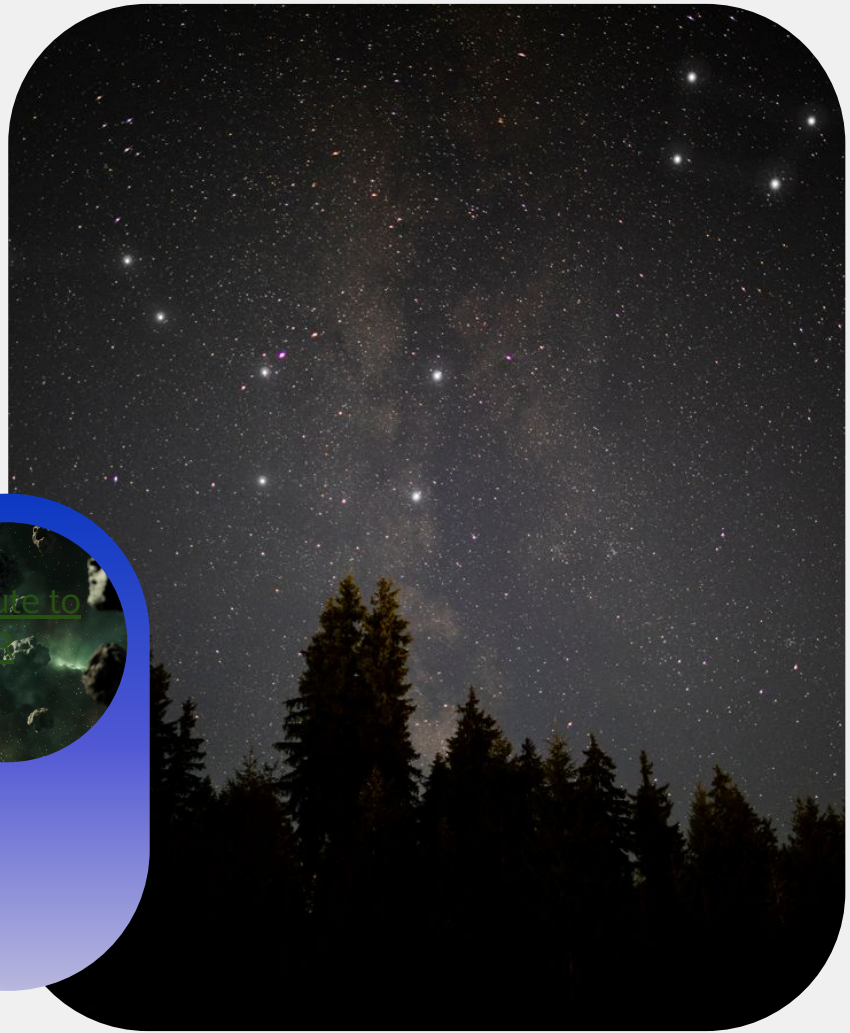
New Science Curriculum

Grade 4

Space

February 5, 2024



Facilitators
Chris Zarski
Ted Zarowny

Alberta Regional Professional Development Consortia
Adult learning for students' sake

Land Acknowledgement

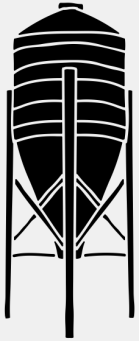
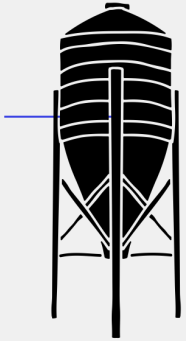
In the spirit of reconciliation, we want to acknowledge that this gathering is taking place on traditional lands across the province of Alberta, home to many diverse First Nations, Métis and Inuit peoples. We acknowledge that this land is a traditional meeting ground giving voice to its original peoples and the story of creation of this country in a way that history has forgotten.

“Canada's Indigenous people looked to the sky for guidance in practical endeavours but also spiritual identity. They look to the sky as a map, clock and calendar for thousands of years. The movement of celestial objects were observed and followed using the stars as a compass, for orientation and direction.” (ROA, University of Calgary)
The Moon and Indigenous Skylore

Agenda

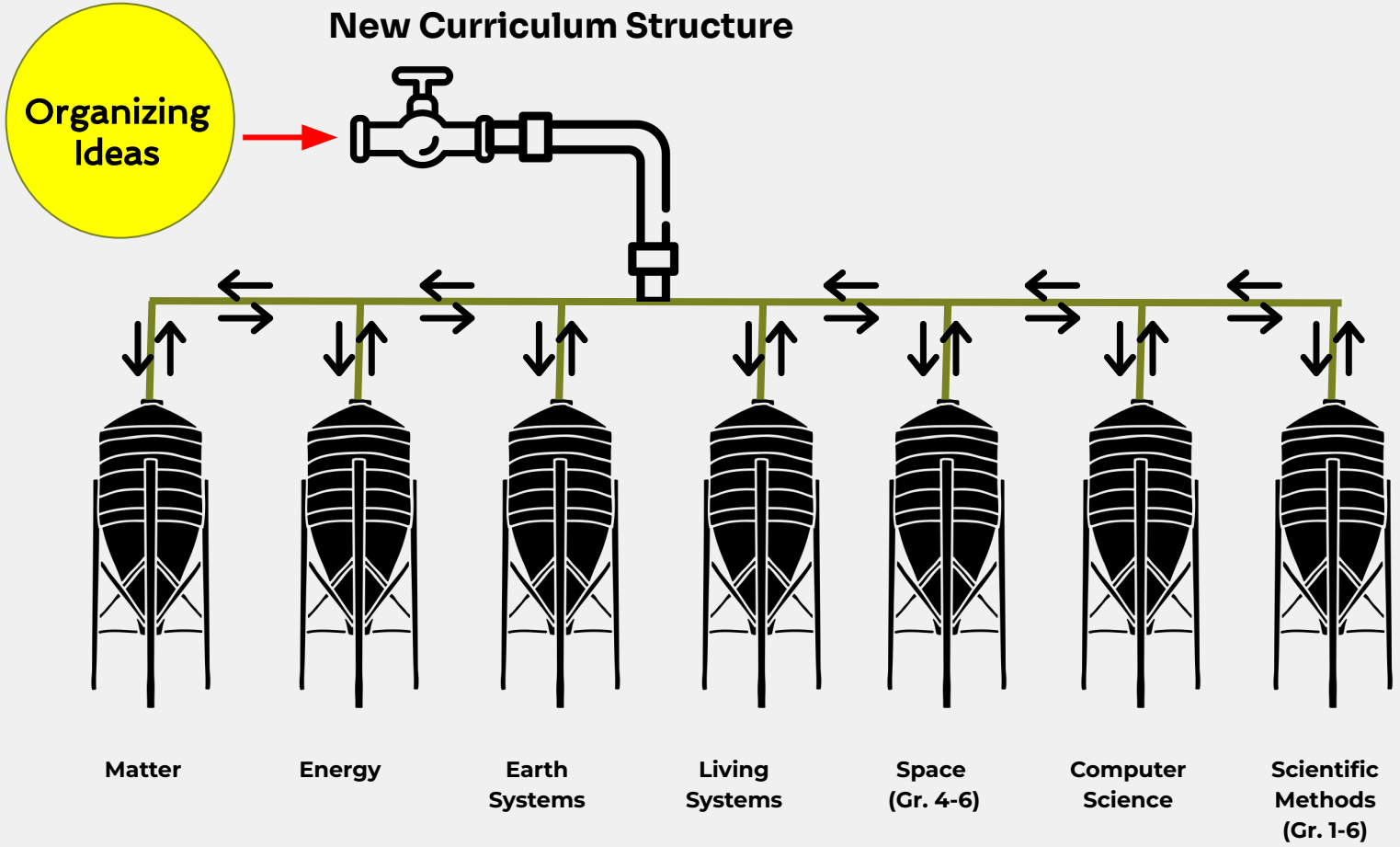
1. The New and Old Science Curriculum
2. What do Students need to Know?
3. What do Students need to be able to Do?
4. What do Students need to Know Understand?
5. Planning for Instruction (Surface - Deep - Transfer)
6. Sample Surface Level Activities
7. Sample Deep Level Activities
8. Transfer/Assessment
9. Resources

Previous Science Curriculum: Topics

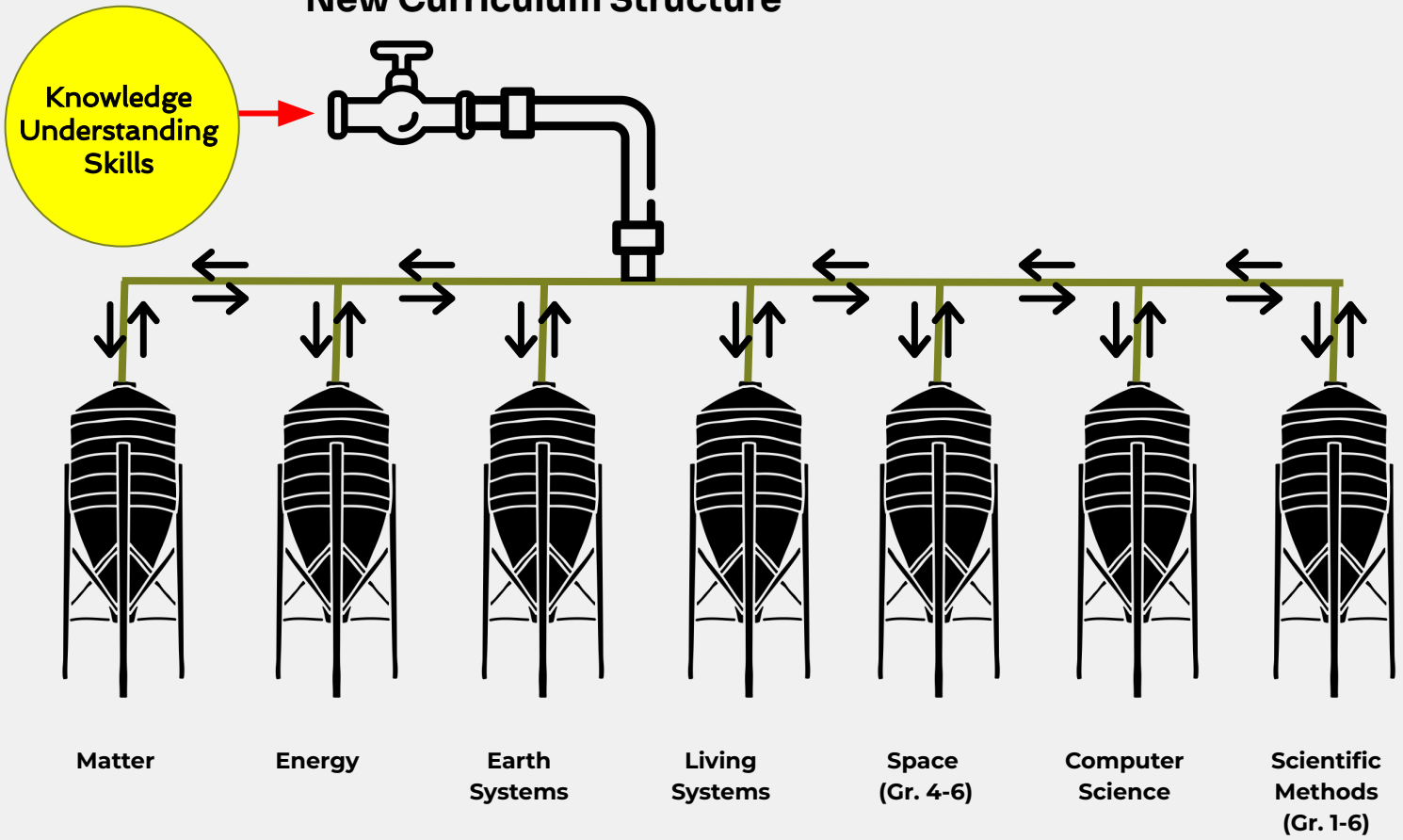




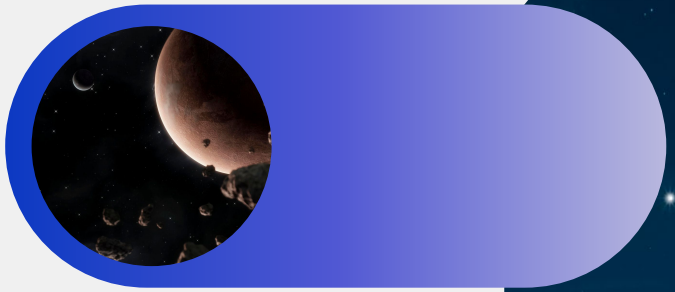
GR. 1	Seasonal Changes	Needs of Animals and Plants	Creating Colour	Building Things	Senses
GR. 2	Small Crawling and Flying Animals	Buoyancy and Boats	Magnetism	Exploring Liquids	Hot and Cold Temperature
GR. 3	Building with a Variety of Materials	Testing Materials and Designs	Rocks and Minerals	Hearing and Sound	Animal Life Cycles
GR. 4	Building Devices and Vehicles	Light and Shadows	Plant Growth and Changes	Waste and Our World	Wheels and Levers
GR. 5	Electricity and Magnetism	Mechanisms using Electricity	Classroom Chemistry	Weather Watch	Wetlands Ecosystems
GR. 6	Air and Aerodynamics	Flight	Sky Science	Evidence and Investigation	Trees and Forests

New Curriculum Structure



New Curriculum Structure





Learner Outcome:
Students investigate and describe objects in space in connection to daily life.

Guiding Question

How do objects in space impact daily life?

What Do Students Need to Know?

KNOWLEDGE

Conceptual Knowledge

Students need to know certain concepts and their attributes related to space such as star and constellation. Some concepts are related to skills such as a prediction.

Factual Knowledge

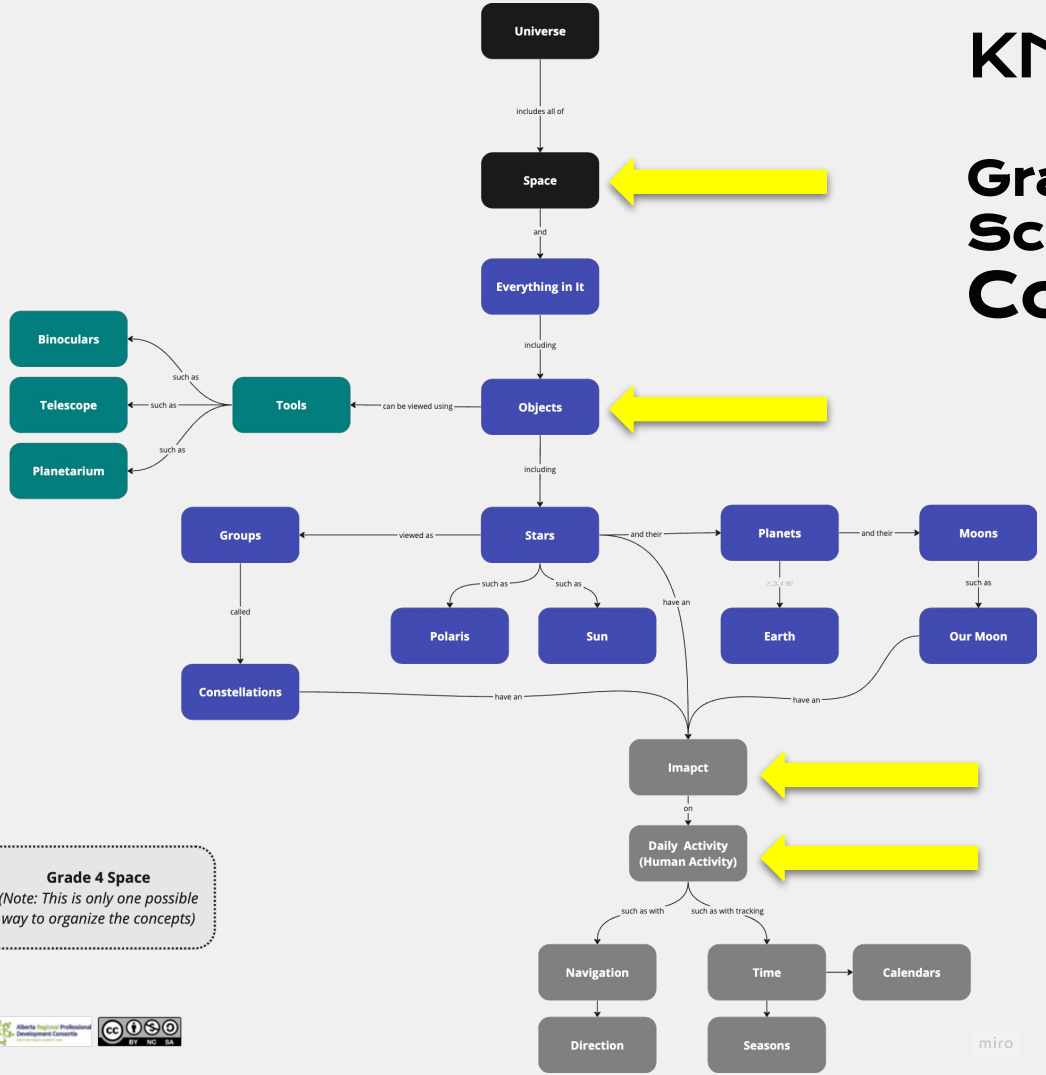
Facts are objective, verifiable pieces of information about the world such as “Earth revolves around the sun.”

Skill/Procedure Knowledge

Students need to know how to do certain skills and procedures such as the steps in an investigation, how to sort, or how to compare.

KNOWLEDGE

Grade 4 Science:Space Concept Map



"Grasping the structure of a subject is understanding it in a way that permits many other things to be related to it meaningfully. To learn the structure in short, is to learn how things are related."

-Jerome Bruner

Skills & Procedures

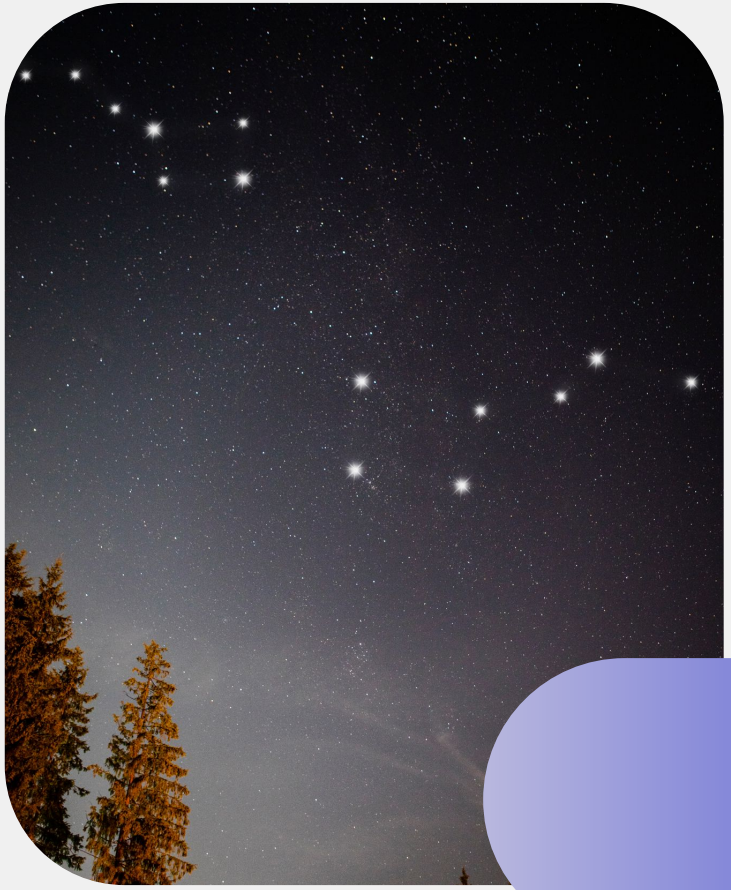
What students do to demonstrate their learning.

Verbs highlighted in yellow relate to steps in an **investigation (Scientific Methods)**

Verbs highlighted in yellow relate to **design thinking (Computer Science).**

Grade 4 Skills and Procedure Verbs			
By Alphabetical Order		**By Frequency**	
Skill/Procedure	Frequency	Skill/Procedure	Frequency
Analyze	2	Discuss	9
Classify	1	Relate	6
Collaborate	3	Compare	5
Collect Data	2	Collaborate	3
Compare	5	Demonstrate	3
Conclude	1	Describe	3
Conduct Investigation	2	Plan	3
Create	1	Analyze	2
Decide	1	Collect Data	2
Demonstrate	3	Conduct Investigation	2
Describe	3	Explain	2
Discuss	9	Interpret	2
Evaluate	1	Investigate	2
Examine	1	Represent	2
Explain	2	Classify	1
Explore	1	Conclude	1
Identify	1	Create	1
Interpret	2	Decide	1
Investigate	2	Evaluate	1
Magnetize	1	Examine	1
Plan	3	Explore	1
Record Observations	1	Identify	1
Relate	6	Magnetize	1
Represent	2	Record Observations	1
Test	1	Test	1

Grade K-3 Skills & ProcedureVerbs				
Skill/Procedure	**Grade**			
	K	**1**	**2**	**3**
Ask Questions				
Classify (Sort)				
Compare (find similarities and differences)				
Conclude				
Create				
Demonstrate Safety				
Describe				
Design				
Discuss				
Examine				
Explain				
Explore				
Investigate				
Observe				
Predict				
Record Data/Observations				
Relate				
Represent				



Skills from Scientific Methods

Investigation Progression

The steps of an investigation are introduced in **Grade 2 Scientific Methods.**

Grades 3, 4, 5 and 6 build on those steps.

Investigations 1-6 Progression

The information presented here is not intended to be a detailed summary of the Scientific Methods Organizing Idea. The intent is to highlight how the **steps of an investigation** grow in **complexity** and **depth** from Grade 1 to Grade 6

Grade 1

Steps followed during an investigation include:

1) Asking **Questions**
2) Making **Predictions**
3) Gathering **Data**
4) Forming **Conclusions**

Grade 2

Procedures scientists use to guide investigations include:

1) Asking **Questions**
2) Making **Predictions**
3) **Planning** the Investigation
4) **Observing** and **Recording Data**
5) **Analyzing** Data
6) Reaching **Conclusions**
7) **Discussing** Observations and Conclusions

Grade 3

Data

- Accuracy
- Objectivity
- Sources (Accurate & Trustworthy)

Analyzing

- Techniques

Grade 4

Data

- Descriptive (qualitative)
- Numbers (quantitative)
- Relevance

Evidence

- Data that supports the conclusion becomes evidence
- Reliability
- Validity

Système international d'unités

- international system of units

Grade 5

Phenomena

- facts or events that can be observed

Bias

Variables

- Manipulated (independent)
- Responding (dependent)
- Controlled

Experiment

- Controlled Experiment

Evidence

Communication

- Representation
- Clarity & Accuracy

Scientific Ethics

GRADE 6

Explanations

- Hypothesis
- Testable (falsifiable)
- Use of reliable objective data and evidence
- Describe natural phenomena
- Use of variety of texts and representations

Skills from Computer Science

Grade	Skills
K-1	Following/ Creating Instructions
2	Creativity - Originality
3	Creativity - Divergent Thinking & Computational Thinking
4	Design Thinking

Computational Thinking (Gr. 3)

Sub-Skill
Break a task into smaller chunks.
Identify the important details when reading or solving a problem.
Find patterns and similarities in tasks.
Design instructions.
Working backward if a mistake is made.

Science Grade 3 Computer Science - Curriculum Planning & Assessment Resource.pdf

Application:

Create a set of instructions that could be followed by a human or a machine to complete a task.

Examples:

- Planning an Investigation.
- Planning the construction of something.

Design Thinking (Gr. 4)

Sub-Skill
Understand the problem.
Form ideas (ideating). *(Divergent Thinking)*
Plan
Create
Analyze
Test
Troubleshoot

[Science Grade 4 Computer Science - Curriculum Planning & Assessment Resource.pdf]

Application Example

Skills & Procedure: 4S1.3: *Represent observations of objects in space as they connect to seasons, plants, and animals in a local area.*

This can be rephrased as "Design a representation f objects in space as they connect to seasons, plants, and animals in a local area."

Understandings

Understanding is “how facts and knowledge fit together in a logical and meaningful order.”

Stars

Constellation

Navigation

Time

Travel to stars in other constellations would require careful navigation and take much time.

Stars and constellations assist with navigation and tracking time.

Understandings

4S1.1: Observing objects in space helps us connect Earth to its place in the universe.
4S1.2: Stars and **constellation**s are recognizable from Earth and can be used for **navigation** and tracking the passage of **time.**
4S1.3: Many cultures connect **observations** of **objects** in space to **time,** place, and **daily life** in various ways.


PLANNING
Begin with the end in mind.

Summative Assessment

Sample Assessment:

Choose three objects in space. Rank order them by the significance of their impact daily life. Choose a way to represent your ranking and justify your ranking.

What Do Students Need to Know, Do and Understand?

- Objects in Space
- Rank Order/Evaluate
- Significance
- Impact
- Representation
- Explain/Justify
- Human Activity

Hattie, Fisher & Frey: *Visible Learning for Literacy* (2016)

Phases of Learning

Surface

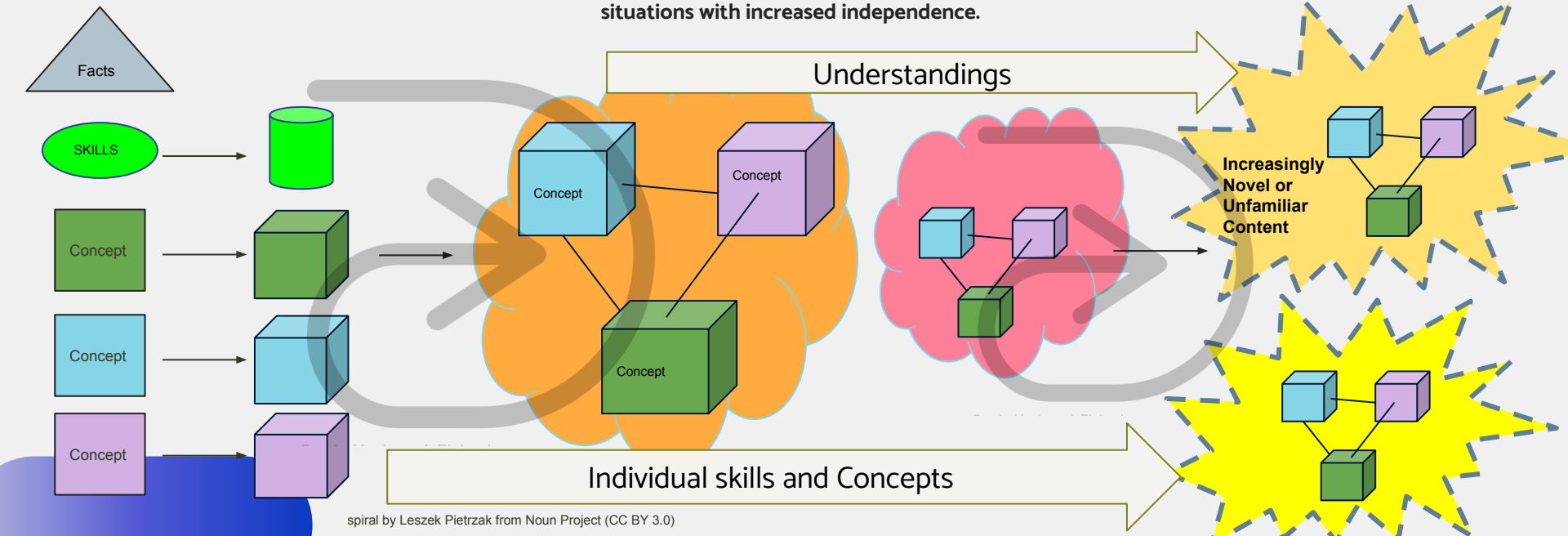
Students are first exposed to individual skills, concepts and their related knowledge.

Deep

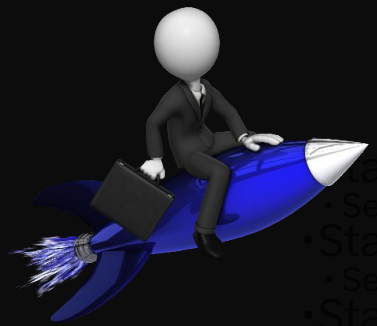
Students make connections between concepts to create deeper understanding and appropriately skills/ procedures to new situations with increased independence.

Transfer

Students apply concepts, understandings and skills to a variety of novel and unfamiliar contexts.



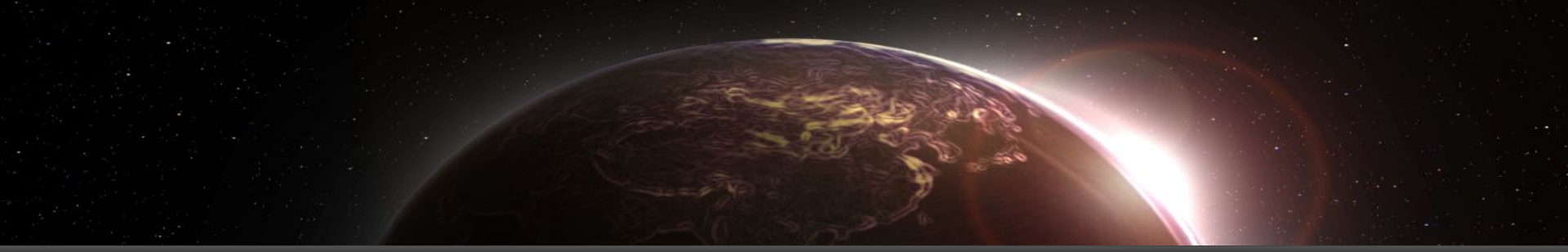
Why do humans study and explore space?



Have students work with a partner and make a list.

What are the advantages and disadvantages of this exploration?

Advantages	Disadvantages



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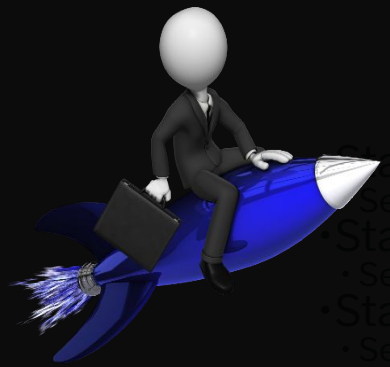


Have students work with a partner and make a list.

What are the advantages and disadvantages of this exploration?

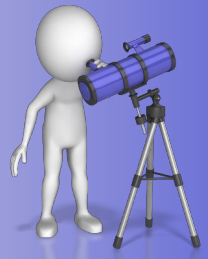
Advantages	Disadvantages
helps to address questions about our place in the Universe	danger/risk
history of our solar system	higher exposure to radiation
collaboration with other countries	cost
expands technology and create new industries	gravity, closed environment

01

Surface Level

What's Up There?

What objects and terms related to ***space*** can you name?



What do we mean when we say “The Universe”?

The Universe is everything! It includes planets, stars, the smallest particles to the largest galaxy.

Photo: NASA Adapted from *The Universe*

What are some of the space objects we see in the sky?

Make a list of objects you notice in the sky with your partner.

- What is an Exploration?

What are some of the space objects we see in the sky?

- moon
- sun (is a star)
- stars
- planets (appear as stars without assistance to see them.

Brainstorm wonders or questions might you have?

- Notice and Wonder
- Divergent Thinking

What are some of the space objects we see in the sky?

- moon
- sun (is a star)
- stars
- planets (appear as stars without assistance to see them.

Create an infographic describing each.

Infographic

- What is an Infographic?
- Infographic Examples
- 5 Key Elements of a Successful Infographic

Surface Level Practice Ideas:

~ Best Sandwich Ever
~ Recess Do's and Don'ts
~ How to Watch a Hockey Game
~ etc.

Create an infographic describing objects in space.

How can DESIGN THINKING be used here?

- Understand the problem.
- Form ideas (ideating). (Divergent Thinking)
- Plan
- Create
- Analyze
- Test
- Troubleshoot

What technologies do we have to view objects in space?

- moon
- sun (is a star)
- stars
- planets (appear as stars without assistance to see them.

Can we see stars with our eyes just by looking up? (discuss when is the best time to see Stars (night); are there any safety concerns to be discussed (can't look at the sun directly sometimes a double layer of sunglasses allows you to see a solar eclipse)
What is light pollution?
What other technologies assist us in seeing objects in space?

Resource- look to the bottom of each linked page for individual resources.

Astronomy: Student Resource

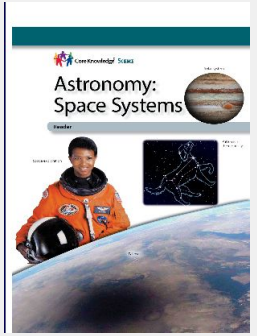
Chapter 6: Constellations

Astronomy :Teacher's Guide

Lessons 8, 11 & 12.
AP (Activity Pages located at the end of the Teacher's Guide.

Astronomy : Space Systems

Online resource links



Sun, Moon and Stars: Student resources

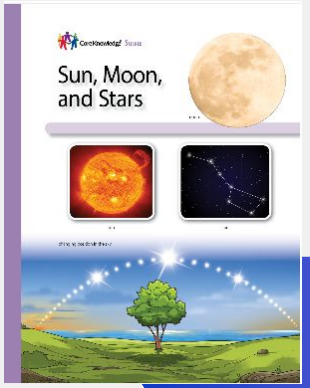
Chapters 5 & 6: How Does the Starry Sky Change? & Astronomers

Sun, Moon and Stars: Teacher's guide

Lesson 4

Sun, Moon and Stars

Online resource links



Other Sample Activities (Surface)

*While planning surface activities, keep in mind that many skills have related **concepts.***

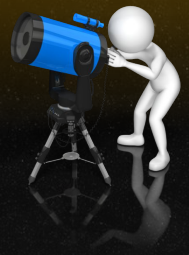
Broad Concepts & Skills

- System (Under Revision)
- Relationship
  - Concept Map
  - Cause and Effect
  - Dependence
  - Affect/Effect
  - Interaction
  - Interconnection
- Change
  - What is Change?
  - What is Significant Change?
  - Change & Time
  - Physical Change
- Representation
- Human Activity
- Impact (Under Construction)
- Compare and Contrast
  - Criteria
  - Similarity and Difference
- Investigation Steps
  - Asking Questions (Notice and Wonder)
  - Observing (Using senses)
  - Analyzing
  - Prediction and Predicting
  - Conclusion
  - Sample Introduction to Research as an Investigation (Gr. 3)
    - One Point Research Rubric (Gr. 4-6)
    - Research Information Gathering
- Div 2 Discussing Checklist
- Evaluating (Under Construction)

Deep Level

Stargazing tips

Dreamstime.com ID#29143802



Dreamstime.com ID#6097954 Jeff Whyte

What are binoculars? How do they help us see stars?

How does a telescope work?

Compare the observations you would get from a telescope pictured above with the one at the Hesje Observatory at Miquelon Lake Provincial Park. (Dark Sky Reserve)

Telus World of Science

Research this centre or one closer to you and determine where and how you can view space objects.

STEAM Challenge - Getting Telescopes to Space!

STEAM CHALLENGE

Define the Problem

Scientists have developed a new infrared telescope. The images will provide more data about stars and the Milky Way. Now, they must use a spacecraft to send it into space. Your task is to design and build a shield for the spacecraft. It must block radiation from the sun and other objects in space.

Constraints: You may only use types of paper to build the shield.

Criteria: You will test your design by placing the shield on top of a flashlight. The materials must prevent the light from traveling through.

1 Research and Brainstorm

How do infrared telescopes work? Why are infrared telescopes used mostly in space? What types of materials absorb light?

2 Design and Build

Sketch your design. What purpose will each part serve? Which types of paper will work best? Build the model.

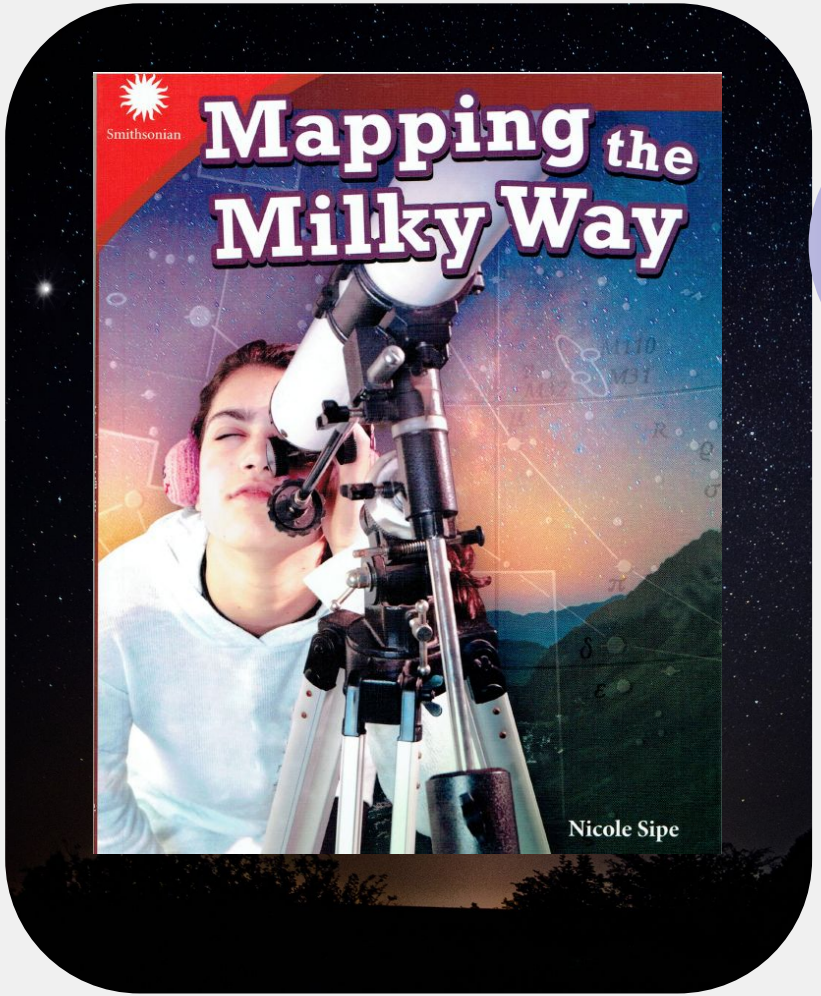
3 Test and Improve

Test your design by shining a light on the model. Did the materials work to shield the light? How can you improve it? Modify your design, and try again.

4 Reflect and Share

Could it work with less paper? Does the model also shield heat? How could you test this? How do you think scientists test space instruments on Earth?

Mapping the Milky Way by Nicole Sype. Teacher Created materias Inc., 2019. Pg. 28-29



When it comes to mapping the Milky Way, scientists know one thing for sure. They know that there is still a lot that they do not know! Discover how they study the Milky Way, and learn about the galaxy that we call home. Created in collaboration with the Smithsonian Institution, this Smithsonian Informational Text builds students' reading skills while engaging their curiosity about STEAM topics through real-world examples. It features a hands-on STEAM challenge that guides students through every step of the engineering design process and is perfect for makerspace activities. It makes STEAM career connections by providing a glimpse into the lives of real-life Smithsonian employees currently working in STEAM fields. Discover engineering innovations that solve real-world problems with this book that touches on all aspects of STEAM: Science, Technology, Engineering, the Arts, and Math!

EPIC

Compare Binoculars and Telescopes

- What You Can See In A Telescope
  - https://www.youtube.com/watch?v=-gF0kp2EK20
  - https://www.youtube.com/shorts/pNhJwQzaHPM
- Telescope Expectation and Reality #1: https://www.youtube.com/watch?v=Z6NIBBldy8U
- Telescope Expectation and Reality #2 : https://www.youtube.com/watch?v=jI7IPPmu76U
- Binoculars: https://www.youtube.com/watch?v=b61hchvp8es (begin at 3:25)

Hubble Telescope

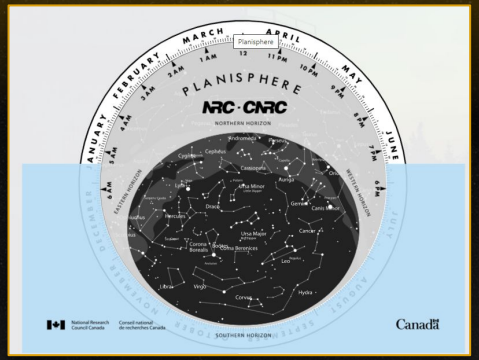
- Hubble: Tour: https://www.youtube.com/watch?v=XZ_WeTGCU90
- Visible Light vs. ultraviolet light: https://www.nasa.gov/content/explore-light
- Hubble https://www.nasa.gov/content/discoveries-hubbles-deep-fields
- Example of Hubble observation: https://www.youtube.com/watch?v=yfWYXY85mBk

4S1.2

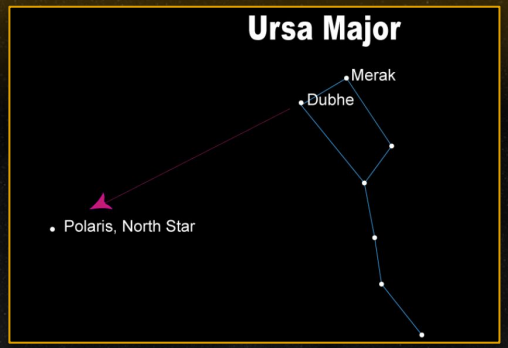
Stars and constellations are recognizable from Earth and can be used for navigation and tracking the passage of time.

How can stars and constellations be used for navigation and the passage of time?

Shutterstock: ID 1451142569



Canada Under the Stars © ASTROLab du parc national du Mont-Mégantic 2023



EarthSky.org

Record and compare observations of objects in space during the day and night.

Safety caution!

How do the objects in space change position over time?

Planisphere

Why is polaris an important star?

Do you know the name of any stars or constellations?
Who created the constellations? Why are they important?

Use if students did not engage in the research earlier.

Polaris is part of the Big Dipper. Why is it an important star to know how to find?
Orion also has an important star to help find locations. Explain?
Find one of the 88 constellations located along the belt used by scientists and research it. How did it gets its name, where and when would we see it?

Star Finder - Find Constellations based on date and time

First Nations & Other Cultures

Makinak: The Turtle by Wilfred Buck

Star Stories: The Never-ending Bear Hunt Smithsonian

Star Stories: Quillwork Girl and Her New Seven Brothers (Cheyenne Story)

Star Stories: The Girl and Her Seven Brothers (Native American)

Star Stories: The Star That Does Not Move (Paiute)

What is Inuit Mythology? |

The SKY - *Live*

What can you see [tonight](#)?

Night Sky Network

Real Time Night Sky [Planner]

Sky and Telescope

Interactive [Sky Chart] - enter your postal code

Lab: Mini Constellation Viewer

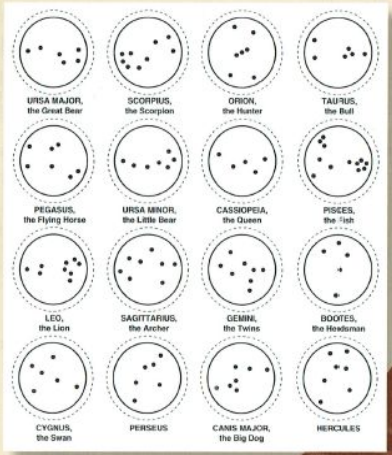
Constellations are patterns formed by stars. Centuries ago, humans used their imaginations to link star patterns. They did this by drawing dot-to-dot pictures in their heads. They named the constellations after ancient gods, objects, and animals. After you do this activity, try to find some constellations in the night sky.

Materials

- 35mm film canisters (one for each constellation you want to view) or other such containers
- scissors
- tape
- pushpin
- constellation patterns (page 29)
- paper
- pen

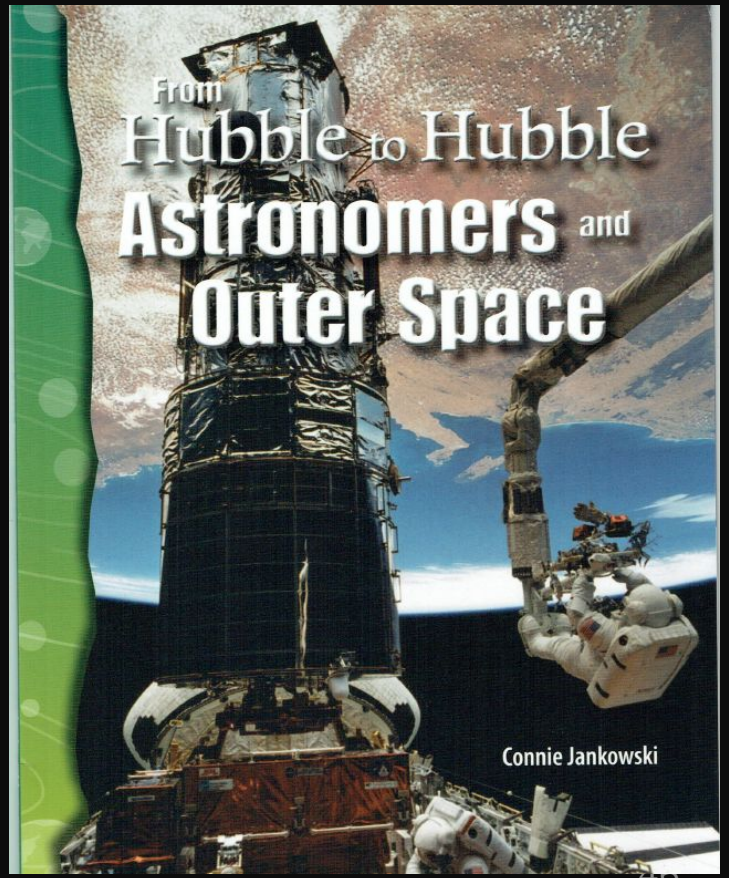
Procedure

1. Choose a constellation from the patterns on page 29. Trace it and cut it out on the dotted lines. (If you have a copy machine, you can copy it that way.)
2. Tape the pattern in place over the bottom of the film canister.
3. Using a pushpin, punch a small hole through the paper and the canister for each star in the pattern.
4. Hold the film canister up to the light. You should see light through each hole.
5. Take the pattern off the canister. Trade with a partner and see if you can both figure out which constellation the other chose.
6. Try to find the same constellations in the night sky.



From Hubble to Hubble Astronomers and Outer Space by Connie Jankowski. Teacher Created Material, 207. Pp. 28-29

Telescopes and high-tech equipment help astronomers explore deep space. This captivating title introduces readers to some of the most notable scientists who helped develop technology that allows for space exploration, such as Galileo Galilei, Edwin Hubble, Annie Cannon, George Ellery Hale, Lyman Spitzer, and Jocelyn Bell Burnell. The vibrant, stunning images and easy-to-read text will have readers engaged and eager to learn more about such topics as interstellar matter, pulsars, neutron stars, white dwarfs, and astrophysics! Readers are encouraged to explore astronomy even further with the featured lab activity!



Many cultures connect observations of objects in space to time, place, and daily life in various ways.

Images reveal large amounts of data, so remember: use an image instead of a long text. Your audience will appreciate it

Lunar Calendar

How the Moon Makes Calendars

What's the difference between lunar and solar years?

Gregorian Calendar

Turtle Island

You may wish to revisit the video of *Makinak: The Turtle by Wilfred Buck*

The full story of each Moon from a Cree Culture perspective can be found here.

Transfer:
What is the relationship between the lunar calendar and Makinak?

How do people use both the Solar and Lunar calendars at the same time? Explain.

TRANSFER/ ASSESSMENT

Ask Conceptual Questions

What is the relationship between **objects in space** and **human activity**? Provide examples.

Read a case study on tides. Does the case study support the understanding that objects in space impact daily life?

Make Concept Maps

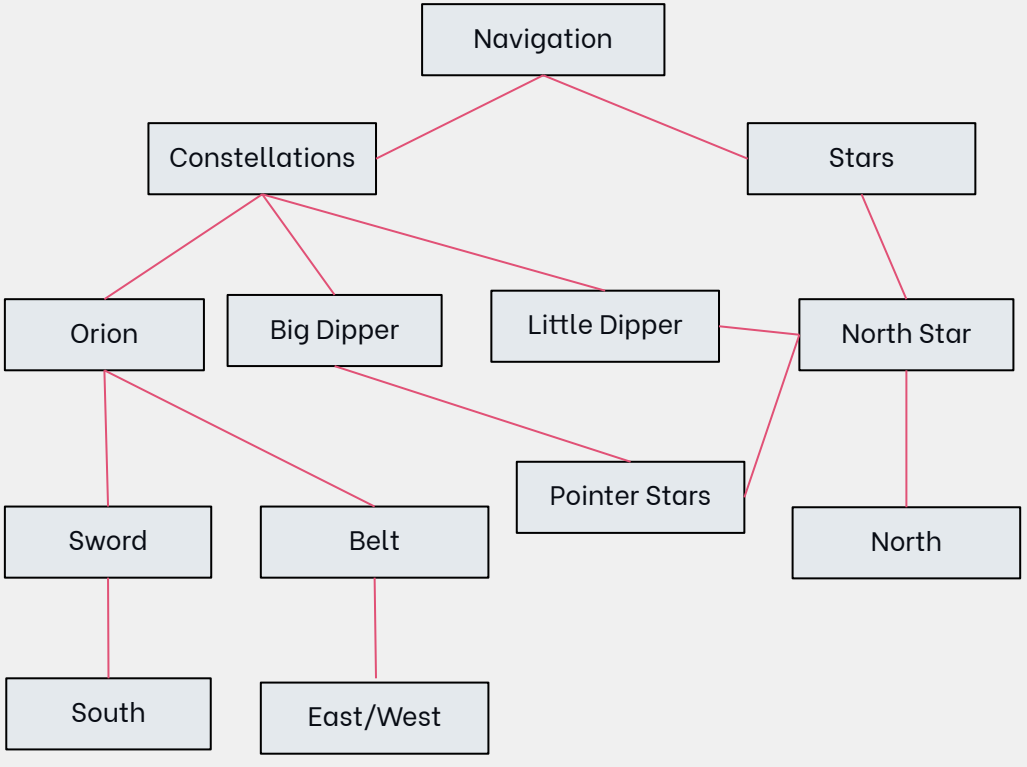
Task: Organize the ideas below into a concept map that helps explain how stars and constellations can be used for navigation.

Little Dipper | Orion

North | North Star | Navigation

Belt | East/West | Big Dipper

Constellations | Sword | Stars



Make a Performance Task

Example:

Choose three objects in space. Rank order them by the significance of their impact on daily life. Choose a way to represent your ranking and be prepared to justify your ranking.

Additional Resources

EarthSky.org

Best targets for binoculars, for beginners.

Author: Kelly Kizer Whitt

March 30, 2023

https://earthsky.org/astronomy-essentials/best-targets-for-binoculars-moon-planets-nebula-clusters/

Space Place: Explore earth and Space!
NASA Science
What are constellations?
Navigating Space By The Stars (video)
https://spaceplace.nasa.gov/constellations/en/

The Night Sky

Wilfred Buck
Melissa Purcell

Pearson

Contents

Stories in the sky

At night, the sky covers us like a blanket. From beneath this twinkling blanket come stories that remind us of who we are and where we came from. Our Elders have told us these stories.

Across Canada, Elders from First Nations, Métis, and Inuit communities share different stories about the sky at night. Stories differ from one community to another but they all help us to understand and learn about our **culture**.

Dans le ciel

Wilfred Buck
Melissa Purcell

Traduit et adapté par
Johanne Proulx

Vivre
AU CANADA

Table des matières

Les histoires dans le ciel

La nuit, le ciel nous enveloppe, comme une couverture. Les étoiles nous racontent des histoires sur nos **origines** et sur notre culture. Nos aînés ont raconté ces histoires.

Les aînés inuits, métis et des peuples des Premières Nations partagent des histoires sur les étoiles et les **constellations**. Les histoires sont différentes d'un peuple à l'autre. Chaque histoire contribue à notre culture.

Sources

Erickson, K & Doyle, H. NASA Space Place
https://spaceplace.nasa.gov/

McClure, B & Macholtz, EarthSky: Polaris is the North Star. May 22, 2020
https://earthsky.org/brightest-stars/polaris-the-present-day-north-star/

Patel, Z.S., Brunstetter, T.J., Tarver, W.J. *et al.* Red risks for a journey to the red planet: The highest priority human health risks for a mission to Mars. *npj Microgravity* 6, 33 (2020).
https://doi.org/10.1038/s41526-020-00124-6

Taylor, C. Science Friday: *Relearning the Star Stories of Indigenous People's. 2019*
https://www.sciencefriday.com/articles/indigenous-peoples-astronomy/

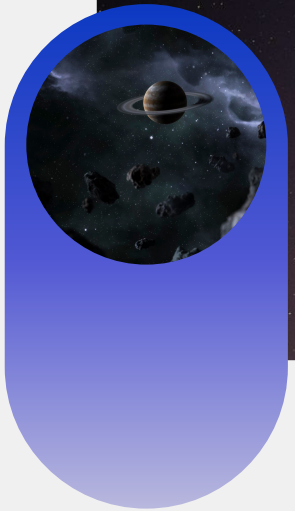
Alberta Regional Consortia

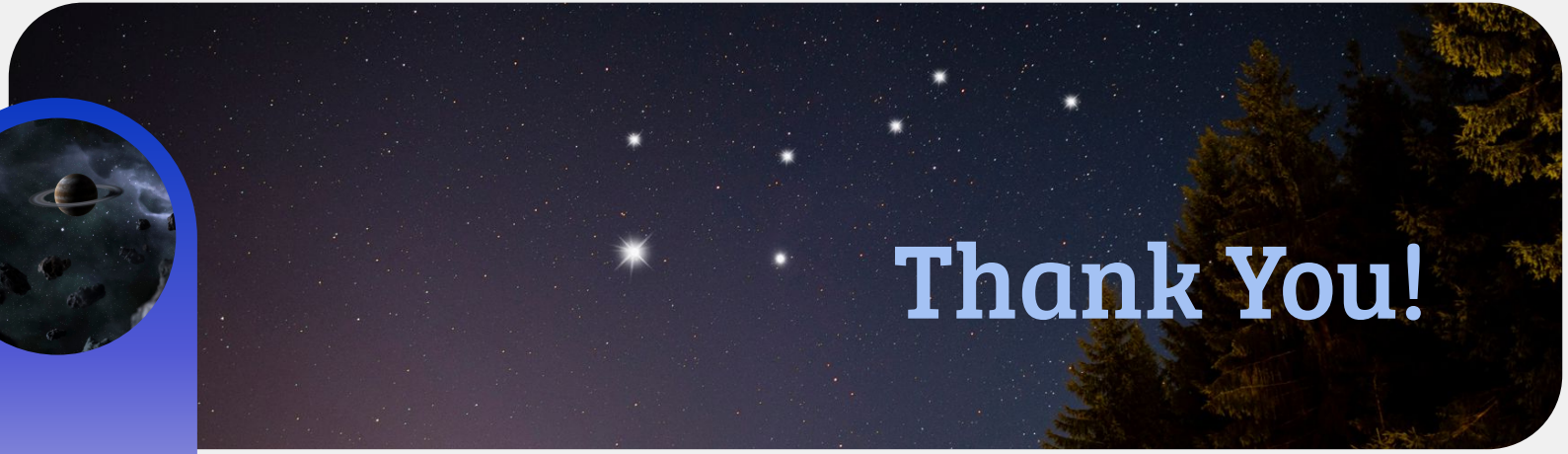
Resources

UNIVERSITY OF CALGARY

ROTHNEY ASTROPHYSICAL OBSERVATORY

The Rothney Astrophysical Observatory is located under the starry skies of the traditional territories of the peoples of Treaty 7, which include the Blackfoot Confederacy (comprised of the Siksika, the Piikani, and the Kainai First Nations), the Tsuut'ina First Nation, and the Stoney Nakoda (including Chiniki, Bearspaw, and Goodstoney First Nations). The City of Calgary is also home to the Métis Nation of Alberta (Districts 5 and 6).
This site offers a wealth of information for teachers and students to use in the study of Space.





Assessment in Grade 4 Science (February 26 & April 8) - full days
This session will be one of two sessions in which we will look at Transfer (Summative) Assessment development to meet the new Grade 4 Science Curriculum. It would be helpful to have Piloted or Optionally Implemented the Grade 4 Science Curriculum or parts thereof. Participants will collaborate as a large group and in smaller breakout groups as we work through and review each Organizing Idea. Come and share your great thinking!

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Chris Zarski **chris.zarski@arpdc.ab.ca**