# Grade 9 Earth and Space Science (SNC1W)

## *Lesson Plans, Unit Plan, & Culminating Task*

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| **Grade/Subject:** | Grade 9 De-Streamed *Earth and Space Science* (SNC1W) |
| **Number of Lessons:** | 18 |
| **Culminating Task:** | Space Colonization: A Holistic Approach Rooted in Inclusivity, Ethics, Sustainability, and a Commitment to Indigenous Education |

| **Big Ideas:** |
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| ● The solar system and the universe have various components with distinct characteristics that can be investigated and quantified.<br>● The Sun plays a critical role in sustaining life on Earth and in contributing to renewable energy production.<br>● Space observation, space exploration, and associated space exploration technologies advance our understanding of the universe, and have social, economic, and environmental impacts.<br>● Many perspectives found throughout Indigenous education can help deepen our understanding of Earth and space science. |

| **Overall Expectation(s):** |
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**A1.** apply scientific processes and an engineering design process in their investigations to develop a conceptual understanding of the science they are learning, and apply coding skills to model scientific concepts and relationships

**A2.** analyse how scientific concepts and processes can be applied in practical ways to address real-world issues and in various careers, and describe contributions to science from people with diverse lived experiences

**E1.** evaluate social, environmental, and economic impacts of space exploration and of technological innovations derived from space exploration

**E2.** demonstrate an understanding of the components, characteristics, and associated phenomena of the solar system and the universe, and the importance of the Sun to processes on Earth

| **Specific Expectation(s):** | |
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| **Interactive Visual Illustration of All Expectations + Clusters:** https://gitmind.com/app/docs/m3s26vem<br><br>**PDF Visual Illustration of All Expectations + Clusters:** https://drive.google.com/file/d/1AjBtjwhzJfxveyy-8N9NGUS7AjtWPiEq/view?usp=sharing | |
| **Cluster 1:** | *Our Place in Space* [A1.2], [E2.1], [E2.2], [E2.4], [E2.5], [E2.6] |
| **Cluster 2:** | *Beyond the Solar System* [A1.2], [E2.4], [E2.5], [E2.6] |
| **Cluster 3:** | *Space Research and Exploration* [A2.1], [A2.2], [A2.3], [A2.5], [E1.1], [E1.2], [E1.3] |

| **Unit Overview:** | | | | |
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| **Lesson #1:** Diagnostic Intro to Cluster 1 | **Lesson #2:** The Sun | **Lesson #3:** Sun's Role for Earth | **Lesson #4:** Solar System | **Lesson #5:** How the Earth, Moon, and Planets Move |
| **Lesson #6:** Investigating Astrological Phenomena | **Lesson #7:** Quiz /Silent Reading | **Lesson #8:** Culminating Task Introduction /Diagnostic Intro to Cluster 2 | **Lesson #9:** Measuring Distances in the Universe | **Lesson #10:** Stars: Characteristics and Life Cycle |
| **Lesson #11:** Brightness of Stars Investigation | **Lesson #12:** The Broader Universe | **Lesson #13:** Quiz /Silent Reading | **Lesson #14:** Diagnostic Intro to Cluster 3 /Marginalized Scientific Members | **Lesson #15:** Challenges, Benefits, and the Future of Space Exploration |
| **Lesson #16:** Space Tools | **Lesson #17:** STSE Focus | **Lesson #18:** Culminating Unit Task | ***For Lesson Plans:*** Assessment for learning = AFL Assessment as learning = AAL Assessment of learning = AOL | |

**Culminating Task:**

- Students will have to design their own human-colonized civilization on a different planet based on the unit's content.
    - They are welcome to demonstrate their work through various mediums. These can include but are not limited to fake blog posts or journal entries, creation software of the world such as Minecraft, slideshow presentations, physical models, video explanations, etc. A variety of options follows Universal Design for Learning (UDL) and accommodate the different needs of a diverse group of students.
- Students will have to consider five main aspects:
    - **Planetary Basics:** The defining characteristics of the planet and how these would impact the colony (e.g. climate, size, gravity, distance from Sun)
    - **STSE Focus:** Social, economic, political, and environmental ramifications of colonization (e.g. socioeconomic considerations of marginalized groups, preventing climate change issues similar to Earth, sustainable practices or renewable energy technologies that can be applied to the new colony)
    - **Broader Universe Considerations:** How other celestial bodies and other universe factors impact the new colony (e.g. distance from the Sun? Other planets? The Sun's energy and its role in supporting life, renewable energy, and natural phenomena? Other astrological phenomena?)
    - **STEM Focus:** STEM skills associated with interplanetary space travel (e.g. artificial intelligence, renewable energy sources, satellites)
    - **Marginalized Contributions:** Identify contributions made to science by people from different scientific communities that made this colonization process possible, with an emphasis on marginalized members of the community (e.g. scientists, astronauts, engineers)

**Link to Culminating Task Handout and Rubric can be found at the bottom of the document**

**First Nations, Metis, Inuit (FNMI) Connections Across the Unit:**

**Lesson 2:**

- Indigenous communities have a strong relationship with both the Sun and the aurora borealis. Students can research these relationships and share in a Snowball activity.
- Sun
    - Inuit groups consider that the Sun and Moon are siblings Malina (sun goddess) and Anningan (Moon god), who constantly quarrel with one another. Their quarrel explains many astrological phenomena: because Anningan is in constant pursuit of Malina, he does not eat and becomes thinner and thinner, explaining the waning phase of the Moon. The Inuit believe that Anningan is feeding when the Moon disappears, with the search recontinuing during the Moon's waxing period. A solar eclipse is believed to be when Anningan is finally able to catch up to his sister Malina. First Nations perform an important religious ceremony where their basic beliefs about the universe are reaffirmed through a Sun Dance. Here, a dance is enacted with a central pole that symbolizes a connection with the divine, which is embodied as the sun.
- Aurora borealis
    - Cree legends call this phenomenom the "dance of the spirits", where the figures are spirits of the dead who remain in the sky and try to communicate with loved ones on Earth. Nakoda Cree Saulteaux communities teach their children not to whistle or disturb the sacred lights, as they represent timeless energy of when their ancestors lived on the land. Inuvialuit legends also say that they can see reflections of those once living that play soccer with a walrus skull
- Information obtained from:
    - The Inuit Moon and Sun Gods - Top 10 Sun Myths - TIME
    - Legends of the Aurora | Spectacular Northwest Territories.
    - 'Those are our ancestors in the sky:' Sacred beliefs about the Northern Lights | CTV News

- Sun Dance | religious ceremony | Britannica

**Lesson 6 and 12:**

- Wilfred Buck is a Cree science educator at the Manitoba First Nations Education Resource Centre who is known for his deep knowledge concerning First Nations astronomy.
- In Lesson 6, students will be introduced to Wilfred Buck's lecture videos on YouTube that demonstrate various constellations and their ties to Indigenous culture.
- In Lesson 12, students will be introduced to a video by Wilfred Buck where he discusses many broader universe phenomena and how these have Indigenous connections.

**Lesson 14:**

- Class can be introduced to Indigenous American members of the space exploration scientific community:
  - Mary G. Ross: first Indigenous American engineer that worked on the Apollo program, interplanetary space probes, and the Polaris re-entry vehicle
  - John Herrington: first Indigenous American astronaut to travel into space.
- Information obtained from:
  - 7 Indigenous People in STEM You Should Know - Westcoast Women in Engineering, Science and Technology - Simon Fraser University
  - John Herrington | International Indigenous Speakers Bureau

**Lesson 17:**

- Students will learn the concept of "interconnectedness" in First Nations, Inuit, and Metis worldviews. This belief states that everyone and everything in the universe is connected. As such, the environment must be respected and cared for, with humans acting as stewards of the Earth. Interconnectedness promotes sustainability and ecological awareness and knowledge.
- Information obtained from:

- https://firstnationspedagogy.ca/interconnect.html

**Key Topics to Keep in Mind for the Final Culminating Task:**

- Land consideration
  - Humans colonizing another planet resembles the colonists of Canada.
  - Keeping Indigenous perspectives in mind, the new colonized land must be respected and cared for. The tattered history of the Indigenous peoples of Canada reflects this notion.
  - Identify that a new colony entails that we all foreign to the planet and we can share and embrace this similarity to create peace and harmony among everyone.
- Marginalization of Indigenous peoples
  - Discuss that Indigenous communities should not be discriminated against while colonizing the new planet (attempting to circumvent the historical and ongoing colonization process in Canada).
  - Provide opportunities for Indigenous scientists, engineers, and organizational bodies to contribute to the process of colonization.
- Interconnectedness: Environmental stewardship practices of Indigenous communities
  - Incorporate these frameworks, ideas, and practices throughout the new colony to exist in harmony with the new planet's natural environment.

**IMPORTANT: Throughout the unit, aim for a sense of cultural *appreciation*, as opposed to cultural *appropriation*.**

**Areas of Integration Across the Unit:**

**English:**

- Reading various sections of Ray Bradbury's *The Martian Chronicles* (1950), a ground-breaking science fiction novel that predicted interplanetary travel and Mars colonization. The novel's main themes center around human civilization rapidly colonizing Mars and eventually depleting its resources, causing severe consequences to both the planet and humanity itself. These themes have direct connections with the unit's material and the culminating task.
- Bradbury also published many other short stories concerning interplanetary travel on other planets, such as *The Long Rain* and *Frost and Fire* set on Venus and Mercury, respectively. In both stories, the planets' various phenomena are discussed (radiation, gravity, climate, etc). These will be discussed to demonstrate differences among planets.
- Bradbury's other short stories like *The Rocket*, *The Other Foot*, *Way in the Middle of the Air*, and *The Taxpayer* also detail issues regarding marginalized groups that cannot participate in space travel due to low socioeconomic status and belonging to groups of ethnic minorities.

**Math:**

- Mathematical principles can have many ties to the culminating task of designing a colony on a different planet (e.g. distance from the Sun and other planets, angles and trigonometry to determine orbital patterns, etc.)

**Science, technology, society, and environment (STSE) education:**

- An integral component of the culminating task is having students consider ways in which they can help reduce the human impact on the environment of their new colonized planet using science and technology concepts. These include, but are not limited to, renewable energy technologies, mitigating exhausting the planet's resources, preventing climate change, to name a few.

- STSE also allows students to connect the science they are learning and their everyday lives. In the context of the culminating task, students can apply science concepts to their everyday lives on a new planet. Students are encouraged to realize the potential consequences that their scientific and technological advancements can have on social, economic, political, and environmental contexts.

**Safety Guidelines:**

**Students with Physical Needs:**

- Consistently modify group activities and physical demonstrations to best accommodate the student(s).

**Lesson 4:**

- In this lesson, the class will attempt to build a model of the Solar System, requiring a large open space such as a football field, local park, or school lawn to complete the activity. Therefore, caution must be exercised when transporting students to an off-site location. Strict supervision must also be implemented to ensure student safety in an external environment to the school (e.g. one that could be open to the public, one that is in close proximity to public roads, etc.).
- Before taking students off-site, educators should ensure the following:
    - An appropriate safety plan is in place for emergencies
    - There are enough adult supervisors present based on the group's size
    - A first aid kit is readily available
    - The office has been informed of the departure, arrival, and return times, as well as the trip location

**Lesson 11:**

- In this lesson, the class is assigned with the activity of manipulating LED lights to demonstrate how a star's distance affects its brightness from Earth. As LED lights can be quite bright, students are advised to avoid prolonged direct eye-contact and refrain from shining the lights into the eyes of others, ensuring that the activity proceeds successfully and safely.

**Learning Goals – By the end of this unit, I will grasp and understand…**

- The major components of the Universe and their characteristics
- The Sun's role in the Universe and in sustaining life on Earth
- How to quantify distances throughout the Universe and the Solar System
- Scientific investigation processes and skills that help explain astrological phenomena
- The value of Indigenous perspectives in explaining Earth and space science
- The role that space exploration has throughout social, economic, environmental, and political contexts
- How various communities within STEM-related occupations, the skilled trades, and marginalized groups have contributed to technological advancements in space exploration and on Earth
- STSE and STEM connections throughout space exploration

**Success Criteria – By the end of this unit, I will be successful when I can…**

- Identify the Universe's main components and explain how their characteristics contribute to astrological processes
- Articulate the Sun's purpose throughout the Universe, the Solar System, and Earth
- Accurately quantify distances in the Universe and Solar System by using appropriate and relative units of measurement

- Apply reliable scientific investigation processes and skills to draw connections between observations and scientific concepts
- Relate scientific phenomena in Earth and space science to concepts found within Indigenous education
- Address the social, economic, environmental, and political consequences that space exploration can have
- Incorporate the perspectives of various communities within STEM-related occupations, the skilled trades, and marginalized groups into multiple scientific contexts
- Create, using STSE and STEM connections, various technologies that could aid planetary colonization efforts

| **Lesson #1: Diagnostic Intro to Cluster 1 [E2.4]** | **75 minutes** |
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| **Learning Goals:**<br>● Basic introduction of Earth and space science<br>● Implications of space exploration<br>**Success Criteria:**<br>● Defend your position in the Barometer activity<br>● Accurately reflect on the Cassini Equinox Mission and your own learning | **Materials:**<br>● Computer & projector<br>● Chart paper (Word Wall)<br>● Encounter With Titan<br>● Google Doc and Google Form<br>**Environment:**<br>● Classroom |

- **Minds-On (~15 min):** The diagnostic lesson will activate prior knowledge and begin by having students participate in a Barometer activity (students move to one side of the room depending on whether they agree or disagree with certain statements). They will be asked:
    - There is evidence of scientists observing life on other planets
    - There are many planets in our Solar System that have moons
    - Canada is currently one of the world leaders in satellite technology
    - Stars and constellations are useful for navigation purposes and can map the night sky
    - From Earth, the same side of the Moon is always visible
    - Storms that occur on the surface of the Sun affect Earth
- A class discussion will follow each statement where students defend their positioning in the room. Anecdotal observation notes can be recorded here as to where the class's level of understanding currently stands.

- **Activity (~50 min):** The class will be introduced to this unit's Word Wall. Key terms will be added here throughout the unit. Through direct instruction, students will learn key concepts that establish a foundation for the unit.
- Next, students in groups of 3-4 will have to briefly discuss and prepare a Google Doc concerning a topic the teacher gave. Students must read about the Cassini Equinox Mission (see Google Doc) and answer questions. They will collaborate on their ideas here.
- Teacher will circulate and provide formative feedback throughout the activity.

- **Consolidation (~10 min):** 3-2-1 Questioning Method using an exit ticket in Google Forms as a form of self-assessment. The students will be asked:
    - What are *three* things you learned today?
    - What are *two* things you still don't understand?
    - What is *one* thing you with to learn more about?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● 3-2-1 Questioning<br>● Barometer activity<br>● Exit ticket<br>● Word Wall | ● Anecdotal observation notes<br>● Diagnostic assessment (AFL)<br>● Formative feedback<br>● Self-assessment (AAL) |

| **Lesson #2: The Sun [E2.1] [E2.2]** | **75 minutes** |
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| **Learning Goals:**<br>● Key properties of the Sun<br>● FNMI connections to Earth and space science<br>**Success Criteria:**<br>● Research and explore various FNMI connections<br>● Reflect on your learning individually and with peers | **Materials:**<br>● Computer & projector<br>● Chart paper (Word Wall)<br>● Google Doc<br>● KWL Chart<br>**Environment:**<br>● Classroom |

- **Minds-On (~10 min):** The students will fill in the first two columns of a KWL Chart (What I **Know**, What I **Want** to Know) on a Google Doc regarding the topic "The Sun". Afterwards, a class discussion can follow based on their responses.

- **Activity (~55 min):** Through direct instruction, students will learn key concepts about the Sun (the structure of the Sun diagram will be a primary focus). Key words will be added to the Word Wall.
- The class will then participate in an activity where they must research FNMI connections to the Sun and the aurora borealis. They will compile their research in a Google Doc. Their research will focus on:
    - What significance does the Sun and aurora borealis have on Indigenous communities in Canada?
    - What can we learn from the relationship between Indigenous communities and these features of the universe?
- Through a Snowball activity, students must share their findings with a partner. Then, this pair will have to join another pair and discuss. This group of four will join another group of four, repeating the process until the entire class is involved in the discussion.
- Teacher will circulate the class and provide formative feedback through effective questioning. Anecdotal observation notes will be recorded to assess learning skills.

- **Consolidation (~10 min):** the students will finish their KWL Charts by filling in the third column "What I **Learned**". They are to find a partner and share what they learned.

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● KWL Chart<br>● Snowball activity<br>● Word Wall | ● Anecdotal observation notes<br>● Formative feedback |

| **Lesson #3: Sun's Role for Earth [E2.4] [E2.1][E2.2]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● The impact of Earth's position from the Sun<br>● Key concepts involving the Sun's implications for life on Earth<br>**Success Criteria:**<br>● Summarize the Sun's impact on Earth using key concepts<br>● Consolidate how the Sun can negatively and positively benefit Earth | **Materials:**<br>● Two pieces of paper<br>● Whiteboard & magnets<br>● Wix website (Learning centres)<br>● Google slideshow<br>● Google Form<br>**Environment:**<br>● Classroom |

- **Minds-On (~7.5 min):** Students will be provided with a demonstration regarding Earth's placement in the Solar System. Two pieces of paper will be posted on the Whiteboard with magnets that illustrate the Sun and the Earth. Teacher will move the Earth closer and farther from the Sun and ask prompting questions (e.g. what would happen if the Earth moved too close to the sun? What would happen if the Earth was too far from the Sun? What makes Earth's placement so special, especially for us? What does the orbit look like?). Students will Think-Pair-Share after each question and a class discussion can ensue.

- **Activity (~60 min):** The students will circulate through six different learning centres using a Wix website complete with website links. They will create a Google slideshow summarizing each centre (six slides). The learning centres topics include:
  - Climate change
  - Life on Earth
  - Solar panels
  - Solar radiation
  - Solar panels
  - Sunspots, solar flares and prominences
- Students will have 10 minutes per station (6 stations x 10 minutes per station = 60 minutes). Teacher will circulate and provide formative feedback.
- Key words will be added to the Word Wall

- **Consolidation (~7.5 min):** Students will have to complete an exit ticket on Google Forms:
  - Name two advantages of the Sun for Earth
  - Name two disadvantages of the Sun for Earth
  - Name a solution that could help prevent or mitigate one of these disadvantages

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● Exit ticket<br>● Learning centres<br>● Think-Pair-Share | ● Formative feedback<br>● Exit ticket (AFL) |

| | |
|---|---|
| • Word Wall | |

| **Lesson #4: Solar System [A1.2] [E2.4] [E2.1] [E2.5]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>• The basics of the Solar System<br>• The relative distances of planets throughout the Solar System<br>**Success Criteria:**<br>• Calculate and measure planetary distances throughout a physical demonstration<br>• Identify implications of your given planet's position in the Solar System | **Materials:**<br>• Computer & projector<br>• Solar System 101 \| National Geographic<br>• 100m measuring tape<br>• Pictures of objects in Solar System<br>• Planetary Distances from the Sun.docx<br>• Chart paper (Word Wall)<br>• Google Doc<br>**Environment:**<br>• Classroom<br>• Large open space |

- **Minds-On (~10 min):** the students will watch a National Geographic video titled *Solar System 101*. They will then Think-Pair-Share with a partner about what they think is the most interesting part of the video. A class discussion can follow.

- **Activity (~60 min):** the students will be introduced to the Solar System at a closer look through direct instruction. They will be taught about the planets themselves, what an astronomical unit (AU) is, along with other smaller members of the Solar System.
- In groups of 2-3, the class will attempt to build a model of the Solar System outside (on a football field, local park, front lawn, etc). Each group will receive a 100m tape measure and pictures of objects within the Solar System.
- Taking into consideration the Solar System's radius (50 AU), 2 metres will be represent 1 AU (therefore, 100m = 50 AU). Beforehand, students will have to fill in the rest of a table (see Google Doc) that outlines the Planetary Distances from the Sun using this conversion method of 2 metres equalling 50 AU.
- Depending on which object the student groups receive, they will have to place themselves in the Solar System outside.
- Formative feedback during the table completion activity as well as the activity outside will be enacted. While outside, effective questioning will be used to draw responses from students concerning the nature of the Solar System.

- **Consolidation (~5 min):** Key words will be added to the Word wall.
- In their groups, students will have to record in a Google Doc for an assessment of learning activity:
    - What was your object?
    - What implications might your distance from the sun have on your objects?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| • Physical demo<br>• Think-Pair-Share<br>• Word Wall | • Formative feedback<br>• Google doc (AFL) |

| Lesson #5: How the Earth, Moon, and Planets Move [E2.4] [E2.1] [E2.5] | 75 minutes |
|---|---|
| **Learning Goals:**<br>● How the Earth, Moon, and planets move in our Solar System<br>● The Moon's phases, eclipses, and relations to tides<br>**Success Criteria:**<br>● Interpret how different variables affect certain astral bodies in simulations<br>● Consolidate your learning both individually and with others | **Materials:**<br>● Computer & projector<br>● Rotation and Revolution of Earth \| Educational Video for Kids<br>● PhET simulations: Gravity and Orbits My Solar System<br>● Google Doc<br>● Chart paper (Word Wall)<br>● Kahoot quiz<br>**Environment:**<br>● Classroom |

- **Minds-On (~10 min):** To activate prior knowledge, students will use a Google Jamboard to explain everything they know about the following topics:
    - What is an orbit?
    - How does gravity affect the Earth's rotation around the Sun?
    - What does "Phases of the Moon" mean?

- **Activity (Parts 1 and 2) (~55 min):**
- **Part 1:** Students will watch the video by Happy Learning English that demonstrates the rotation and revolution of the Earth.
- Through direct instruction, teacher will provide students with concepts concerning the motions of Earth, planets, and the Moon in space.
- Through a Predict-Observe-Explain activity on a Google Doc, students will be provided with several different scenarios based on the *Gravity and Orbits* and *My Solar Systems* PhET simulations. They will have to predict how certain astral bodies will behave when certain variables are changed in each simulation, record their observations, and explain why these occurred. A class discussion can follow each scenario.
- **Part 2:** Next, students will be introduced to concepts surrounding the Moon in a deeper examination. Half the class will be divided into two groups with the following prompts:
    - What are: (1) The phases of the Moon (2) Eclipses
    - How do tides work in regards to the Moon?
- Then, through a Jigsaw activity, groups of 3-4 in each prompt must research the prompts and become "experts". Each group will pair with another group of a different topic and teach them the content.
- Formative feedback will be provided throughout the activity. Anecdotal observation notes will be taken to assess whether students are understanding the content in the unit thus far. Key words will be added to the Word Wall

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- **Consolidation (~10 min):** A series of multiple choice questions through Kahoot as a class. A class discussion will follow each question. The multiple choice questions will be:
    - How long does it take for Earth to rotate around its own axis? Around the Sun?
    - What is gravity's role in the Solar System?
    - What is the most accurate description of why seasons occur?
    - What are the proper definitions of a solar and lunar eclipse?
    - How are the tides caused by the Sun and the Moon?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● Brainstorm<br>● Jigsaw activity<br>● Kahoot quiz<br>● Predict-Observe-Explain<br>● Word Wall | ● Anecdotal observation notes<br>● Formative feedback<br>● Google Jamboard (AFL) |

| **Lesson #6: Investigating Astrological Phenomena [E2.4] [E2.1] [E2.6]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● The structure and FMNI connections of constellations<br>● Key astrological phenomena in space<br>**Success Criteria:**<br>● Complete constellation drawings and analyze the Wilfred Buck videos<br>● Research, compile, and present astrological phenomena mind maps | **Materials:**<br>● Fill-in-the-blank drawings of constellations<br>● GitMind website<br>● Chart paper (Word Wall)<br>● Wilfred Buck constellation videos:<br>Atima Atchakosuk: The Dog Stars by Wilfred Buck<br>Makinak: The Turtle by Wilfred Buck<br>Sisikwun: The Rattle by Wilfred Buck<br>**Environment:**<br>● Classroom |

- **Minds-On (~25 min):** The students, using a blank paper with various dots on it, are to fill in the various constellations using a picture as reference. They must then identify which constellation it is. These will be taken up as a class and discussed. Students can keep these for future reference.
- Students will also be introduced to Wilfred Buck's lecture videos on YouTube; specifically, his constellation videos that connect to Indigenous culture.

- **Activity (~35 min):** Students will be told that there are many other astronomical phenomena that we are able to observe and investigate in space. They will conduct investigations in groups of 3-4 that will help explain the causes of certain astrological phenomena. These will include:
  - The ecliptic
  - The aurora borealis
  - Retrograde motion
  - Azimuth and altitude
  - Eclipses
  - Earth's magnetic field
- They are to create Mind Maps using GitMind that address the following sub-topics through a 5Ws + 1H exercise:
  - Who is impacted by the phenomenon?
  - What causes the phenomenon?
  - Where does the phenomenon occur?
  - Why is the phenomenon important?
  - When does the phenomenon occur?
  - How does the phenomenon work?
- Groups will have to select another group's work to briefly peer review. They will use the Two Stars and One Wish method.
- Teacher will circulate and record anecdotal observation notes, comparing collaborative efforts to previous collaboration among students. Formative feedback will also be provided.

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- **Consolidation (~10 min):** The mind maps will be presented to the class so that everyone can learn the content regarding astrological phenomena. Questions from the class are encouraged. Key terms will be added to the Word Wall.

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**Teaching Strategies:**

- 5Ws + 1H
- Fill-In-The-Blank
- Mind maps
- Two Stars One Wish
- Word Wall

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**Assessment:**

- Anecdotal observation notes
- Formative feedback
- Peer review (AAL)

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| Lesson #7: Quiz/Silent Reading [E2.4] [E2.1] [E2.2] [E2.5] [E2.6]– 75 minutes | |
|---|---|
| **Learning Goals:**<br>● The material discussed thus far in the unit<br>● Characteristics of different planetary environments<br>**Success Criteria:**<br>● Sufficiently answer questions within the quiz<br>● Summarize your findings within the short stories that deal with various characteristics of planets | **Materials:**<br>● Quiz<br>● Ray Bradbury short stories<br>● Google Doc<br>**Environment:**<br>● Classroom |
| ● **Minds-On (~5 min):** Last minute questions can be addressed before the quiz.<br>● **Activity (~50 min):** Students will have 30 minutes to complete the quiz based on everything covered so far (Cluster 1).<br>● Once students finish the quiz, they are to silently read through the short stories *The Long Rain* and half of *Frost and Fire* by Ray Bradbury, which take place on Venus and Mercury, respectively. They are to take note of various phenomena that present themselves in each story (e.g. radiation, gravity, climate) in a Google Doc.<br>● **Consolidation (~20 min):** The students are to Think-Pair-Share about their notes taken during the reading. Class discussion regarding the phenomena that occurred on each planet and why these might have occurred will follow.<br>● **Note:** critically analyzing the effects of these phenomena on various planets is important for the culminating task. They will have to take similar considerations into account (the different phenomena) based on the planet they choose to colonize on. This activity feeds into the next lesson well, where students are introduced to the culminating task. | |
| **Teaching Strategies:**<br>● Note-taking<br>● Silent Reading<br>● Think-Pair-Share | **Assessment:**<br>● Quiz (AOL) |

| **Lesson #8: Culminating Task Introduction/Diagnostic Intro to Cluster 2 [E2.4]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● Basic concepts of aspects beyond our solar system<br>● The components of the Culminating Task<br>**Success Criteria:**<br>● Defend your position in the Barometer activity<br>● Begin planning your topic regarding the Culminating Task<br>● Reflect on your learning thus far | **Materials:**<br>● Culminating Task handout<br>● Google Form<br>**Environment:**<br>● Classroom |

- **Minds-On (~15 min):** Similar to the introduction of Cluster 1 topics, students will participate in a Barometer activity to introduce Cluster 2 based on the following prompts:
    - The only difference between stars is their size and distance from Earth
    - The Big Bang can explain how the Universe started
    - Spacecraft that orbits Earth can observe objects that are billions of km away
    - Scientists have the ability to detect everything in the Universe
    - Every galaxy in the Universe are similar to the Milky Way
    - Telescopes can let astronomers view every celestial object in the Universe
- A class discussion will follow the statements where students will defend their positioning in the room. Anecdotal observation notes can be recorded here to document the class's level of understanding of the new topic.

- **Activity (~50 min):** The students have thus far been learning mostly knowledge and understanding type concepts, with some focus on thinking about, communicating, and applying the content. To expand on this current foundation (now that the quiz is completed), students will be introduced through direct instruction to the culminating task: choosing a different planet to form a new human colonization on. They will be told to start thinking about and researching what planet they will choose based on the five aspects that must be considered in the assignment (see above in **Culminating Task** section) and will record their choice next class.

- **Consolidation (~10 min):** students will complete an exit ticket in Google Forms that poses as a self-assessment. They will be asked:
    - How confident are you with this unit after completing the quiz? Why?
    - Are there any topics that you are still unclear with?
    - What next steps can you take to help improve this?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● Barometer activity<br>● Direct instruction | ● Anecdotal observation notes<br>● Diagnostic assessment (AFL)<br>● Exit ticket (AAL) |

## Lesson #9: Measuring Distances in the Universe [E2.5] — 75 minutes

**Learning Goals:**
- Light years and how they are applied in space
- How the concept of parallax demonstrates a visual representation of space

**Success Criteria:**
- Calculate distances in light years and light seconds
- Explore the parallax phenomena through a demonstration

**Materials:**
- Light year & Milky Way - NASA Video
- Whiteboards
- Globe
- Chart paper (Word Wall)
- Google Form

**Environment:**
- Classroom

- **Minds-On (~10 min):** Through Google Forms, students will sign up for a planet for their culminating task. These will be approved by the teacher later.
- Students will watch the NASA video demonstrating distances within space using light years. Through a Think-Pair-Share, students will be asked what they found most interesting about the video. A class discussion can ensue.

- **Activity (~45 min):** through direct instruction, teacher will expand on the term light year. Teacher will also provide examples of how to calculate distances in the Universe.
- Through a series of sample problems, students will calculate the distance to different objects in the Universe in light years and convert light years to light seconds. They will do this using whiteboards in pairs and must show their work.
- Teacher will provide formative feedback during the activity.
- After the first activity, students will be introduced to parallax. Students will be told to look at a globe in the middle of the room provided by the teacher and perform the thumb activity (students hold their thumb out towards an object. Their thumbs move around the object according to which eye they close). This demonstrates parallax. They will be asked what they are noticing during the activity. They will be introduced to illustrations in space that display the parallax phenomenon well.

- **Consolidation (~20 min):** Key terms will be added to the Word Wall. An exit ticket in Google Forms will be completed for assessment of learning that asks students:
  - Which of the following is NOT correct regarding light years:
  - Convert the following to light years and convert the following to light seconds:
  - Why did we perform the thumb activity? Explain. What measurement is a parallax measured in?

**Teaching Strategies:**
- Exit ticket
- Think-Pair-Share
- Whiteboard learning
- Word Wall

**Assessment:**
- Exit ticket (AOL)
- Formative feedback

## Lesson #10: Stars: Characteristics and Life Cycle [E2.4] [E2.1] — 75 minutes

**Learning Goals:**
- Various stars and their characteristics, similarities, and differences
- The life cycle of stars

**Success Criteria:**
- Analyze stars and life cycles through a variety of investigative methods
- Apply your learning to correctly answer questions in a Kahoot quiz

**Materials:**
- Computer & projector
- Physical dice or dice outlines online
- Google Doc
- Kahoot Quiz

**Environment:**
- Classroom

- **Minds-On (~10 min):** The students will be shown a series of photos that include the Sun, Vega, Spica, and Antares. They will be asked in a Think-Pair-Share:
  - What do the following have in common?
- The main answer to elicit is that they are all stars. However, this activity also allows for many other answers that may help students learn the content. A class discussion can follow.

- **Activity (~50 min):** Through direct instruction, students will learn about 12 characteristics and life cycle factors of stars: luminosity, apparent and absolute magnitude, solar masses, nebulas, protostars, main sequences, red giants, red supergiants, white dwarfs, supernova, neutron star, black holes.
- Through a Cubing activity, students will have to investigate these different characteristics and life cycles of stars. Students will be assigned to groups of 3-4. They will have to collaborate on their work in a shared Google Doc. The six sides of one die will contain the following prompts:
  - Describe it
  - Compare it
  - Associate it
  - Analyze it
  - Apply it
  - Argue for or against its importance
- Another die will contain 2 of the 12 topics on each side. Students can choose which they want to discuss and must discuss both if they are eventually rolled.
- Teacher will circulate and provide formative feedback and effective questioning.

- **Consolidation (~15 min):** Key terms will be added to a Word Wall. A Kahoot quiz will consolidate the material discussed by quizzing all of the 12 terms.

**Teaching Strategies:**
- Brainstorm
- Cubing activity
- Think-Pair-Share

**Assessment:**
- Formative feedback

| | |
|---|---|
| • Word Wall | |

| **Lesson #11: Brightness of Stars Investigation [A1.2] [E2.6]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>• Different brightness's of stars in space<br>• How the brightness of stars changes based on distance<br>**Success Criteria:**<br>• Investigate brightness factors through a physical activity<br>• Review your learning both individually and with peers | **Materials:**<br>• Computer & projector<br>• Google Jamboard<br>• Gathering Light: Hubble Ultra Deep Field<br>• Metre sticks, LED lights, & masking tape<br>• Google Doc<br>• Google Form<br>**Environment:**<br>• Classroom |
| • **Minds-On (~10 min):** Based on the previous lesson, students will contribute to a Google Jamboard any star characteristics they can think of. This will be a diagnostic assessment for learning for the investigation today. A class discussion can follow.<br><br>• **Activity (~50 min):** Using the Hubble telescope simulation, students will be walked through different brightness's of stars. They will be asked what they observe at each time mark.<br>• The students will have to investigate different factors that affect the brightness of stars. Students, in groups of 3-4, will receive a metre stick, two LEDs that display different amounts of light and masking tape. The students must develop a hypothesis based on:<br>  ○ How does a star's distance affect its brightness from Earth?<br>• Students must consider how to design an experiment that allows both LEDs to have the same brightness. They will record everything on a Google Doc.<br>• Brightness of stars within the Universe is a prudent consideration for the culminating task: these factors will set the tone for many phenomena that occur on the student's planet (distance from Sun, constellations, other astrological phenomena, etc)<br>• Teacher will circulate and provide formative feedback and record anecdotal observation notes as to how the students are performing in an investigation.<br><br>• **Consolidation (~15 min):** Students will perform a Gallery Walk throughout the other groups' investigation set ups, comparing and contrasting their experimental design.<br>• In an exit ticket through Google forms, students must indicate one similarity and one difference. In the difference category, they must explain how this difference may have improved or worsened their experimental design. | |
| **Teaching Strategies:**<br>• Brainstorm<br>• Compare and Contrast<br>• Exit ticket<br>• Gallery Walk | **Assessment:**<br>• Anecdotal observation notes<br>• Diagnostic assessment (AFL)<br>• Formative feedback |

| | |
|---|---|
| • Investigation activity | |

| **Lesson #12: The Broader Universe [E2.4]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>• Consider the broader universe and its multiple components<br>• Connections of astrology to Indigenous culture<br>**Success Criteria:**<br>• Define, categorize, compare, and contrast different components of the universe<br>• Synthesize any main takeaways from the Wilfred Buck videos | **Materials:**<br>• Computer & projector<br>• Lessons From Beyond with Wilfred Buck (grades 9 -12) AM session<br>• Google Form<br>**Environment:**<br>• Classroom |

- **Minds-On (~15 min):** To begin the lesson on considering the broader Universe, students will watch segments of a video by Wilfred Buck, a Cree knowledge keeper known for his deep understanding of astrology and its connections to Indigenous culture. Students will watch *The Winter Keeper*, *Cree Star Map*, and the *Milky Way* segments (outlined in the video). Through a Think-Pair-Share, students will discuss the main takeaways from the video. A class discussion can follow.

- **Activity (~45 min):** Through direct instruction, students will learn about the broader universe and its components: star clusters, the four different galaxy types (elliptical, spiral, lenticular, and irregular), quasars, and the Milky Way Galaxy.
- Through a Four Corners activity, students must choose a corner of the room to answer prompts posed by the teacher. To make more room in the class, choose individual rows at a time to participate. They will be shown various photos of different galaxies and must go to the corner of the room based on which type of galaxy they think it is.
- Through another Four Corners activity, students must choose a corner of the room based on the definitions of each of the four galaxies being described.
- While at each corner, students must justify their choice. Anecdotal observation notes can be recorded to assess student understanding.

- **Consolidation (~15 min):** Students must complete an exit ticket in Google Forms for assessment of learning with the following questions:
    - What is a star cluster? How are open star clusters different than globular star clusters?
    - Categorize each of these various galaxy shapes into the four types.
- How are the Milky Way Galaxy and a quasar similar? Different?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| • Four Corners activity<br>• Think-Pair-Share | • Anecdotal observation notes<br>• Exit ticket (AOL) |

| | |
|---|---|

| **Lesson #13: Quiz/Silent Reading [E2.4], [E2.5], [E2.6]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● The material discussed since the last quiz<br>● Examples of different scenarios of discrimination<br>**Success Criteria:**<br>● Sufficiently answer questions within the quiz<br>● Summarize your findings within the short stories that deal with marginalized groups | **Materials:**<br>● Quiz<br>● Ray Bradbury short stories<br>● Google Doc<br>**Environment:**<br>● Classroom |

- **Minds-On (~5 min):** Last minute questions can be addressed before the quiz.

- **Activity (~50 min):** Students will have 30 minutes to complete the quiz based on everything recently covered (Cluster 2).

- When students finish their quiz, they must silently read through the short stories *Way in the Middle of the Air* and *The Rocket* by Ray Bradbury. They are to take note of various instances that present themselves in each story of discrimination towards marginalized groups in the process of space travel in a Google Doc.

- **Consolidation (~20 min):** The students are to Think-Pair-Share about their individual notes taken while reading these short stories. Class discussion regarding the topics of marginalization that occurred will be discussed.

- **Note:** critically analyzing the instances of discrimination towards members of a lower socioeconomic status and an ethnic minority are crucial for their culminating task: the assignment requires students to keep these instances in mind and how to prevent these occurrences while colonizing a new planet.

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● Note taking<br>● Silent reading<br>● Think-Pair-Share | ● Quiz (AOL) |

**Lesson #14: Diagnostic Intro to Cluster 3/Marginalized Scientific Members [A2.5] [E1.2] [E1.3] [E1.1]** **75 minutes**

**Learning Goals:**

- Various marginalized members of the scientific and space exploration community

**Success Criteria:**

- Defend your position in the Barometer activity
- Reflect on your learning individually and with peers

**Materials:**

- Computer & projector
- Google Form

**Environment:**

- Classroom

- **Minds-On (~15 min):** similar to the introduction of Cluster 1 and 2 topics, students will participate in a Barometer activity to introduce Cluster 3 based on the following:
  - Sending human astronauts into space is crucial for research and discovery
  - All celestial objects are viewable from Earth in a telescope
  - International cooperation and understanding is encouraged by space exploration
  - Investing billions into robots for Mars exploration is worth it
  - Technology developed to explore space has practical uses on Earth
- A class discussion will follow the statements where students will defend their positioning in the room based on the prompts. Anecdotal observation notes can be recorded here to document the class's level of understanding of the new topic.
- **Activity (~50 min):** Through direct instruction, space exploration will be introduced to students. They will be introduced to four marginalized members within the scientific community that helped pave the way for space exploration:
  - Mary G. Ross (first Indigenous American woman engineer)
  - Julie Payette (engineer and former astronaut)
  - John Herrington (first Indigenous American astronaut to travel into space)
  - Mae Carol Jemison (first black woman astronaut to travel into space)
- In pairs, students are to research a member of the scientific community that has contributed to space exploration. In a Jigsaw activity, these students must pair with another pair and teach them about their members. They must rotate throughout the class and choose another pair three times.
- **Consolidation (~10 min):** Through an exit ticket in Google Forms, students will be asked:
  - What most surprised you about your scientific member?
  - What was the most important insight you gained in today's lesson regarding marginalized groups in space exploration?
  - How will you ensure marginalized groups receive equal opportunity in your new space colony?

**Teaching Strategies:**

- Exit ticket
- Jigsaw activity

**Assessment:**

- Anecdotal observation notes
- Diagnostic assessment (AFL)
- Exit ticket (AAL)

## Lesson #15: Challenges, Benefits, and the Future of Space Exploration [A2.2] [E1.2] [E1.3] [E1.1] - 75 minutes

**Learning Goals:**

- Challenges, benefits, and the current future outlook of space exploration

**Success Criteria:**

- Investigate and summarize key factors that impact space exploration
- Consolidate your learning through self reflection

**Materials:**

- Could we survive prolonged space travel? - Lisa Nip
- Wix website
- Google Slides and Forms
- Chart paper (Word Wall)

**Environment:**

- Classroom

- **Minds-On (~7.5 min):** Students will watch the TED-Ed video about whether humans can survive prolonged periods within space. Students will be asked in a Think-Pair-Share:
  - What was one of the dangers of space travel discussed in the video?
- A class discussion can follow the activity.
- **Activity (~60 min):** Using learning centres, students will learn about the challenges, benefits, and future of space exploration. The students must circulate through six different learning centres using a Wix website with links attached. They will create a Google slideshow that summarizes each of the six centres (six slides). The learning centres topics include:
  - Fuel sources
  - Health risks
  - Space junk
  - Economic concerns
  - The space elevator
  - Space tourism

- Students will have around 10 minutes per station (6 stations x 10 minutes per station = 60 minutes). Teacher will circulate and provide formative feedback.

- **Note:** Allowing students to understand the challenges and dangers of space travel will guide their thinking when planning their new space colonies. They can plan for mitigative strategies to these dangers through technology or other mediums while building their colony. The benefits tie in well with the following lesson on space tools.

- **Consolidation (~7.5 min):** Key terms will be added to the Word Wall. Through an exit ticket, students will answer questions using the 3-2-1 Questioning method:
  - Name *three* dangers of space travel that could affect your new colony.
  - Name *two* challenges of space travel that could present themselves to your new colony on a different planet.
  - Name *one* potential benefit that building this colony would provide for humans on Earth.

| | |
|---|---|
| | ***Continued on the next page…*** |
| **Teaching Strategies:**<br>● 3-2-1 Questioning<br>● Exit ticket<br>● Learning centres<br>● Think-Pair-Share<br>● Word Wall | **Assessment:**<br>● Formative feedback |

| **Lesson #16: Space Tools [A2.1] [A2.2] [A2.3] [E1.1] [E1.2] [E1.3]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● Technological innovations made by NASA that we use in our daily lives<br>● Space technology viewed through an STSE lens<br>**Success Criteria:**<br>● Design your own space technology based on individual topics of your choice<br>● Review your design process in a self-assessment | **Materials:**<br>● Computer & projector<br>● Everything Science video: 13 NASA Inventions You Use Every Day<br>● Whiteboards<br>● Google Forms<br>**Environment:**<br>● Classroom |

- **Minds-On (~10 min):** To help prepare students to design their new colonization on a different planet, space technology and tools will be introduced. Students will watch an Everything Science YouTube video that demonstrates technological inventions by NASA that we as humans use every day.

- **Activity (~55 min):** Through direct instruction, students will be shown several different kinds of technology that have impacted humans socially, environmentally, and economically due to space exploration (e.g. RADARSAT, SCISAT, sphygmomanometers, oil exploration technology, consumer goods materials).
- In groups of 3-4, have students design space technology that could help astronauts and people solve issues in space and on Earth. These designs will be completed on whiteboards. These topics could range from:
    - Artificial intelligence
    - Robotic technology
    - Global positioning systems
    - Satellites
    - Healthcare
    - Renewable energy technology
- Teacher will circulate and provide formative feedback and record anecdotal observation notes to assess student STEM investigation skills.

- **Consolidation (~10 min):** Key terms will be added to Word Wall. In a self-assessment using the 3-2-1 Questioning method, students will complete an exit ticket through a Google Form that asks:
    - What are *three* things you contributed to the technology's design?
    - What are *two* things that could have gone better?
    - What is *one* thing you want to learn more about?

| **Teaching Strategies:** | **Assessment:** |
|---|---|
| ● 3-2-1 Questioning<br>● Exit ticket<br>● Whiteboard activity<br>● Word Wall | ● Anecdotal observation notes<br>● Formative feedback<br>● Self-assessment (AAL) |

| **Lesson #17: STSE Focus [A2.3] [E1.1]** | **75 minutes** |
|---|---|
| **Learning Goals:**<br>● The concept of Interconnectedness<br>● How STSE can relate to space exploration<br>**Success Criteria:**<br>● Determine key STSE aspects throughout a short story focused on space exploration<br>● Consider how STSE relates to your new colony | **Materials:**<br>● Computer & projector<br>● Google Jamboard<br>● Ray Bradbury short stories<br>● Google Forms<br>**Environment:**<br>● Classroom |
| ● **Minds-On (~10 min):** Using a Google Jamboard, students will be asked:<br>○ What do you think the term "Interconnectedness" means?<br>● A class discussion can follow the brainstorming activity. Students will be introduced to the concept of interconnectedness among First Nations, Inuit, and Metis communities: where everything in the universe is connected and people are responsible for being stewards of the environment.<br><br>● **Activity (~50 min):** Through direct instruction, students will be introduced to the concept of STSE (science, technology, society and environment education) and how this framework relates to the Indigenous perspective of interconnectedness.<br>● Next, there will be a class read-through of the chapter *And The Moon Be Still As Bright* from Ray Bradbury's novel *The Martian Chronicles*. This chapter is the most pivotal part of the book and sets the tone for the rest of the novel regarding human colonization on another planet and its grave consequences: socially, politically, and economically. The activity will pose as the final amalgamation of the unit's several Ray Bradbury short stories, with the story containing individual elements from all of the previous ones.<br>● Students will be told that the short story is a great representation of STSE concepts being applied to realistic contexts: especially in the lens of human colonization on another planet.<br>● Students will read the short story through a randomized Popcorn-style read-through, where any student can start and stop reading where they wish. Afterwards, through a Think-Pair-Share, students will be asked:<br>○ What was your main takeaway from this short story?<br>● Students will be given plenty of time to discuss their takeaway in the Think-Pair-Share thoroughly. A class discussion will follow the prompt.<br><br>● **Consolidation (~15 min):** Through an exit ticket in Google Forms, students will be asked:<br>○ From a social, environmental, or economical standpoint, what might be the most prominent issue we humans might face while trying to colonize a new planet?<br>○ What is environmental stewardship's role in interconnectedness and how could this impact your new colony?<br>○ Name one way you will consciously incorporate STSE thinking into your new colony. | |
| **Teaching Strategies:**<br>● Brainstorm<br>● Exit ticket<br>● Popcorn style class read-through | **Assessment:**<br>● Google Jamboard on "Interconnectedness" (AFL) |

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|---|---|
| ● Think-Pair-Share | |

| **Lesson #18: Culminating Unit Task [A2.1] [A2.2] [A2.3] [A2.5] [E1.1] [E1.2] [E1.3] [E2.1] [E2.2] [E2.4] [E2.5] [E2.6]** | **Indefinite Time** |
|---|---|
| **Learning Goals:**<br>● How to perform space exploration and colonization in a 21st century world by<br>**Success Criteria:**<br>● Combine inclusivity, ethics, sustainability, and a commitment to Indigenous education in your process<br>● Focus on the five key components:<br>○ Planetary Basics<br>○ STSE Focus<br>○ Broader Universe Considerations<br>○ STEM Focus<br>○ Marginalized Contributions | **Materials:**<br>● Computer & projector<br>● Culminating task handout<br>**Environment:**<br>● Classroom |
| ● Students will be told that they are to start working on their culminating task for the unit.<br><br>● Through direct instruction, students will be reminded of the assignment's description and the five main areas to focus on, which we have focused on extensively throughout the unit:<br>○ Planetary Basics<br>○ STSE Focus<br>○ Broader Universe Considerations<br>○ STEM Focus<br>○ Marginalized Contributions<br><br>● Conforming to UDL, students will be allowed to display their work through a variety of different mediums.<br><br>● Students will have the next few lessons to continue working on their projects. | |
| **Teaching Strategies:**<br>● Universal design for learning (UDL) | **Assessment:**<br>● Culminating unit task (AOL) |

| Potential Application of the Assessment Triangle Across the Unit (Optional) | | |
|---|---|---|
| **Observation** | **Conversation** | **Product** |
| **#1:** Anecdotal observation notes based on the class's current understanding of Earth and Space science topics.<br><br>**#2:** Anecdotal observation notes during Snowball activity that assesses student learning skills.<br><br>**#4:** Anecdotal observation notes to assess further learning skills for the unit's first physical demonstration activity.<br><br>**#5:** Anecdotal observation notes regarding whether students are understanding the content thus far in the unit.<br><br>**#6:** Anecdotal observation notes comparing the collaborative effort of students in the mind map activity compared to previous collaborative efforts among the class.<br><br>**#8:** Anecdotal observation notes concerning the Barometer activity and the class's current understanding for Cluster 2. | **#1:** Class discussion based on the Barometer activity.<br><br>**#2:** Class discussion that summarizes the class's findings.<br><br>**#3:** Class discussion during the initial Think-Pair-Share activity about Earth's placement in the Solar System to the Sun. Conversation during formative feedback in learning centres activity.<br><br>**#4:** Class discussion regarding the most interesting part of the National Geographic video. Effective questioning will draw responses and discussion from students during the Solar System outside activity.<br><br>**#5:** Class discussion during the Predict-Observe-Explain activity with simulations. Conversation with students during the Jigsaw activity while providing formative feedback. | **#1:** Collaborative Google Doc that contains answers to the Cassini Equinox Mission questions. Google Form that self-assesses students based on the new unit.<br><br>**#2:** KWL Chart that consolidates student learning based on the Sun. Google Doc based on the FMNI connections with the Sun and the aurora borealis.<br><br>**#3:** Google slideshow regarding the learning centre activity. Consolidation Google Forms exit ticket that concerns advantages and disadvantages of the Sun for Earth.<br><br>**#4:** Google Doc that consolidates the Solar System activity.<br><br>**#5:** Predict-Observe-Explain work in a Google Doc regarding the simulations.<br><br>**#6:** Worksheet that displays the prominent constellations. Mind map that investigates astrological phenomena through a 5W + 1H exercise. |

| | | |
|---|---|---|
| **#11:** Anecdotal observation notes while students are completing their investigation.<br><br>**#12:** Anecdotal observation notes to assess student understanding so far of the broader components of the Universe.<br><br>**#14:** Anecdotal observation notes regarding the Barometer activity and the class's current understanding for Cluster 3<br><br>**#16:** Anecdotal observation notes that assess student understanding of STEM investigation skills. | **#6:** Class discussion while taking up the constellations. Conversations while teacher circulates and provides formative feedback during the mind map activity.<br><br>**#7:** Class discussion following the Think-Pair-Share after students read the Ray Bradbury short stories.<br><br>**#8:** Class discussion while students defend their positioning in the classroom during the Barometer activity.<br><br>**#9:** Class discussion during Think-Pair-Share activity about NASA video. Conversation during whiteboard activity. Conversation while students discuss findings in parallax activity.<br><br>**#10:** Class discussion during Think-Pair-Share. Conversation during formative feedback and effective questioning in the activity.<br><br>**#11:** Class conversation during initial brainstorm, Hubble telescope simulation, and while performing formative feedback in the investigation. | **#7:** Quiz that consolidates everything covered in the unit thus far (Cluster 1). Google Doc that contains important notes (regarding various planetary phenomena) taken while reading the Ray Bradbury short stories.<br><br>**#8:** Exit ticket that poses as a self-assessment for their prior learning and future learning.<br><br>**#9:** Google Form where students select planet for culminating task. Exit ticket that consolidates light years and parallax.<br><br>**#10:** Google Doc that students must collaborate their ideas based on the activity.<br><br>**#11:** Google Doc that records their investigation information. Exit ticket that compares and contrasts the work of other groups.<br><br>**#12:** An exit ticket that consolidates the different components of the broader Universe.<br><br>**#13:** Quiz that consolidates everything recently covered (Cluster 2). Google Doc that contains student notes (regarding discrimination of marginalized groups) taken while reading the Ray Bradbury short stories. |

| | | |
|---|---|---|
| | **#12:** Class discussion around the Think-Pair-Share responses to the Wilfred Buck video and Four Corners activity.<br><br>**#13:** Class discussion following the Think-Pair-Share after reading through the Ray Bradbury short stories.<br><br>**#14:** Class discussion while students defend their positioning in the classroom during the Barometer activity.<br><br>**#15**: Class discussion following the TED-Ed video and Think-Pair-Share. Conversation during the learning centres activity.<br><br>**#16**: Conversation while circulating throughout the whiteboard activity.<br><br>**#17:** Class discussion regarding interconnectedness among First Nations, Inuit, and Metis peoples, and after the Ray Bradbury short story Popcorn read-through about the main takeaways. | **#14:** Exit ticket that consolidates the topic of marginalized members in the space exploration field and how they can apply this new insight to their culminating task.<br><br>**#15**: Exit ticket through Google Forms that consolidates the lesson and helps inform the culminating task.<br><br>**#16:** Exit ticket through Google Forms that poses as a self-assessment regarding the whiteboard activity.<br><br>**#17:** Exit ticket through Google Forms that consolidates STSE concepts, interconnectedness, and the consequences of human colonization on another planet. |

**SNC1W Culminating Task – Earth and Space Science**

# *Space Colonization:*
## *A Holistic Approach Rooted in Inclusivity, Ethics, Sustainability, and a Commitment to Indigenous Education*

In our rapidly advancing 21st century world, space exploration and colonization seems to be something that is seemingly attainable within the near future. It is up to YOU to successfully plan, implement, and design a space colony on another planet; one that reflects the morals and values of a 21st century world. Here are the five components that you must keep in mind:

- **Planetary Basics:** The defining characteristics of the planet and how these would impact the colony (e.g. climate, size, gravity, distance from Sun)

- **STSE Focus:** Social, economic, political, and environmental ramifications of colonization (e.g. socioeconomic considerations of marginalized groups, preventing climate change issues similar to Earth, sustainable practices or renewable energy technologies that can be applied to the new colony)

- **Broader Universe Considerations:** How other celestial bodies and other universe factors impact the new colony (e.g. distance from the Sun? Other planets? The Sun's energy and its role in supporting life, renewable energy, and natural phenomena? Other astrological phenomena?)

- **STEM Focus:** STEM skills associated with interplanetary space travel (e.g. artificial intelligence, renewable energy sources, satellites)

- **Marginalized Contributions:** Identify contributions made to science by people from different scientific communities that made this colonization process possible, with an emphasis on marginalized members of the community (e.g. scientists, astronauts, engineers)

**You can present your work in fake blog posts, journal entries, creation software of the world such as Minecraft, slideshow presentations, physical models, video explanations, etc.**



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# Culminating Task Rubric

**Name: _____** **/40**

| **Knowledge and Understanding** | | | | |
|---|---|---|---|---|
| **Category** | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| **Incorporates accurate components and characteristics of the Universe into the new colonization** | Limited number of accurate components and characteristics are included | Demonstrates some knowledge of the Universe's components and characteristics in the new colonization | Demonstrates considerable knowledge of the Universe's components and characteristics in the new colonization | Demonstrates thorough knowledge of the Universe's components and characteristics in the new colonization |
| **Recognizes correct astrological processes and phenomena that would occur throughout the new colonization** | Limited number of astrological processes and phenomena are recognized | Demonstrates some understanding of the astrological processes and phenomena that would occur throughout the new colonization | Demonstrates considerable understanding of the astrological processes and phenomena that would occur throughout the new colonization | Demonstrates thorough understanding of the astrological processes and phenomena that would occur throughout the new colonization |

| Thinking and Investigation | | | | |
|---|---|---|---|---|
| **Category** | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| **Assesses how the planet's characteristics and position in the Solar System and Universe would affect the new colonization** | Limited assessment of the planet's characteristics and position | Assesses how the planet's characteristics and position would affect the new colonization with some effectiveness | Assesses how the planet's characteristics and position would affect the new colonization with considerable effectiveness | Assesses how the planet's characteristics and position would affect the new colonization with a high degree of effectiveness |
| **Gathers sufficient evidence of how the new colonization would survive based on the new planet's conditions** | Limited amount of sufficient evidence | Gathers sufficient evidence of how the new colonization would survive with some effectiveness | Gathers sufficient evidence of how the new colonization would survive with considerable effectiveness | Gathers sufficient evidence of how the new colonization would survive with a high degree of effectiveness |

| Communication | | | | |
|---|---|---|---|---|
| **Category** | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| **Justifies ideas, choices, and plans for the new colonization** | Limited justification of ideas, choices, and plans | Justifies choices, ideas, and plans with some effectiveness | Justifies choices, ideas, and plans with considerable effectiveness | Justifies choices, ideas, and plans with a high degree of effectiveness |
| **Presents content within the project in an organized and complete manner** | Limited organization and completion | Presents content within the project with some effectiveness | Presents content within the project with considerable effectiveness | Presents content within the project with a high degree of effectiveness |
| **Articulates correct terminology throughout the project** | Limited articulation of correct terminology | Articulates correct terminology with some effectiveness | Articulates correct terminology with considerable effectiveness | Articulates correct terminology with a high degree of effectiveness |

| Application | | | | |
|---|---|---|---|---|
| **Category** | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| **Applies scientific investigation skills and STEM connections to help successfully colonize a new planet** | Limited application of scientific investigation skills and STEM connections | Applies scientific investigation skills and STEM connections with some effectiveness | Applies scientific investigation skills and STEM connections with considerable effectiveness | Applies scientific investigation skills and STEM connections with a high degree of effectiveness |
| **Integrates the STSE framework's perspectives while planning, establishing, and running the new colonization** | Limited integration of the STSE framework's perspectives | Integrates the STSE framework's perspectives with some effectiveness | Integrates the STSE framework's perspectives with considerable effectiveness | Integrates the STSE framework's perspectives with a high degree of effectiveness |
| **Incorporates contributions of marginalized members within the scientific community in the colonization process** | Limited incorporation of contributions | Incorporates contributions of marginalized members within the scientific community with some effectiveness | Incorporates contributions of marginalized members within the scientific community with considerable effectiveness | Incorporates contributions of marginalized members within the scientific community with a high degree of effectiveness |