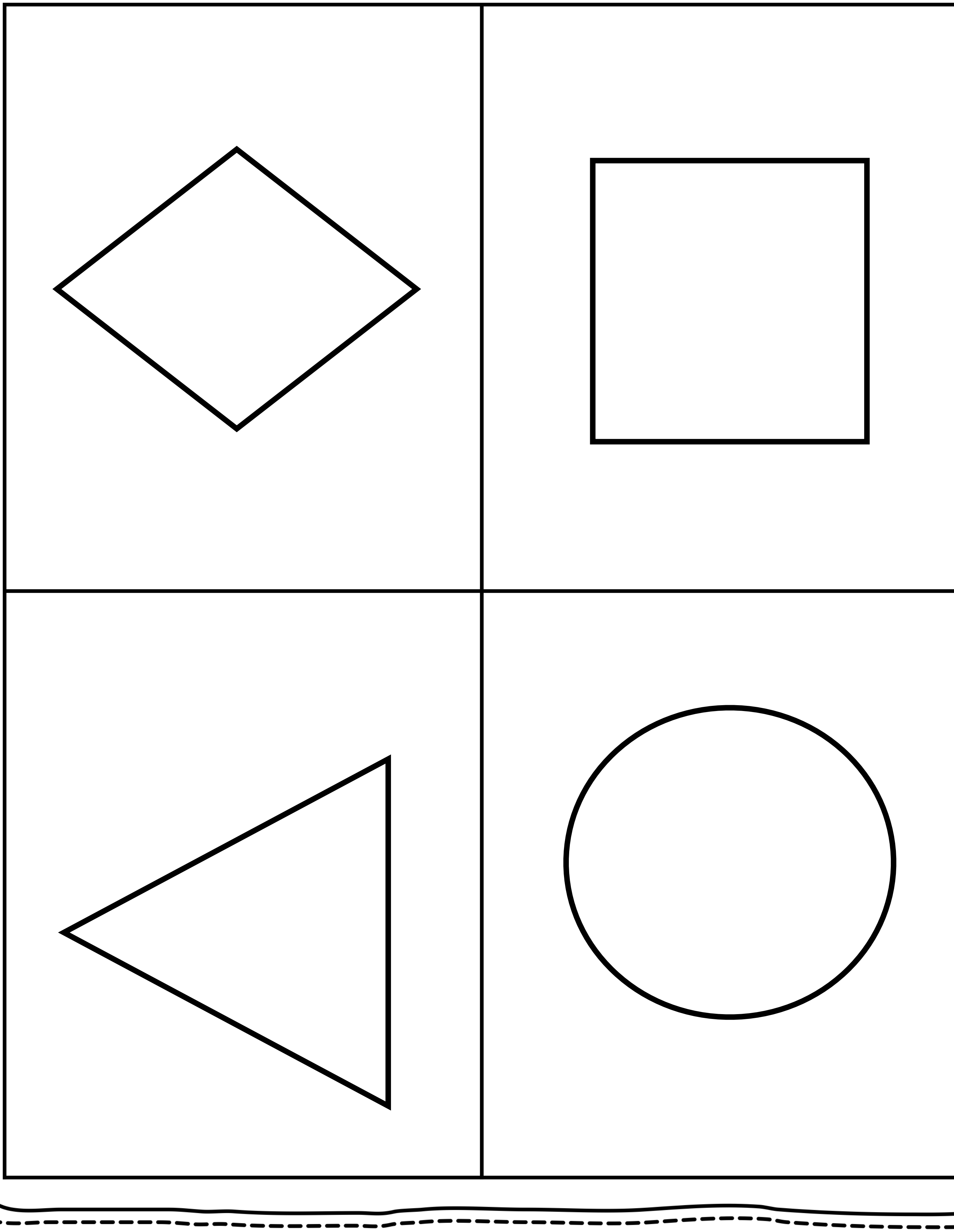
- A **Rubric** has been provided to help guide your assessment. Modify as needed.

NOTES

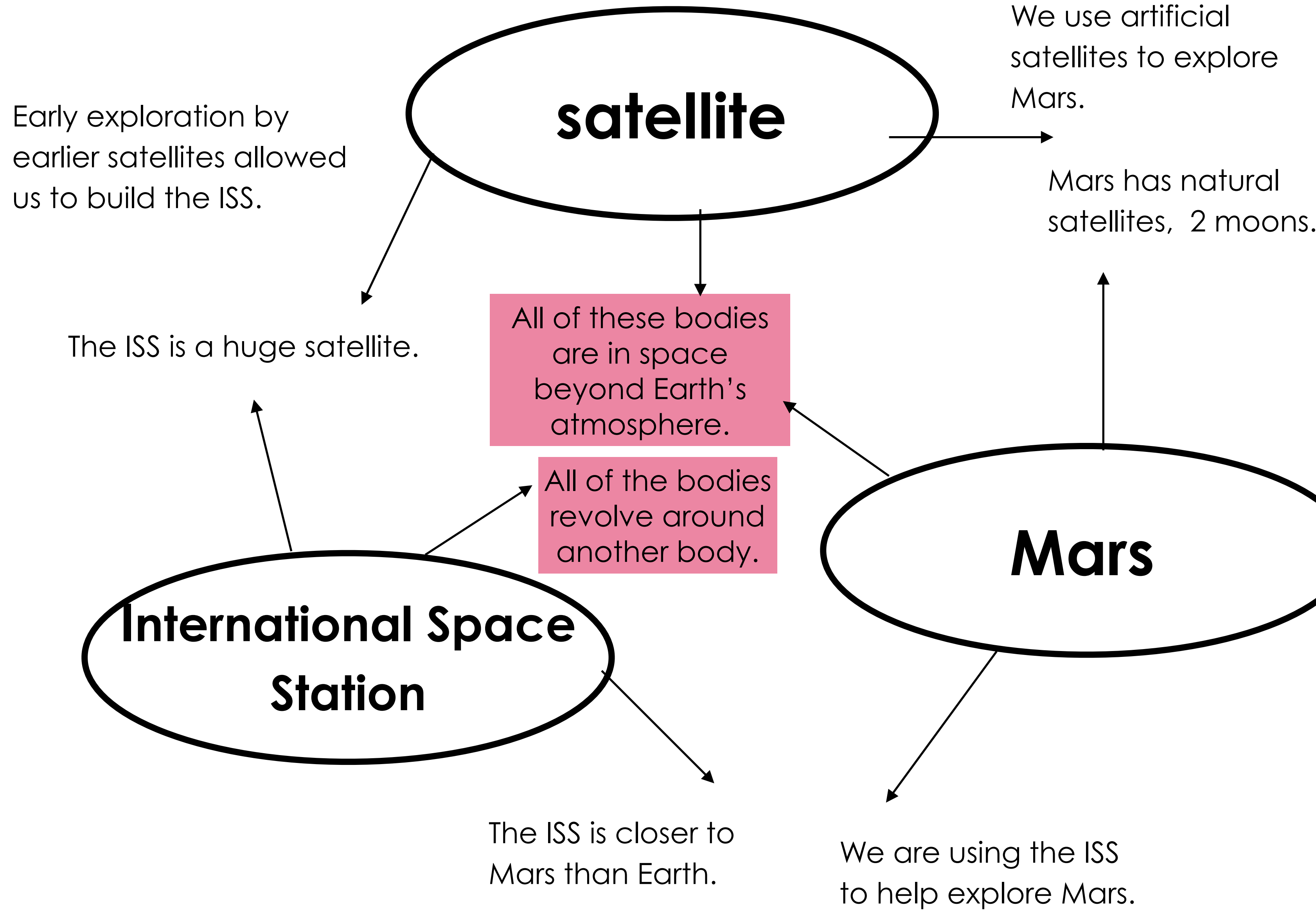


KAHOOT ANSWER SQUARE

you can colour the boxes kahoot style.



OUR INTERCONNECTED UNIVERSE – VOCABULARY



OUR INTERCONNECTED UNIVERSE - VOCABULARY

Level 1	Level 2	Level 3	Level 4
Demonstrates limited understanding of content.	Demonstrates some understanding of content.	Demonstrates considerable understanding of content.	Demonstrates thorough understanding of content.
Links between words are not always correct. Links involve mainly physical aspects.	Links between words are appropriate most of the time. Links involve mainly physical aspects, but few that refer to movements and function.	Links between words are appropriate. Links involve mainly physical aspects, but some that refer to movements and function.	Links between words are appropriate. Links involve mainly physical aspects, but some that refer to movements and function.
Student rarely uses subject-specific vocabulary to communicate.	Students occasionally uses subject-specific vocabulary to communicate.	Students sometimes uses subject-specific vocabulary to communicate.	Students frequently uses subject-specific vocabulary to communicate.

LESSON TWELVE

Independent Inquiry

grade six

LESSON TWELVE

The format for these lessons is structured into two parts. One part is designed as a teacher directed lesson. The second part of the lesson is designed as an independent or small group learning activity. The teacher directed is noted in **PINK** and the small group/independent task is YELLOW

Learning Goal

Students will design and carry out an inquiry project.

Preparation

- Prior to assigning the project, review the **Student Inquiry** instructions.
- Prepare **Inquiry Booklets** with students. This can be done in one of two ways.
  - Print out the pages double-sided on an 8.5 x 11 piece of paper and bind papers together in a booklet with the staples up the left side.
  - Using the settings of your printer, select only the pages of the inquiry booklet from the PDF to print. In the print dialog box, select the option to print as a double-sided booklet.

Lesson - Introdution

- Revisit **Wonder Wall Questions**. Note the questions that you have answered through the lessons.
- Look at the questions that have not been answered. Try to align them with the topics outlined in the **Inquiry Project**.
- Allow students some time to choose a topic and do some initial research. This should help confirm their choice of topic.

Lesson Part B

- Students should be firm in their choice after doing a small amount of reading about the topic.
- Students begin with asking questions they hope to answer through their research and record background knowledge.
- They should check in with the teacher at this point to ensure they are ready to start their research.
- Continue to check in as the process continues.

Assessment

- An assessment **Rubric** has been provided and should be given to all students.
- Students will choose their delivery of their research and will be assessed based on the rubric criteria.

NOTES

- Students will have two weeks to complete project.
- If presenting, this will take an additional week.

STUDENT INQUIRY

The purpose of student inquiry is to allow students to explore concepts of flight that interests them, to learn more, to solve problems, look at an issue from different perspectives, and develop solutions. The inquiry project will take about two weeks to complete, depending on the amount of lesson time you have for science. After that, depending on the media forms your students choose, you may need to allot time for presentations.

Students have explored some introductory topics related to space. They will now be encouraged to work beyond these topics for inquiry, if they're ready and capable. The introductory information in lessons, after exploring the physical make up of the solar system, falls into three categories:

A. Technology in Space
B. Canada's Role in Space
C. The Benefits of Space Exploration

Based on these areas, three tasks have been provided that should help focus students' scope for research. The tasks have choices embedded.

However, if a student wishes to investigate a topic that is interesting, relevant, and timely to them, teachers are encourage to support and help students develop an appropriate scope to help them carry out the research.

Students who struggle with reading and research skills may require modifications. You can limit them to one of the tasks that interest them or a concrete topic (e.g. black holes, biography of an astronaut) to explore. This will make finding materials at an appropriate level easier. EPIC Books, PBS, National Geographic for Kids, and NASA for Kids are all good sites with varying levels of materials.

All topics will require the students to move through the stages of inquiry and research:

- develop/brainstorm an Idea
- ask questions
- research and grow background knowledge
- apply learning
- evaluate learning and draw conclusions
- share their learning

This will look slightly different for each topic and is outlined on the task pages.

An inquiry booklet has been included that that will help to scaffold student inquiry. As the teacher, it is important that you conference with students to ensure that they are moving through their inquiry journey appropriately.

At times you may need to stop a group of students for a guided inquiry lesson on topics such as brainstorming, how to research, or how to synthesize information. Lessons during your other areas of instruction, such as during your language arts time, will help to support students in understanding how to do many of these things successfully. A cross-curricular approach is very helpful when conducting inquiry projects.

By the end of the student inquiry research, students will share what they have learned. Teachers should avoid restricting student creativity by planning how students will present this information.

INQUIRY PROJECT

INQUIRY PROJECT

TOPIC #1 – TECHNOLOGY IN SPACE

The knowledge we have about our universe is largely due to technologies that we continue to create. These technologies help us explore space and improve our lives on Earth.

TASK

Design a new invention that would further our progress in space. Would it allow humans to settle a specific place, extend our ability to stay in space, or improve life aboard the ISS? What type of technologies are required for your design? Draw a sketch of how you imagine it might look and describe how it might work.

Option: Explore an existing piece of technology.

INQUIRY / RESEARCH PROCESS

Use the inquiry/research steps below to help you through the process. The questions are to help guide you.

brainstorm/develop Ideas	Is there a need for an invention? (e.g., a new habitat to live on Mars?) How can I improve the life for astronauts? Will it be used for travel aboard the ISS or on another planet?
ask questions	What will I need to build my piece of technology?
research and grow background knowledge	Are there existing technologies I can incorporate into my design? What kinds of materials will I need?
apply learning	How will my design work? What will it look like?
evaluate learning and draw conclusions	How will it benefit the space industry? Are there benefits here on Earth?
share findings	How will I present the information? (slide show? model?)

INQUIRY PROJECT

TOPIC #2- CANADA'S ROLE IN SPACE (HUMAN FACTOR)

Canada continues to play a vital role in space exploration, contributing both technology and human resources (scientists, astronauts, astronomers). What careers are part of the space industry? What training is needed for different jobs? What contributions can you make through a job in the space industry? Here is a list of some of the jobs that currently exist.

Astronomer/Astrophysicist
Geologist Meteorologist
Oceanographer
Physicist
Chemist
Biologist
Medical Doctor
Psychologist
Nutritionist
Mathematician
Statistician
Computer Scientist
Aerospace/Astronautics Engineer
Instrumentation Engineer
Robotics
Materials Engineer
Safety Engineer
Biomedical Engineer
Crew Members of Spacecraft
Pilot Astronaut
Mission Specialist

INQUIRY PROJECT

TASK

Select a career in the space industry that interests you. What is the job description? Research the educational path you need to follow in order to prepare for this job. What extra training or experience do you need? Imagine you finished your education and training. Create a resume you can use to apply for a job and a cover letter or video presentation explaining why you are the perfect candidate for this job and what you want to accomplish in your career.

INQUIRY/ RESEARCH PROCESS

Use the inquiry/research steps below to help you through the process. The questions are to help guide.

brainstorm/develop Ideas	What are my interests now? What jobs might I be interested in?
ask questions	What kinds of courses would I need to take? What type of degree would I need?
research and grow background knowledge	job description, courses, degrees What schools offer these types of degrees? What training would I need?
apply learning	Look at sample resumes and cover letters. Use them to guide your writing.
evaluate learning and draw conclusions	Is this a job for which I am willing and able to complete the education and training? Do I have the personality to be successful at this job? What would I like to accomplish?
share findings	How will I present the information ?

INQUIRY PROJECT

Topic #3- Costs of Space Exploration

Space exploration has brought many benefits to our daily lives and has given us vital information to help us work towards solutions to problems on our planet. This comes at an extremely high cost, which means less money for other sectors that could use the funding. It also creates pollution and space junk. Are the benefits worth the money and environmental costs?

TASK

Imagine that the Canadian Government announces that our country has been invited to be part of the team that will be colonizing Mars. This comes at a tremendous financial cost. It is asking Canadian cities, towns, and villages to vote on the issue because the money will impact the funding used for municipal services. How would you vote? Create an argument to present to your fellow citizens.

INQUIRY / RESEARCH PROCESS

Use the inquiry/research steps below to help you through the process. The questions are to help guide.

brainstorm/develop Ideas	What is my first reaction? What risks are involved? Pros? Cons?
ask questions	What are municipal services? What is required to live on Mars? Etc.
research and grow background knowledge	• municipal services • costs of space exploration • need to colonize Mars • ability to colonize Mars
apply learning	Make a decision.
evaluate learning and draw conclusions	List arguments and support for your decision based on your reserch
share findings	How will I present the information ?

MY INQUIRY PROJECT

NAME:

____

My Topic

BRAINSTORMING

1 WHAT I WONDER ABOUT MY TOPIC

Record some questions you can ask about your topic. What questions will your research answer?

2 WHAT DO I KNOW ABOUT MY TOPIC

What background knowledge do you already know about your topic?

BRAINSTORMING

3

TIME TO RESEARCH

Using your questions to help guide your research, begin to learn more about your topic. Record your jot notes and organize what you find into separate categories.

BRAINSTORMING

3

TIME TO RESEARCH

Using your questions to help guide your research, begin to learn more about your topic. Record your jot notes and organize what you find into separate categories.

BRAINSTORMING

4

SUMMARIZE YOUR FINDINGS

Write a paragraph for each of your subtopics in your own words.

BRAINSTORMING

4 SUMMARIZE YOUR FINDINGS

BRAINSTORMING

5

MAKE A PLAN

How will you share what you learned with others in a creative way?

- ☐ poster
- ☐ podcast
- ☐ video
- ☐ speech
- ☐ pamphlet
- ☐ song
- ☐ museum exhibit
- ☐ model

6

SOURCES

RECORD THE SOURCES YOU USED FOR YOUR RESEARCH BELOW

ASSESSMENT PAGES

SPACE INQUIRY PROJECT
assessment

CRITERIA	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Knowledge and Understanding: • benefits and costs of aviation technology • social and economic perspectives into account	Student has a limited understanding of key concepts learned and with significant support.	Student has a basic understanding of key concepts learned and uses them appropriately some of the time.	Student has a solid understanding of key concepts learned and uses them appropriately most of the time.	Student has a deep understanding of key concepts learned and uses them appropriately all of the time.
Thinking: • research skills • analyze and synthesize information • make connections and inferences	Student requires a high degree of support to research and struggles to analyze and synthesize what they read to answer inquiry questions.	Student demonstrates basic research skills and with some support can analyze and then synthesize what they read to answer questions.	Student demonstrates good research skills by analyzing and synthesizing what they read to answer inquiry questions.	Student demonstrates excellent research skills by analyzing and synthesizing what they read to answer inquiry questions.
Communication: • appropriate terminology/vocabulary • communicate and collaborate with others	Student rarely uses subject specific vocabulary correctly. Student rarely communicates and collaborates with others to share ideas and insights.	Student uses a few subject specific vocabulary correctly. Student communicates and collaborates some of the time with others to share ideas and insights.	Student uses some subject specific vocabulary correctly. Student communicates and collaborate effectively with others to share ideas and insights.	Students uses most subject specific vocabulary correctly. Student communicates and collaborates effectively with others to share ideas and insights.
Application: • make connections between research and real life	Student struggles to use the information from their research to identify a problem and possible solutions.	Student partially uses the information from their research to identify a problem and possible solutions.	Student sufficiently uses the information from their research to identify a problem and possible solutions.	Student comprehensively uses the information from their research to identify a problem and possible solutions.