Alberta Regional Professional Development Consortia

Adult learning for students' sake

Grade 3

Integrating Scientific Methods with other Organizing Ideas

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

Sample Energy:
Forces can affect properties and movement of objects

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. Curriculum Subject Introduction (2023)

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 Sequence & Align Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: **Plan for Instruction**

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

How can forces relate to changes in movement?

Energy	Scientific Methods
Students investigate and explain how **forces** affect the **movement of objects**.	Students relate **investigation** to **building knowledge**.

Note: The skills & procedures from the scientific methods development is 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?

"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 3 Science

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

Start with Curriculum First

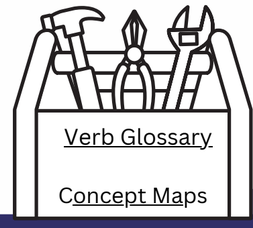
- Step 1: **Analyze the outcomes**
- Step 2: **Examine KUSPS Related To Learning Outcome.**
- Step 3: **Connect Concepts to Foundational Knowledge**
- Step 4: **Develop Learning Sequence & Align Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: **Plan for Instruction**

Forces can affect properties and **movement** of **objects** in different ways.

Knowledge: A force is a push or pull on an object resulting from an interaction with another object	**Skills**: Describe where forces may exist in everyday situations.
Knowledge: An object that is not moving will stay still until a **force** makes it move, and an object that is moving will keep moving until a force stops it. (Newton's First Law) **Contact forces** occur between **objects** that touch each other. **Contact forces** include **forces** that are • applied by a person or an object on another object (applied) • caused by objects, surfaces, or substances sliding against each other (friction) • applied by pulling on a string or rope connected to an object (tension) • caused by a compressed or stretched object or spring (elastic or spring) Ways to apply a **contact force** to an object include • stretching • pulling • squeezing • pushing	**Skill:** Conduct investigations to demonstrate the effects of forces on the movement of objects. **Skill:** Predict how an object will be affected by different strengths and directions of force. **Skill:** Describe the strength and direction of forces applied to objects. **Skill:** Compare the strength of forces applied to objects *__Skill:__ Conduct investigations to demonstrate how forces can change the shape or size of objects.(Not included in sample plan)
The direction of forces applied to objects can be described as • upward • downward • from the left • from the right • from both sides • from all directions The strength of forces applied to objects can be described as • strong • weak • large • small	
Changes to an object's movement when a force is applied include • changing speed • starting • stopping • changing direction	

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?



PLANNING GUIDE

Grade 3 Science

Understanding: Forces can affect properties and movement of objects in different ways

Start with Curriculum First

Step 1 — Analyze the outcomes

Step 2 — Examine KUSPS related to learning outcome

Step 3 — Connect Concepts to Foundational Knowledge

Step 4 — Develop learning sequence & align Scientific Methods

Step 5 — Determine Evidence of Success

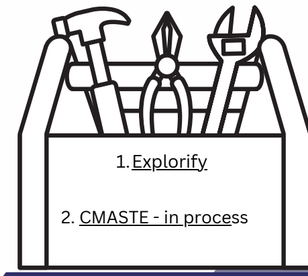
Step 6 — Plan for Instruction

- **Determine essential science ideas for teacher clarity to enhance student learning.**
  - Force is a push and/or pull we cannot see it just the effect
  - Movement (speed, slow down, change direction) or change of shape is the result or consequence of force
  - Friction is a contact force caused by surfaces sliding against each other that affects movement (opposes movement)
  - To slow or stop an object a force must act on it
  - Simple machines allow small force to have greater effect by changing the direction or size of force
- **Determine potential student misconceptions students may develop or bring**
  - If an object is moving, a force must be acting on it. Motion implies force.
  - Forces get things going but don't stop things. An object stops because it runs out of force or energy.
  - All objects slow down and eventually stop on their own.
  - People have the power to move things, so objects move only when people push or pull them
  - Inanimate or inert objects (like a table or chair) don't exert force.

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 do I need to keep in mind when planning instruction?
- 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)
Register free to explorify



Integrating Scientific Methods

PLANNING GUIDE

Grade 3 Science

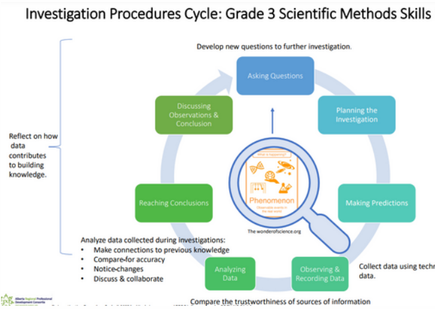
1. **Develop learning progressions that have a logical sequence from the perspective of the student. Combine skills and knowledge stateme Note: Progressions are not lesson plans.**
2. **Consider where scientific methods could be integrated in the progression**

Start with Curriculum First

- Step 1 — **Analyze the outcomes**
- Step 2 — **Examine the KUSPS in the Organizing idea**
- Step 3 — **Connect Concepts to Foundational Knowledge**
- Step 4 — **Develop learning sequence & align Scientific Methods**
- Step 5 — **Determine Evidence of Success**
- Step 6 — **Plan for Instruction**

Forces can affect theproperties and movement of objects Combine skills /procedures with knowledge statements	Scientific Methods Investigation procedure steps Skills/procedures from KUSPS
1. **Conduct investigations to demonstrate the effects of forces,pplied by a person or an object on another object on an object that is not moving will stay still until a contact force makes it move,** ▪ Describe the strength(strong, weak, large or small) and direction(upward, downward, from the left, from the right) of forces applied to objects. ▪ Predict how an object will be affected (changing speed, starting, stopping and changing direction) by different strengths and directions of force. ▪ Compare the strength of forces applied to object **Explore**: Playground Movement,Moving Block **Explain:** Push and pull video, Force Video	**Steps:** Asking questions, making predictions, planning the investigation, observing and recording data, analyzing data, reaching conclusions,discusing observations and conclusions. **Skills:** Collect data using techniques to improve the accuracy of data, Analyze data collected during investigations, Develop questions to further investigation.
2. **Conduct an investigation to demonstrate the effects of the contact force caused by objects, surfaces or substances sliding against each other (friction) affects movement or stops the object** ▪ Describe the strength(strong, weak, large or small) and direction(upward, downward, from the left, from the right) of forces applied to objects. ▪ Compare the strength of forces applied to objects. ▪ Predict how an object will be affected (changing speed, starting, stopping and changing direction) by different strengths and directions of force. **Explore:** Different surfaces **Explain:**: Give it a Push Give it a Pull book & Friction video	**Steps:** Asking questions, making predictions, planning the investigation, observing and recording data, analyzing data, reaching conclusions,discusing observations and conclusions. **Skills:** Collect data using techniques to improve the accuracy of data, Analyze data collected during investigations, Develop questions to further investigation.
3. **Conduct investigations to demonstrate the effects of contact forces applied by pulling on a string or rope connected to an object, on the movement of objects.** ▪ Describe the strength(strong, weak, large or small) and direction(upward, downward, from the left, from the right) of forces applied to objects. ▪ Compare the strength of forces applied to objects. ▪ Predict how an object will be affected (changing speed, starting, stopping and changing direction) by different strengths and directions of force. **Explore**: Tug of War, bridge **Explain:**	**Steps:** Asking questions, making predictions, planning the investigation, observing and recording data, analyzing data, reaching conclusions,discusing observations and conclusions. **Skills:** Collect data using techniques to improve the accuracy of data, Analyze data collected during investigations, Develop questions to further investigation.
4.**Conduct investigations to demonstrate how contact force, applied by compression(stretching) or stretched or spring, can change the properties (shape and size) of objects** **Explore:** Compress & Stretch **Explain:** Give it a Push, Give it a Pull Book, Stretch & Tensile video	**Steps:** Asking questions, making predictions, planning the investigation, observing and recording data, analyzing data, reaching conclusions,discusing observations and conclusions. **Skills:** Collect data using techniques to improve the accuracy of data, Analyze data collected during investigations, Develop questions to further investigation.

See sample plan for example



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?
- Where do students have an opportunities to practice the steps in the investigation cycle and demonstrate the skills from the scientific methods in the learning progressions?
- When will students be conducting an investigation?

Forced copies

Sample Plan

Blank Planner Template

Alberta Regional Professional Development Consortia
Adult learning for students' sake

Integrating Scientific Methods

PLANNING GUIDE

Grade 3 Science

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.

Scientific Methods **Learning Outcome:** Students relate investigation to knowledge building Computer Science: **Learning Outcome:** Students investigate creativity and its relationship to computational thinking	Organizing Idea: Energy **Learning Outcome:** Students investigate and **explain how forces affect the movement** and properties of objects **Understanding:** Forces can affect the properties and **movement of objects in different ways**
Student Name:	Date:

Grow	Met Criteria	Glow
	Skill: Predict how an object will be affected by different strengths and directions of force. ☐ Uses data from previous investigations to support prediction when anticipating how the strength of a kick down a ramp will change the speed of the ball ☐ Uses data from previous investigations to support prediction when anticipating how the ball will change direction ☐ Uses data from previous investigations to support prediction when anticipating how the ball will be slowed or sped up on different surfaces Ex: I predict if we kick the ball from the left towards the wall it will move around the bears and into the goal **because** when we played wall ball and I kicked it from the left	
	Skill: Describe the strength and direction of forces applied to objects. ☐ Uses words or arrows to describe the strength of force **applied to the ball** (strong, weak, large or small) ☐ Uses words (upward, downward, from the left, from the right,from both sides) when describing the direction of the force **applied to the ball**.	
	Skill: Compare the strength of forces applied to objects ☐ Uses words such as stronger, weaker, larger or weaker to compare the strength of forces applied to the ball in the different trials	
	SM Skill: Collect data using techniques to improve the accuracy of data by choosing an appropriate tool to correctly record the data ☐ Selects a ruler to assist with drawing lines and arrows to show movement of ball after force was applied	
	☐ Correctly labels the forces applied (push/pull) the strength and direction of those applied forces using correct words and/or arrows.	
	CM Skill: Create a set of instructions that could be that could be followed by a human or machine to complete a task ☐ Correctly sequences the steps, in writing, for others to apply similar force ☐ Provides recorded diagram of the successful s	

Start with Curriculum First

- Step 1: **Analyze the outcomes**
- Step 2: **Examine the KUSPS in the Organizing idea**
- Step 3: **Connect Concepts to Foundational Knowledge**
- Step 4: **Develop Learning Sequence & Align Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: **Plan for Instruction**

Guiding Questions:

- How will students (insert verb from LO) their understanding of (insert understanding statement from KUSPs? (Ex: How will students investigate how force affects the movement of an object?)

Scientific Methods

- How can I use the Understanding statements to develop summative assessment that assess what students know, understand? EX: How will students support or contradict existing knowledge through an investigation?

Verb Glossary

Sample Rubric

Blank Rubric

Integrating Scientific Methods

PLANNING GUIDE

Grade 3 Science

Start with Curriculum First

- Step 1: **Analyze the outcomes**
- Step 2: **Examine the KUSPS in the Organizing idea**
- Step 3: **Connect Curriculum to Important Science ideas**
- Step 4: **Develop Learning Sequence & Align Scientific Methods**
- Step 5: **Determine Evidence of Success**
- Step 6: **Plan for Instruction**

Understanding: Behaviours of light affect its path.

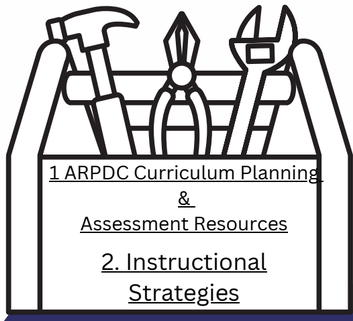
1. **Plan for instruction that is cohesive from the students' perspective.**
2. **Be strategic in sequencing lessons that builds on prior knowledge and learning, as well as having the potential to extend student thinking.**

	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 (Pre-assessment)?
- How can I minimize potential misconceptions with the science ideas?
- How can students use "explore before explain" to integrate the science methods?
- Where can I integrate cross curricular connections for students? For example KUSPs from ELAL (Ex: talking, 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)



Integrating Scientific Methods

Sources

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

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

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

Education Endowment Foundation, Improving Primary Science Retrieved (January, 2024) https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/primary-science-ks1-ks2

Explorify (2024) Forces...Tackle The Tricky Bits. Retrieved from https://explorify.uk/teacher-support/science-teaching-support/forces-tackle-the-tricky-bits

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

Keeley,P Pushes and Pulls: Formative Assessment Probes (p. 28-30), Science and Children (2011) NSTA

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

Windschitl, M. and Thompson, J. Ambitious science teaching. (2018). Harvard Education Press.

*Unless specified, all images are licensed under Canva.com