Alberta Regional Professional Development Consortia

Adult learning for students' sake

Grade 2

Integrating The Scientific Methods (Investigations)

P L A N N I N G G U I D E

Sample: Energy
Behaviour of Light Affects its Path

A planning guide supports teachers in designing a series of lessons integrating the scientific methods with other organizing ideas found in the curriculum. This teaching strategy helps students build scientific knowledge and deepen their learning.

"The Science curriculum engages students in active investigation to build scientific knowledge and develop critical-thinking and problem-solving skills..... Students will have opportunities to integrate these skills into all other areas of the Science curriculum." ***Curriculum Subject Introduction (2023)***

PLANNING GUIDE

Grade 2 Science

Start with Curriculum First

- Step 1: **Analyze the learning outcome**
- Step 2: **Examine KUSPS Related to Learning Outcome**
- Step 3: **Connect Concepts to Foundational Knowledge**
- Step 4: **Develop Learning Progression & Align Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: **Create meaningful Learning Experiences**

Above steps are hyperlinked

- **Analyze the Learning Outcomes to identify the skills & concepts which direct the how and what of summative assessment.**

Where does light come from and how does it move?

Energy	Scientific Methods
Students investigate the behaviours of light and sound	Students examine investigation and explain how it is influenced by purpose

Note: The development of the skills & procedures from the scientific methods are a year long process

Guiding Questions:

- What are the concepts (nouns, science ideas) students need to learn?
- What are the skills (verbs) students use to demonstrate what they know, understand and can do?

Teacher Planning Toolbox (Click Links)

Verb Glossary

"Students will have opportunities to integrate these skills [scientific methods] into all other areas of the Science curriculum." Curriculum Subject Introduction (2023)

PLANNING GUIDE

Grade 2 Science

2. Examine the KUSPS to identify important concepts (science ideas),and the skills students will use to demonstrate successful learning

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Understanding: Behaviours of light affect its path.

Knowledge: Sources of **light** include
- **the Sun**
- **electricity**
- **fire**
- **some plants and animals** (bioluminescence)

Skills: Identify sources of light.

Knowledge: **Light behaves** in various ways, including
- **travelling in a straight line** from its source
- **bouncing off a surface** *(reflection)
- **bending as it travels from one material to another** *(refraction)
- **splitting into colours (**dispersion

Add a little bit of body text

Knowledge: Light travels through objects that can be seen through *(transparent).

Skill: Conduct an investigation to determine how the **path** of **light** can be affected

Knowledge: The **path** of **light** is affected by mirrors, prisms, and water

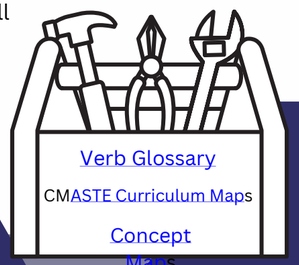
The **path** of **sunlight** can be affected in a variety of ways by **natural objects**, such as
- leaves
- trees
- bodies of water
- mountains

Skill: Examine how **natural objects** affect the **path** of **sunlight.**

*Note: parenthesis is for teacher, not the student
Include means must teach, such as is sampling but not all

Guiding Questions:

- What concepts (nouns, science ideas) in the knowledge & Understanding statements are integral to student understanding?
- What skills (verbs, verb definitions) will students use to show what they know and can do?



Integrating The Scientific Methods

PLANNING GUIDE

Grade 2 Science

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Understanding: Behaviours of light affect its path.

- **Determine essential science ideas for teacher clarity to enhance student learning**

Look for sources of information connected to:

- Sources of light
- Light travels in a straight line
- Light bounces off surfaces (Teacher: Reflection)
- Light bending as it travels from one material to another light path affected by water and prisms(Teacher: Refraction)
- Light splitting into colors light path affected(Teacher: Dispersion)

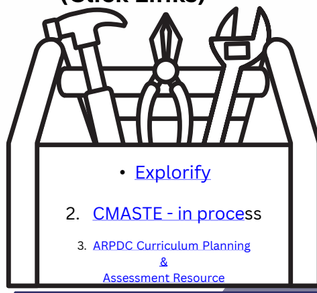
Note: Absorption of light and shadows cast is not a curricular expectation. The terms reflect, refract and dispersion are not curricular expectations for students.

- **Determine potential student misconceptions to consider when teaching and assessing**
  - Reflective surfaces emit light
  - Only shiny surfaces or water reflect light (bounce off surfaces)
  - Confusion about materials that are reflective and surfaces reflecting light (light bouncing off surfaces)
  - Children need multiple experiences with observing light reflecting off objects (colored paper, mirror, flower, baking pan etc.)
  - Opaque objects do not reflect light
  - Opaque surfaces give out colour or ‘darkness’

Guiding Questions:

- What terms and science ideas do I understand and what do I need to learn more about?
- What concepts in this learning outcome are connected to previous grade?
- What science vocabulary might be used in a non-science context that may potentially confuse students? (Ex: force, reflection, etc.)

Teacher Background Builder (Click Links)



PLANNING GUIDE

Grade 2 Science

- **Develop learning progressions that have a logical sequence from the perspective of the student. Combine the skills with knowledge statements.**
- **Consider how the scientific methods will be integrated in the progression**

Start with Curriculum First

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Step 3 — **Connect Concepts to Foundational Knowledge**

Step 4 — **Develop learning progression & align Scientific Methods**

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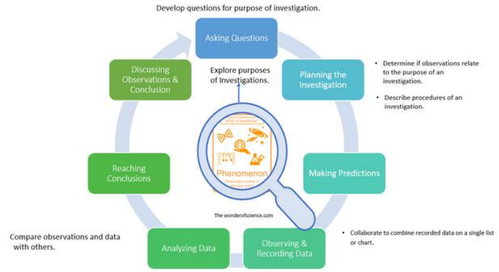
Understanding: Behaviours of light affect its path.

Behaviour of Light Affects Its Path Connect skills and procedures with concepts	Scientific Methods Investigation procedure steps Skills/procedures from KUSPS
1.**Identify sources of light include the Sun, electricity fire, some plants and animals** **Explore:** Mini dark box, Pinhole box **Explain:** St. make conclusions about light. Book: What are light Wave, p.-,4-5, 12 & Video	**Steps**: observations, predict, record observations, making conclusions, asking Questions **Skills**:Compare observations and data with others.
2.**Conduct an investigation to determine the path of light** • **Travels in a straight line** • **Travels through objects that can be see through** **Explore:** Light Beam, Light Traveler **Explain:** Book: Light - First Science p. 10 on Get Epic	**Steps**: Ask questions,plan the investigation, predicting, make & record observations, reach conclusions, **Skills**, Develop questions for the purpose of an investigation, Determine if observations relate to the purpose of the investigation. Compare observations and data with others.
3. **Conduct an investigation to determine the path of light is affected by different surfaces** • **bouncing off surfaces** • **affected by mirrors** • **examine how natural objects such as bodies of water affect path of sunlight**	**Steps**: Ask questions,plan the investigation, predicting, make & record observations, reach conclusions **Skills**:Develop questions for the purpose of an investigation, Determine if observations relate to the purpose of the investigation. Compare observations and data with others.
3. **Conduct an investigation to determine the path of light is affected as it travels from one material to another** • **bending light** • **affected by mirrors, prisms and water**	**Steps:** Ask questions,plan the investigation, predicting, make & record observations, reach conclusions **Skills**:Develop questions for the purpose of an investigation, Determine if observations relate to the purpose of the investigation. Compare observations and data with others.
4. . **Conduct an investigation to determine the path of light is affected as it travels from one material to another** • **splitting into colors** • **affected by mirrors, prisms and water**	**Steps:** Ask questions,plan the investigation, predicting, make & record observations, reach conclusions **Skills**:Develop questions for the purpose of an investigation, Determine if observations relate to the purpose of the investigation. Compare observations and data with others

Note: Progressions are sequencing of combined skills and concepts, not lesson plans

Investigation Procedures Cycle: Grade 2 Scientific Methods Skills & Procedures



Linked Resource

Guiding Questions:

- How will the concepts & skills be combined and sequenced in a way that is cohesive from the students' perspective to build on each idea (flow)?
- How will students use "explore before explain" to integrate the scientific methods to build knowledge?
- What resources would support student learning engagement with both the "explore and explain" phase of concept development?

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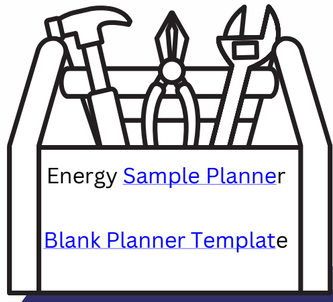

Start with Curriculum First

Step 1 — Analyze the outcomes

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Step 4 — Develop Learning Progressions & Align Scientific Methods

Step 5 — **Determine Evidence of Success**

Step 6 — Create Meaningful Learning Experiences

5. Determine evidence of what students know, understand, and are able put in action in an unfamiliar or real life context as a result of learning in this unit.

Understanding: Behaviours of light affect its path.

Single Point Rubric: Light to A Rainbow Obstacle Course

Grade 2 Science Methods LO Students examine investigation and relate it to purpose Computer Science LO: Students apply creativity when designing instructions to achieve a desired result:.	Grade 2 Organizing Idea: Energy LO: Investigate the behaviour of sound and light Understanding: Behavior of Light Affects its path
Student Name:	Date;

Grow	Met	Glow
	Skill: Determines path of light travels in a straight line and goes through materials. ☐ Course has light traveling in a straight line ☐ Uses material that light will go through	
	Skill: Determines the path of light bends and splits into colors **Knowledge**:Path of light is affected by mirrors, prisms and water. ☐ Uses mirrors to change direction of light path ☐ Uses water and/or prism to bend light and split into colors at the end	
	CS: Skill Create instructions using precise words, pictures or diagrams ☐ Draws and writes directions to set up obstacle course in a precise way others are able to follow	
	SM: Skill Develop Questions For Purpose of Investigation ☐ Generates a question not a statement ☐ The question relates to building an obstacle course with light that includes the 4 pathways	

Guiding Questions:

- How will students (insert verb from LO) their understanding of (insert understanding statement from KUSPs? (Ex: How will students investigate behaviour of light ?)

Scientific Methods

- How can I use the Understanding statements to develop summative assessment that assess what students know, understand? EX: How will students express the purpose of the investigation?

Verb Glossary

Sample Rubric

Blank Rubric

PLANNING GUIDE

Grade 2 Science

- **Plan for instruction that is cohesive from the students' perspective.**
- **Be strategic in sequencing lessons that builds on prior knowledge and learning, as well as having the potential to extend student thinking.**

Start with Curriculum First

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- Step 2: **Examine the KUSPS in the Organizing idea**
- Step 3: **Connect Curriclum to Important Science ideas**
- Step 4: **Examine the KUSPS in the Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: Create Meaningful Learning Experiences

Clarity: Teacher & Learner can answer

	Where the learner is going	Where the learner is	How to get there
Teacher	Clarifying, sharing and understanding learning intentions	Engineering effective discussions, tasks, and activities that elicit evidence of learning	Providing feedback that moves learners forward
Peer		Activating students as learning resources for one another	
Learner		Activating students as owners of their own learning	

Dylan, W. (2011). *Embedded formative assessment*. Bloomington, IN: Solution Tree Press

Guiding Questions:

- What underlying prior knowledge do the students need to have from previous grades?
- How can I access what ideas students' already have (pre-assessment)?
- How can I minimize potential misconceptions with the science ideas?
- What vocabulary in science (scientific methods, every day meaning and science meaning) do students need to use and know?
- Where can I integrate cross curricular connections for students? For example KUSPs from ELAL (Ex: Oral Language, vocabulary development, text) and/or math (Ex: measuring, statistics)?
- What do I want to hear and see from students during lessons that demonstrate their progress in the Skills and Procedures?
  (Formative Assessment)

1 ARPDC CPAR Document
2. CMASTE
3.. Instructional Strategies

Integrating The Scientific Methods

Sources

Almarode J. & Vandas K. L. (2018). *Clarity for learning : five essential practices that empower students and teachers.* Sage/Corwin.

Ashbrook, P. (2012) *Shining Light on Misconceptions.* p. 30-31 Science and Children. National Science Teaching Association.

Brown P. (2020). *Instructional sequence matters grades 3-5 : explore before explai*n. National Science Teaching Association.

Brown P. (2021) *Shining light on explore before explain for early childhood learners.* Science and Children: National Science Teaching Association.

Dylan, W. (2011). *Embedded formative assessmen*t. Bloomington, IN: Solution Tree Press

Education Endowment Fund (December, 2023) Improving Primary Science Report Retrieved from https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/primary-science-ks1-ks2

Fisher D. Frey N. Amador O. & Assof J. (2019). *The teacher clarity playbook : a hands-on guide to creating learning intentions and success criteria for organized effective instruction ; grades k-12 (First)*. Corwin a SAGE Company

Kaiser, N (November 16, 2020) New Resources for Tackling Scientific Misconceptions. Retrieved from https://educationendowmentfoundation.org.uk/news/eef-blog-introducing-new-resources-for-sorting-out-scientific-misconceptions

Keely, P. (February, 2012) *Formative Assessment Probes: Does It Reflect Light?* Science and Children. National Science Teaching Association.

Shallcross, R. (2017) *Common Misconceptions: Seeing the Light* Retrieved from https://explorify.uk/teacher-support

Wiggins G. P. & McTighe J. (2011). T*he understanding by design guide to creating high-quality units.* ASCD.