ELEMENTARY SCIENCE CASE STUDY

Physical Science Standard 3-PS2-3

What are the students learning?

Grade level standard:

3-PS2-3: Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Science and Engineering Practices (SEP): Asking Questions and Defining Problems

- Ask questions that can be investigated based on patterns such as cause and effect relationships.

Disciplinary Core Ideas (DCI): PS2.B: Types of Interactions

- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Cross-Cutting Concepts (CCC): Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change[1]

Example Learning Progression for Elementary Science:

WA-AIM Access Points			Teacher adjusted	Grade Level Standard
Less Complex	**Intermediate**	**More Complex**	**Further Complexity**	**Grade Level Standard**
Student will identify a question about the cause of a magnetic interaction between two objects that do not touch.	Student will ask a question to determine a cause OR an effect relationship of electric or magnetic interactions between two objects that do not touch.	Student will ask a question to determine the cause AND effect relationships of electric or magnetic interactions between two objects that do not touch.	Student will ask multiple questions to determine the cause and effect relationships of electric or magnetic interactions between two objects that do not touch.	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Educator adapts instruction to meet the needs of students and deepen learning toward grade level standard

How could I teach this standard in general education to all

[1] Washington's science standards, adopted from the Next Generation Science Standards, represent a three-dimensional learning framework with the standard (performance expectation) alongside the method (science and engineering practices), the content (disciplinary core ideas), and the conceptual framework (cross-cutting concepts).

students?

Students are investigating how certain objects (magnets and static-charged items) can move each other without touching. The goal isn't just to know that magnets stick to fridges, but to understand the "rules" of the interaction: *If I change X (the cause), what happens to Y (the effect)?*

Planning for Engagement with a Phenomenon

A teacher may choose to start with an Anchoring Phenomenon—a puzzling event that students can’t explain yet.

- **The Phenomenon:** "The Levitating Rings." Show students a stack of ring magnets on a pencil. When flipped, a certain way, the top ring "floats" in mid-air without anything touching it.
- **The Big Idea:** Forces can act across a gap (non-contact), and the strength and direction of that force depend on specific "causes" (distance and orientation).

Eliciting Student Ideas

An educator may see what prior knowledge students have.

- **Initial Observations:** Students observe the rings. You ask, "*What do you see happening?*" and *"What do you think is in that empty space between the rings?*"
- **Initial Models:** Students draw a "before and after" model. They must draw what they see (the rings) and what they *think* is happening that they *cannot* see (the invisible force).

What I see	What I think is happening

The Science Practice (Asking Questions): Facilitate student reflection: "*What questions do we need to answer to figure out how to make the ring float higher or fall down?*"

  - *Student questions might include:* "Does it matter which side is up?" "What if the magnets were farther apart?" "Would a bigger magnet push harder?"

Supporting Ongoing Changes in Thinking Through Investigation

Students investigate the questions they just asked.

- **The Investigation:** Students get a bin of magnets and materials. They test their "Cause and Effect" questions:
  - **Investigation A (Distance):** How close does the magnet have to be to pull a paperclip? (Testing the *effect* of distance).
  - **Investigation B (Orientation):** What happens when we flip the poles? (Testing the *effect* of direction).
  - **Investigation C (Static):** Using a balloon to move a soda can without touching it. (Connecting magnetic forces to electric forces).
- **The Summary Table:** After each mini-lab, the class adds to a giant wall chart:
  - What we did (Flipped the magnet)
  - What we saw (Evidence; It pushed away instead of pulled)
  - What we think it means (Cause/Effect; Orientation changes the direction of force)

What we did	What we saw	What we think it means
Flipped the magnet	It pushed away instead of pulled	Orientation changes the direction of force

Pressing for Evidence-Based Explanations

Students return to the "Levitating Rings" to explain it using their new evidence.

- **Revised Models:** Students update their initial drawings. They might now add "field lines" or arrows of different sizes to represent the strength of the force.
- **The Explanation:** Students must complete a "Cause and Effect" statement: "*The ring floats because the magnetic force is pushing upward. If we increase the distance, the effect is that the force gets weaker and the ring drops.*"
- **General Ed Scaffolding:** For a general education classroom, you might provide "Sentence Frames" to help all learners participate in the science practice of *Constructing Explanations*:

"I think the **cause** of the ring floating is ________. I know this because when we ________, the **effect** was ________."

How could I measure understanding of the standard for students with significant cognitive disabilities?

Start with how you measure student understanding for all students and adapt from there. For example, if you ask students to explain the cause-and-effect relationship to you or a peer while physically moving the magnets, you could do the same for a student who has significant cognitive disabilities. For students who might need alternatives, their task may involve a visual "Menu of Variables" to help them form questions. Multimodal assessments could include tasks like a photo essay demonstrating the cause and effect they investigated alongside interviews or conferences with students to gauge their understanding and inquiry.

If the student requires additional support, use the WA-AIM Access Point Framework to scaffold the standard.

Further Complexity towards the Grade-Level Standard

It is important to give the student an opportunity to demonstrate their understanding of the grade level standard. However, they may need some accommodations and possibly slight modifications in how it is assessed. In this case, two options might be appropriate.

First, the team may increase the amount of scaffolding or accommodations that most students already get on the assessment, and/or provide the student an opportunity to demonstrate skills in the general standard with a focus on the essential components and greater instructional scaffolding. For example, in this lesson, the student may be able to meet the grade-level standard, given:

- More accommodations compared to other students (e.g., written answer choices instead of open response questions, more prompting)
- Additional scaffolding (e.g., question menu, question/sentence starters)

<table>
<tr><th>The Variable</th><th>The Action</th></tr>
<tr><td>Distance</td><td>What if I move the magnet further away?</td></tr>
<tr><td>Orientation</td><td>What if I flip one of the magnets over?</td></tr>
<tr><td>Strength</td><td>What if I use a bigger magnet or stack two together?</td></tr>
<tr><td>Barrier</td><td>What if I put a piece of paper or my hand in between?</td></tr>
<tr><td>Quantity</td><td>How many paperclips can one magnet hold at once?</td></tr>
<tr><td colspan="2">Scientist "Sentence Starter"
• "I wonder if..."
• "What happens to the [push/pull] if I change the [variable]?"
• "If I move it closer, will the effect be stronger or weaker?"</td></tr>
</table>

If the student requires additional scaffolding, consider the More Complex Access Point.

More Complex (WA-AIM Access Point)

For the **More Complex Access Point**, the student is moving toward the full grade-level standard. The key distinction here is the requirement to link **both** the cause (what they change) and the effect (what happens) into a single inquiry.

At this level, we aren't just looking for "What happens?" We are looking for "What happens **to Y** if I change **X**?"

The Goal: Student will ask a question to determine the **cause and effect** relationships between electric or magnetic interactions between two objects that do not touch.

To assess this, provide a **"Build-a-Question" Graphic Organizer**. This allows the student to independently construct a complex scientific question using visual variables.

Assessment Activity: "The Variable Scientist"

- **The Setup:** Provide a "Menu of Causes" (e.g., adding more magnets, flipping poles, changing distance) and a "Menu of Effects" (e.g., moves faster, moves slower, pushes away, pulls closer).
- **The Task:** The student must select one item from each menu to create a complete investigation question.
- **The Action:** The student places their selections into a "Question Template."

Example of a Completed Student Question Template:

"If I **[Icon: Add more magnets]** (The Cause), will the paperclip **[Icon: Move from further away]** (The Effect)?"

If the student requires additional scaffolds beyond the More Complex Access Point, consider using the Intermediate Access Point

Intermediate (WA-AIM Access Point)

The Goal: Student will ask a question to determine a **cause OR an effect** relationship of electric or magnetic interactions between two objects that do not touch.

To assess this, you might provide a Question Choice Board featuring icons. If communication serves as a barrier, give the student options to choose from to initiate the investigation.

Assessment: "Pick the Test"

- **The Setup:** Present a magnet and a paperclip.
- **The Task:** Ask the student, "What should we find out?" Show two visual question cards:
  - **Cause focus:** "What happens if we add a *second* magnet?" (Changing the cause).
  - **Effect focus:** "Will the paperclip *jump* to the magnet?" (Predicting the effect).
- **The Action:** Ensure the student can say, touch, or move the chosen question card to the "Investigation" side of a Venn Diagram or sorting board to show they understand which part of the experiment they are testing.

If the student continues to require additional scaffolding given the Intermediate Access Point, consider the Less Complex Access Point.

Less Complex (WA-AIM Access Point)

The Goal: Student will identify a question about the cause of a magnetic interaction between two objects that do not touch.

The Less Complex Access Point for this standard is to recognize *which* question is actually about the "how" or "why" of the magnet moving. Start by demonstrating the "Levitating Rings" again.

Assessment: "Is this a Science Question?"

- **The Setup:** Show the student the rings "floating."
- **The Task:** Present two auditory or visual choices. One is a scientific question about the cause; the other is a non-scientific observation.
  - **Option A (The Question):** "Does the magnet move because I flipped it?"
  - **Option B (The Statement):** "The magnets are round circles."
- **The Scaffolding:** If the student has difficulty reading text, use High-Contrast Visuals (e.g., a photo of a hand flipping a magnet for Option A vs. a photo of just the shape for Option B). The student identifies the "Question" card to show they recognize inquiry related to the cause.

Reducing Barriers for Learners who have Significant Cognitive Disabilities in Large Group Lessons

Make reducing barriers an ongoing practice embedded in the instructional process—take a few minutes to think about your process! Is there a barrier related to:

- **Interest or engagement?** Think about how to incorporate the student's lived experiences and interests. For example, use magnetic "trains" for a student who loves transportation, or use a static-charged balloon to move a soda can for a student who responds well to high-visual-impact demonstrations.
- **Background knowledge?** Think about highlighting key ideas (e.g., invisible forces can move things without touching them) and define key vocabulary (e.g., Attract means pull; Repel means push). Use consistent hand gestures alongside these words to provide a physical anchor for the concept.

- **Showing what they know?** Think about having options for how students use learning tools (e.g., using a Switch to trigger a motorized magnet, or using pictures or an AAC device to select a variable) and technology to communicate.

Real-World Example

One possible barrier is the communicative demand of "Asking a Question." In a large group, a student may understand the science but lack the verbal syntax to phrase a "What happens if..." question quickly.

Ideas to reduce this barrier could include classroom educators offering a **"**Prediction Choice Board." Instead of asking the student to generate a question from scratch, the teacher provides two photos of an experiment—one where the magnet is close and one where it is far. The student points to the one they want to "ask" about, and the teacher narrates: "*You're asking, 'What happens if we move it far away?' Let's test your question!*"

Other Accessibility Considerations:

- **Sensory Processing:** For students who are sensitive to the "snap" sound of magnets, provide noise-canceling headphones or use soft magnetic materials (like magnetic foam blocks).
- **Physical Access:** Use "jumbo" magnets or magnets with handles for students with limited fine motor grip, ensuring they can play an active role in the class investigation.
- **Visual Clarity:** Use high-contrast tape (like bright yellow) on the "poles" of the magnets so the student can clearly see which side is being flipped.

Expanded Learning Progression for Elementary Science

	WA-AIM Access Points			Teacher Adjusted	Grade Level Standard
	Less Complex	**Intermediate**	**More Complex**	**Further Complexity**	**Grade Level Standard**
Student Skill	Student will identify a question about the cause of a magnetic interaction between two objects that do not touch.	Student will ask a question to determine a cause OR an effect relationship of electric or magnetic interactions between two objects that do not touch.	Student will ask a question to determine the cause AND effect relationships of electric or magnetic interactions between two objects that do not touch.	Student will ask multiple questions to determine the cause and effect relationships of electric or magnetic interactions between two objects that do not touch.	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
Complexity Details	• Identify/select a question about cause (the magnet and object).	• Ask a question about cause OR effect (magnetic or electric interaction)	• Ask a question about cause AND effect (magnetic or electric interaction)	• Ask multiple questions about cause AND effect (magnetic or electric interaction)	• Ask questions about cause AND effect (magnetic or electric interaction).
Success Criteria Ex:	• Points to a word/visual from a word bank to complete a question stem when shown the floating rings (Why did the rings ____?). • Activate a single-message switch to ask a question.	• Uses a choice board to select one variable to test: "What if I flip it?"	• Uses a sentence frame to ask: "If I move the magnet closer, will it pull harder?" • Use a communication device to combine to icons to ask a cause and effect question (e.g., Will [distance] change the [pull]?)	• Uses a "Variable Menu" to select and test three different ways to change the force. • Use a question-building template to select multiple variable.	• Independently generates (writes or dictates) "How does [X] affect [Y]?" questions for magnets and static electricity.
Instructional Strategy Examples	Visual Supports • Photo of phenomenon vs. photo of unrelated object Scaffolds • Identifying the "?" symbol as the start of a science inquiry Technology • Voice output switch with a pre-recorded question	Visual Supports • Icon cards for "Flip," "Move Close," and "Move Far." Scaffolds • "Pick a test" choice board Technology • Virtual magnet simulators	Visual Supports • "If/Then" graphic organizer with icons Scaffolds • Haptic feedback (feeling the push/pull) to ground the question Technology • AAC with scientific vocabulary	Visual Supports • Summary table to track multiple "Cause/Effect" tests Scaffolds • Question starters: "I wonder if..." Technology • Video recording of trials for comparison	Visual Supports • Force field diagrams Scaffolds • Explicit instruction in scientific modeling and variables. Technology • Advanced simulation software