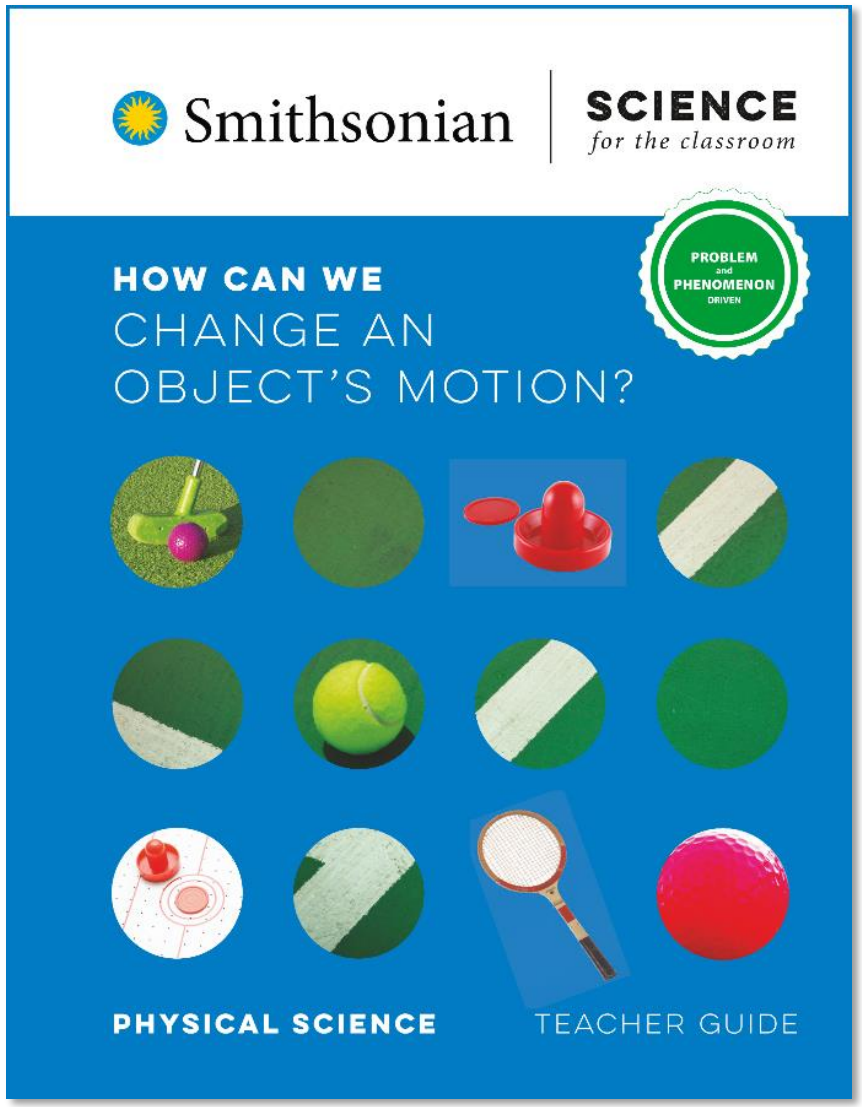
CAROLINA
UNLEASH LEARNING

Smithsonian | SCIENCE for the classroom

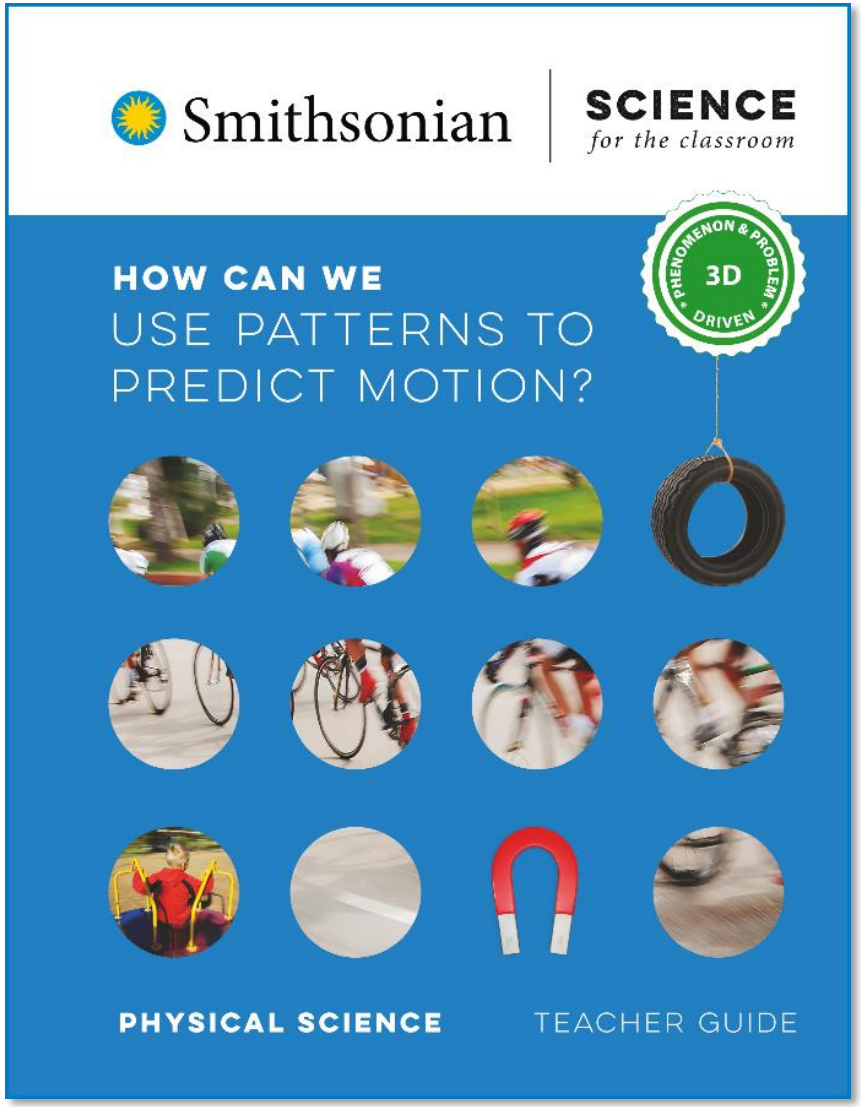
A Force To Be Reckoned With: Using Hands-On and Literacy to Build Elementary Students' Understanding of Forces

PHENOMENON & PROBLEM * 3D * DRIVEN

Kindergarten



3rd Grade



Reading, Writing, and Speaking **for Purpose**

K

3rd

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8:15-8:30	Morning meeting
8:30-9:30	Math
9:30-10:30	Reading
10:30-11:30	Writing
11:30-12:30	Lunch/Recess
12:30-1:30	Specials
1:30-1:45	Snack
1:45-2:45	Science/Social studies
2:45-3:00	Pack up

Using ELA Time to Read and Write About Science

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HOW CAN WE CHANGE AN OBJECT'S MOTION?

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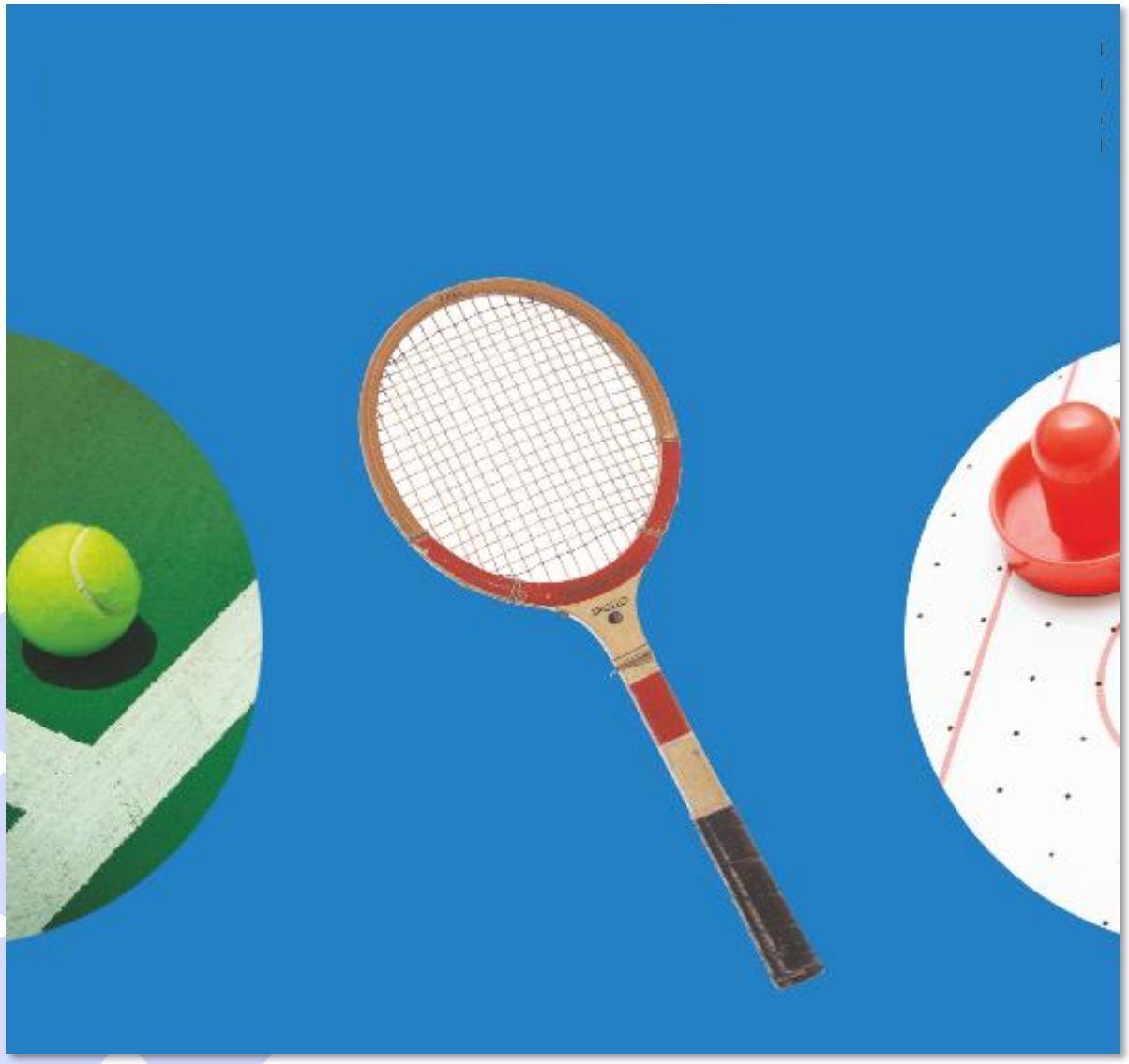

Lesson

7

Wall Tests

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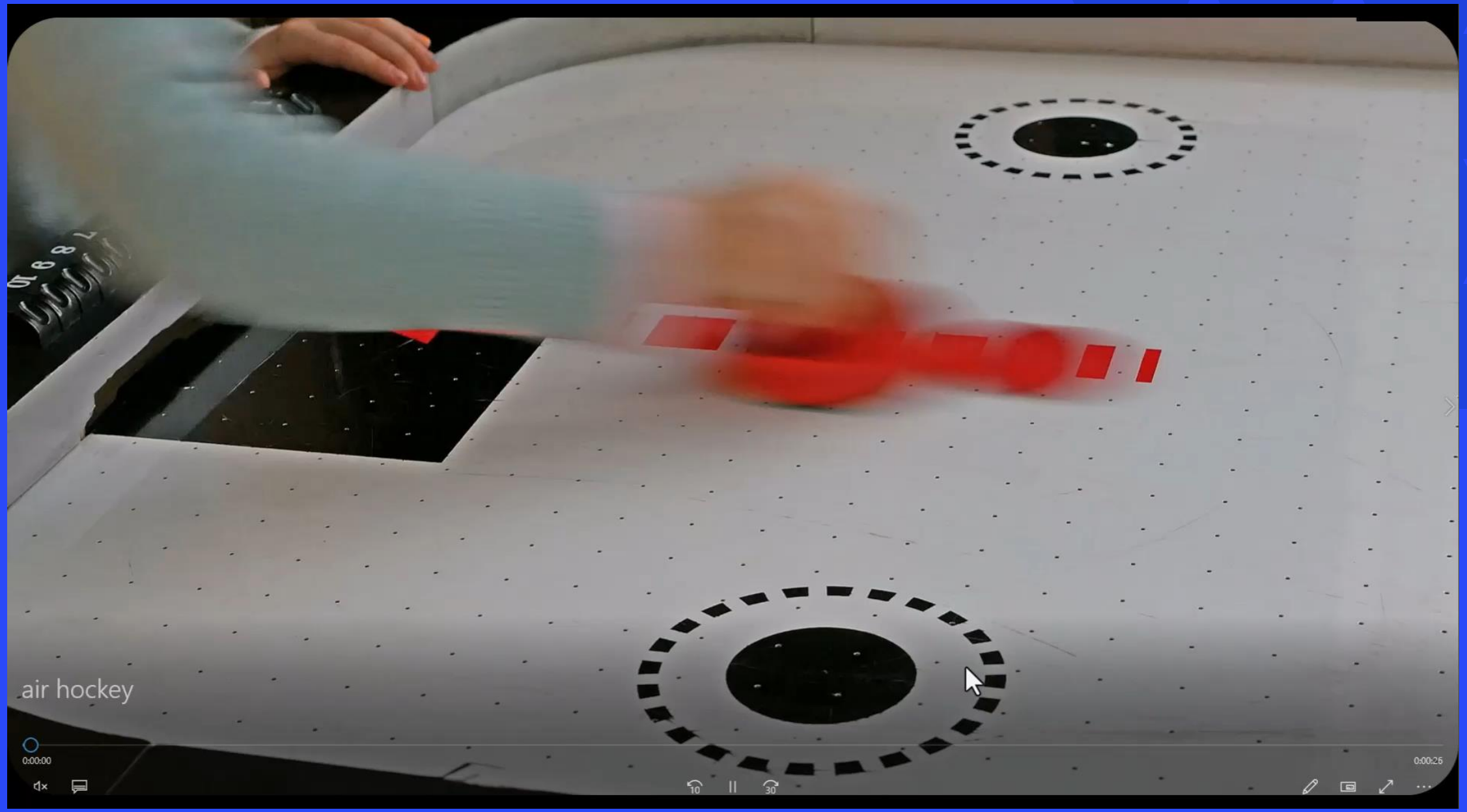
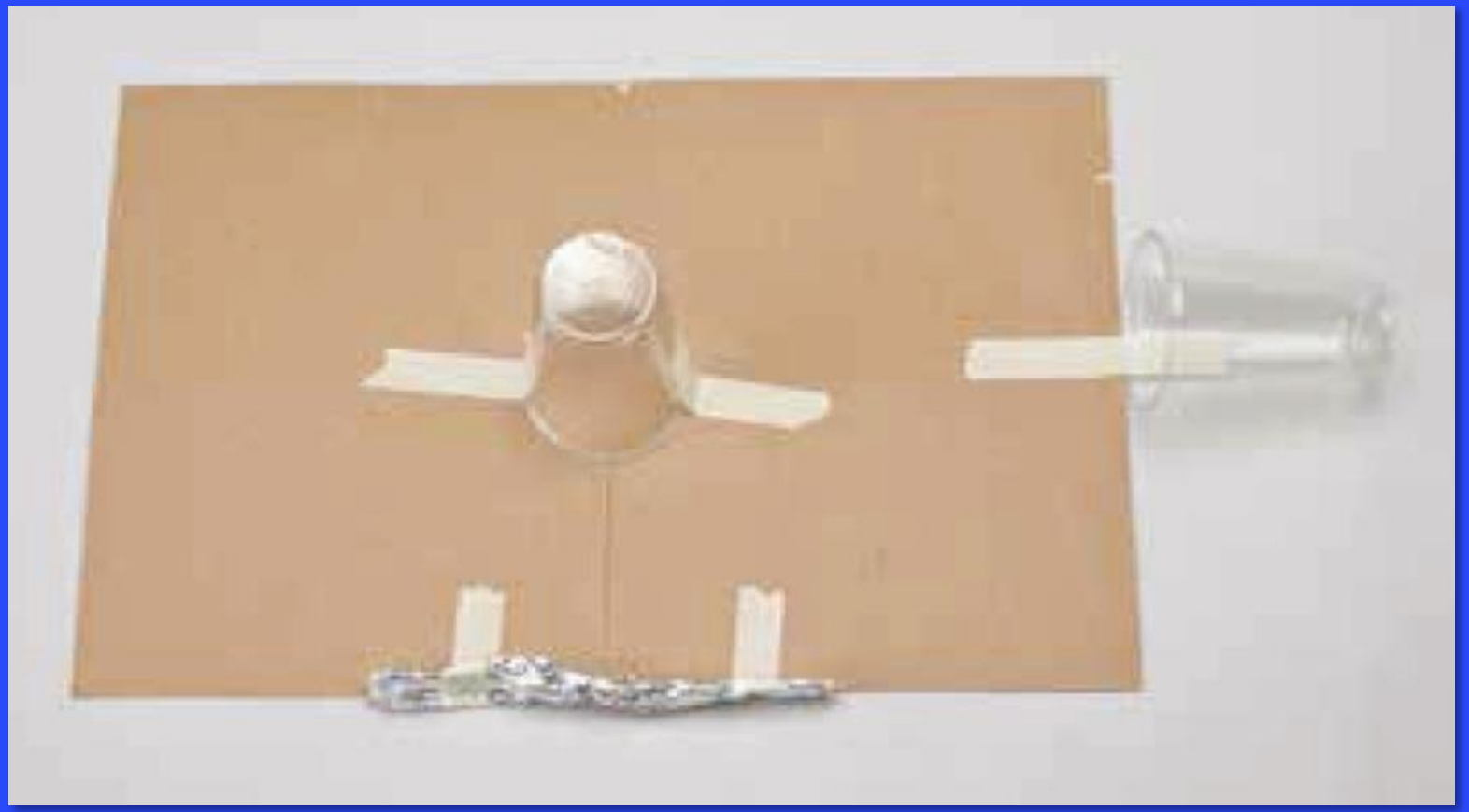


Wall Tests

Aluminum Foil Station



Wall Tests

Aluminum Foil Station

Tongue Depressor Station

Foam Station

Cardboard Tube Station

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Lesson 7 Notebook Sheet

Which Materials Make a Good Side Wall?

Aluminum foil 	
Tongue depressor 	
Foam 	
Wooden dowel	
Cardboard tube 	
Paper 	

✓ Good

X Not Good

Engineers Investigate: Which materials make a good side wall?

Lesson 7 Notebook Sheet

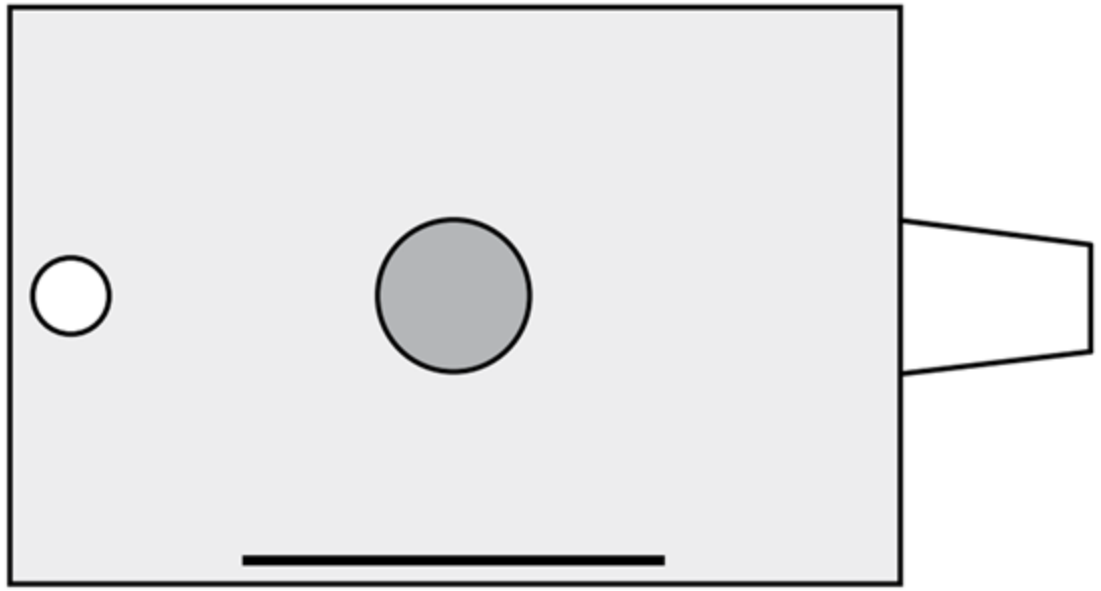
Which Materials Make a Good Side Wall?

Aluminum foil	
Tongue depressor	
Foam	
Wooden dowel	
Cardboard tube	
Paper	

✓ Good
X Not Good

198 How Can We Change an Object's Motion?

Wall Test

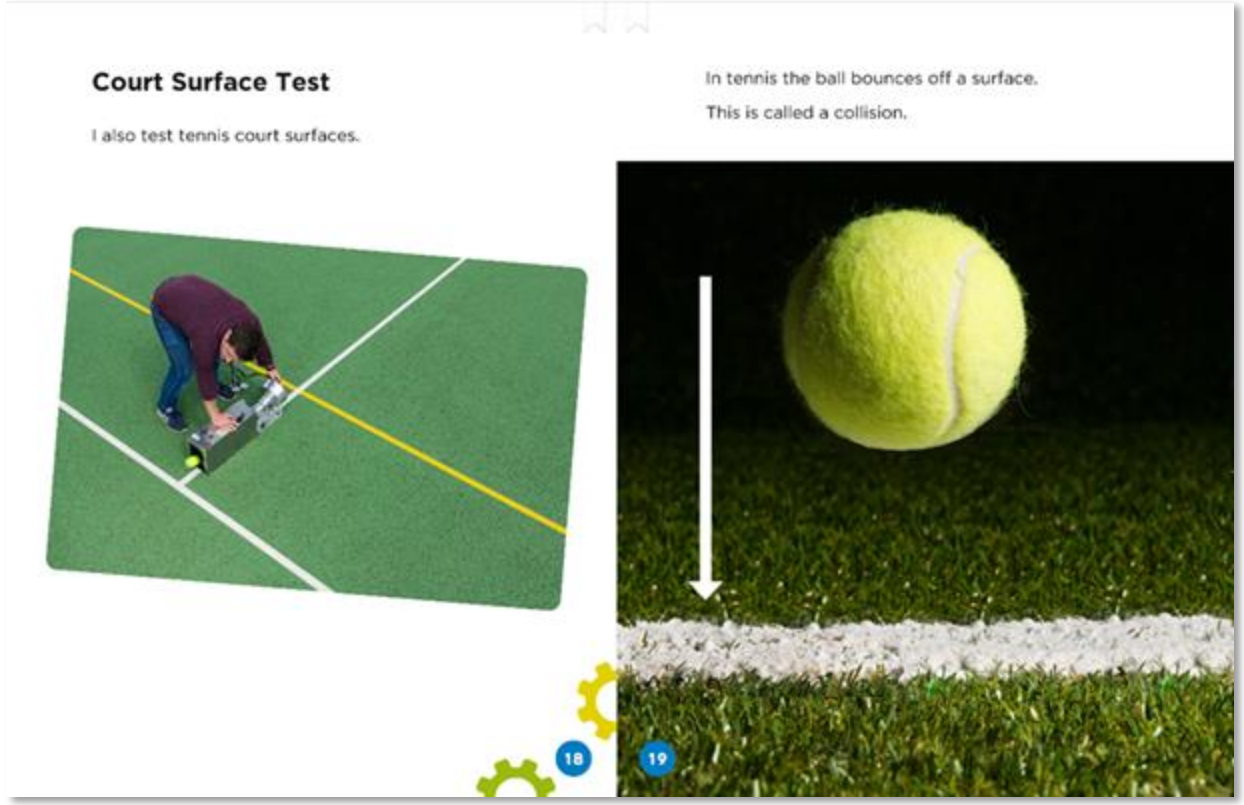


Lesson 7 Activity Sheet

202 How Can We Change an Object's Motion?

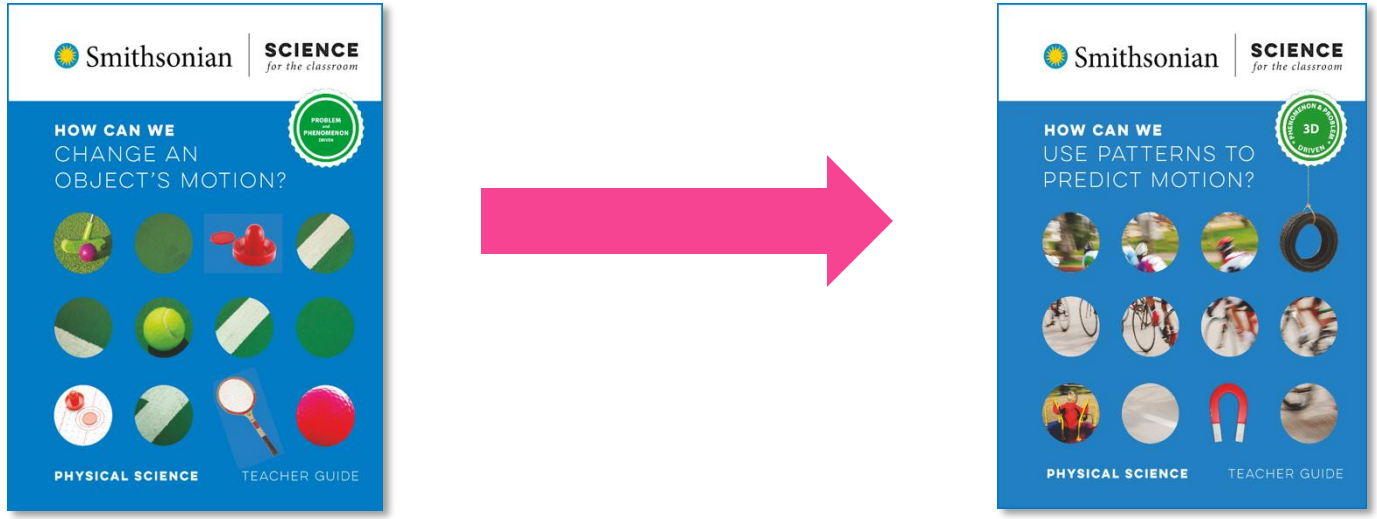
Reading: Tennis Tests

Read: Court Surface Test



Connection Between Kindergarten and 3rd-Grade Modules

- **Kindergarten DCI:** When objects touch or collide they push on one another and can change motion.
- **Grade 3 DCI:** Electrical 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.



HOW CAN WE USE PATTERNS TO PREDICT MOTION?

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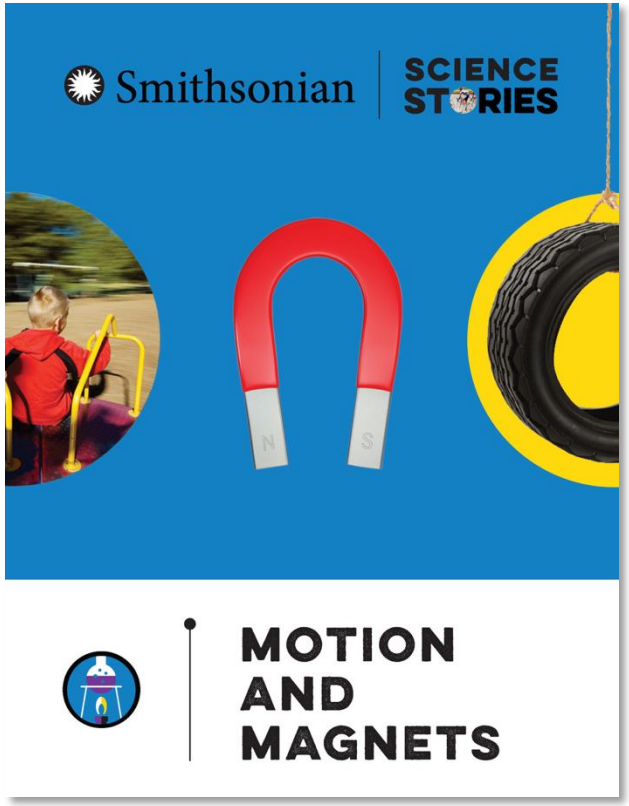
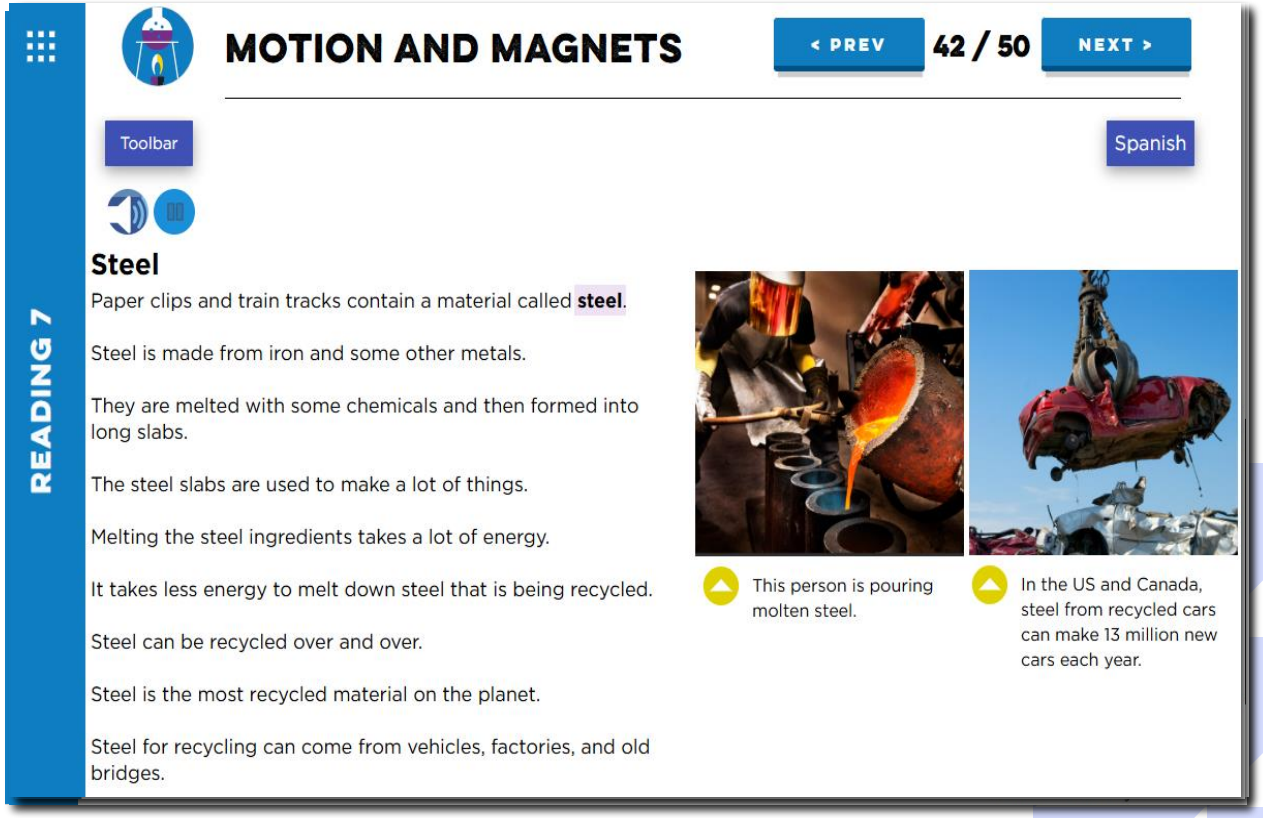
Students' Work Is Driven by a Problem

Problem: Trash has been thrown into a single can and needs to be separated into recyclables.

Read: Recycling Research





Tips for Using Text to Help Explain a Phenomenon or Solve a Problem

- Introduce the text as informational text.
- Flip through the story to look at titles, illustrations, and captions—predict what the reading will be about and maybe how it could help explain the phenomenon or solve the problem.
- Read twice! Many options:
  - Teacher reads aloud
  - Students skim to look for important sections
  - Close read
  - Pair read
- Copy the reading so students can annotate it or have students use sticky notes to label important parts.

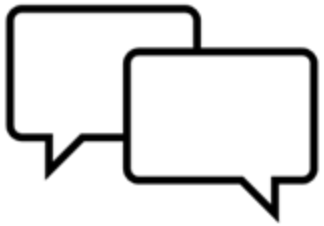
Lesson 9 Activity Sheet A

Recycling Facts

Material	Recycling facts
Aluminum	
Glass	
Paper	
Plastic	
Steel	

Model Trash

Engineers Define Problems



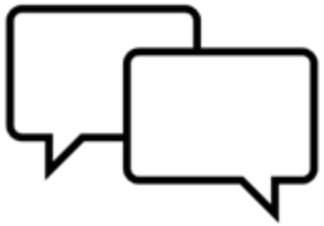
How have we defined our problem so far?

Which materials do you think we should separate out and why?

Some of you mentioned using magnets to separate out steel objects. Why do you think that would help?

Have you thought about how you would get objects off the magnet once you pulled it out of the trash?

Engineers Define Problems



Why do you think a paper clip starts to move toward a magnet when the magnet is close to the clip?

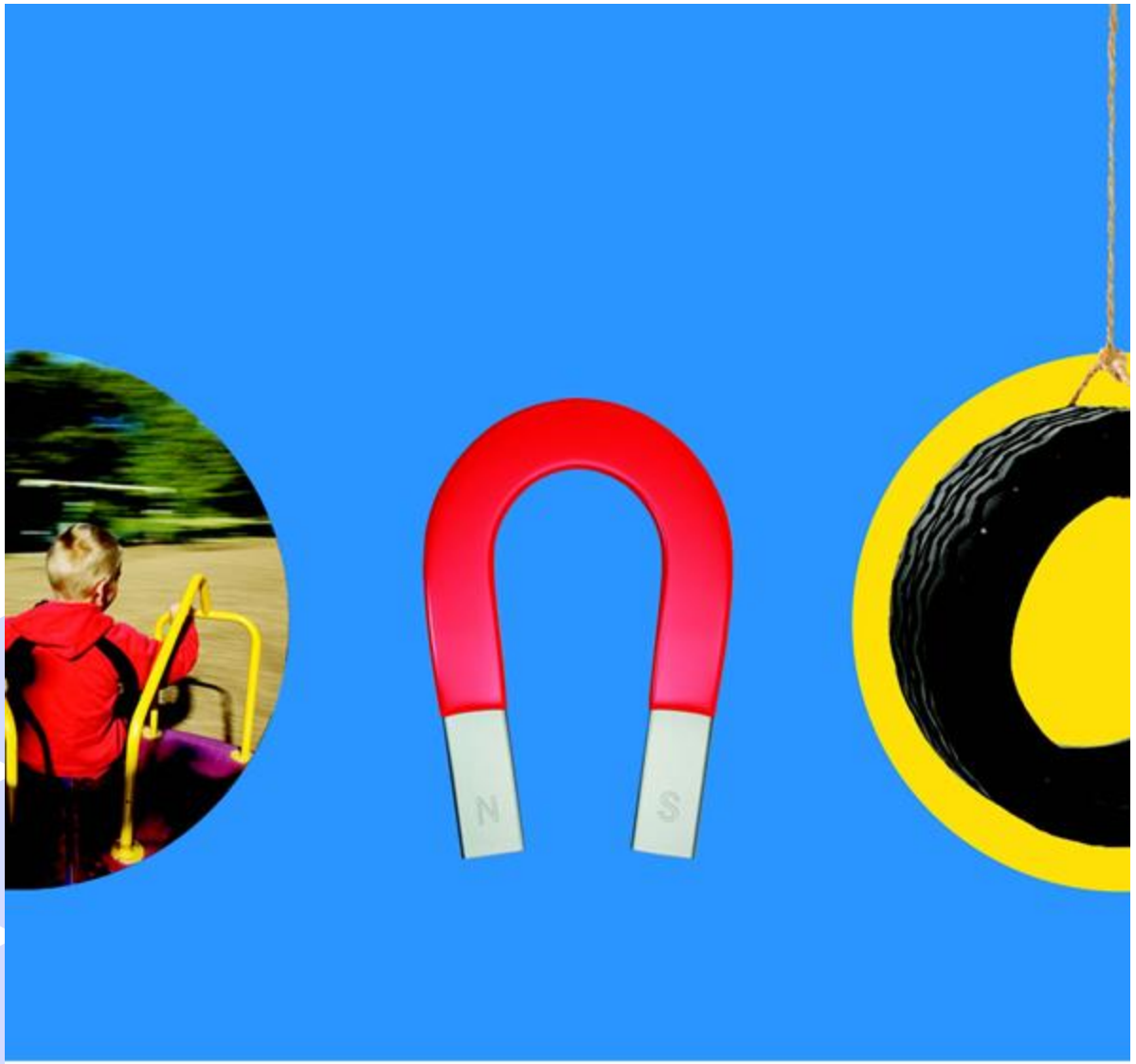
How do you know it was an unbalanced force?

Clip

How would you draw the **force** the magnet applied to the paper clip?

How could you represent **motion** of the paper clip on the diagram?

"Attract" is often used to describe the result of magnetic force on an object that is pulled toward the magnet.



Lesson

10

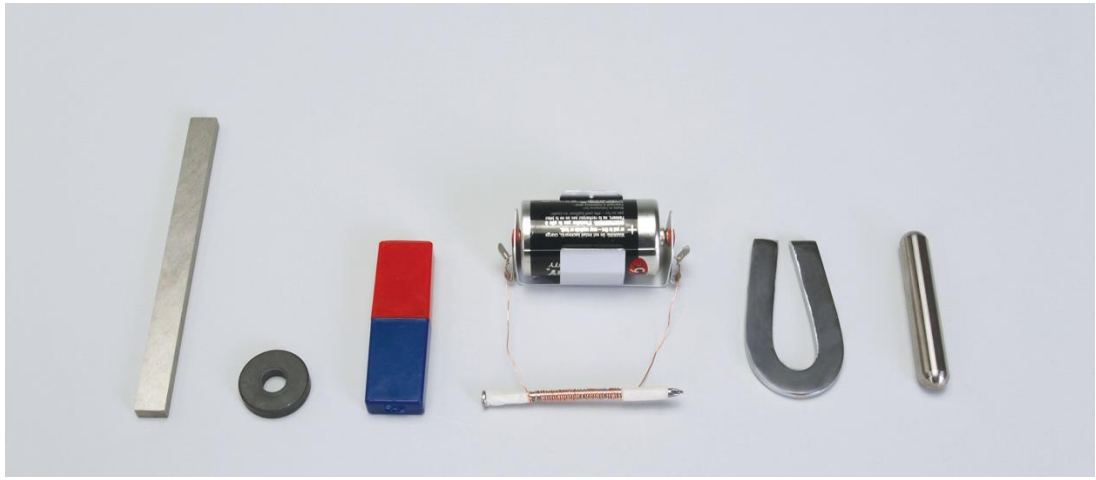
Can Magnets Help?

Group Roles

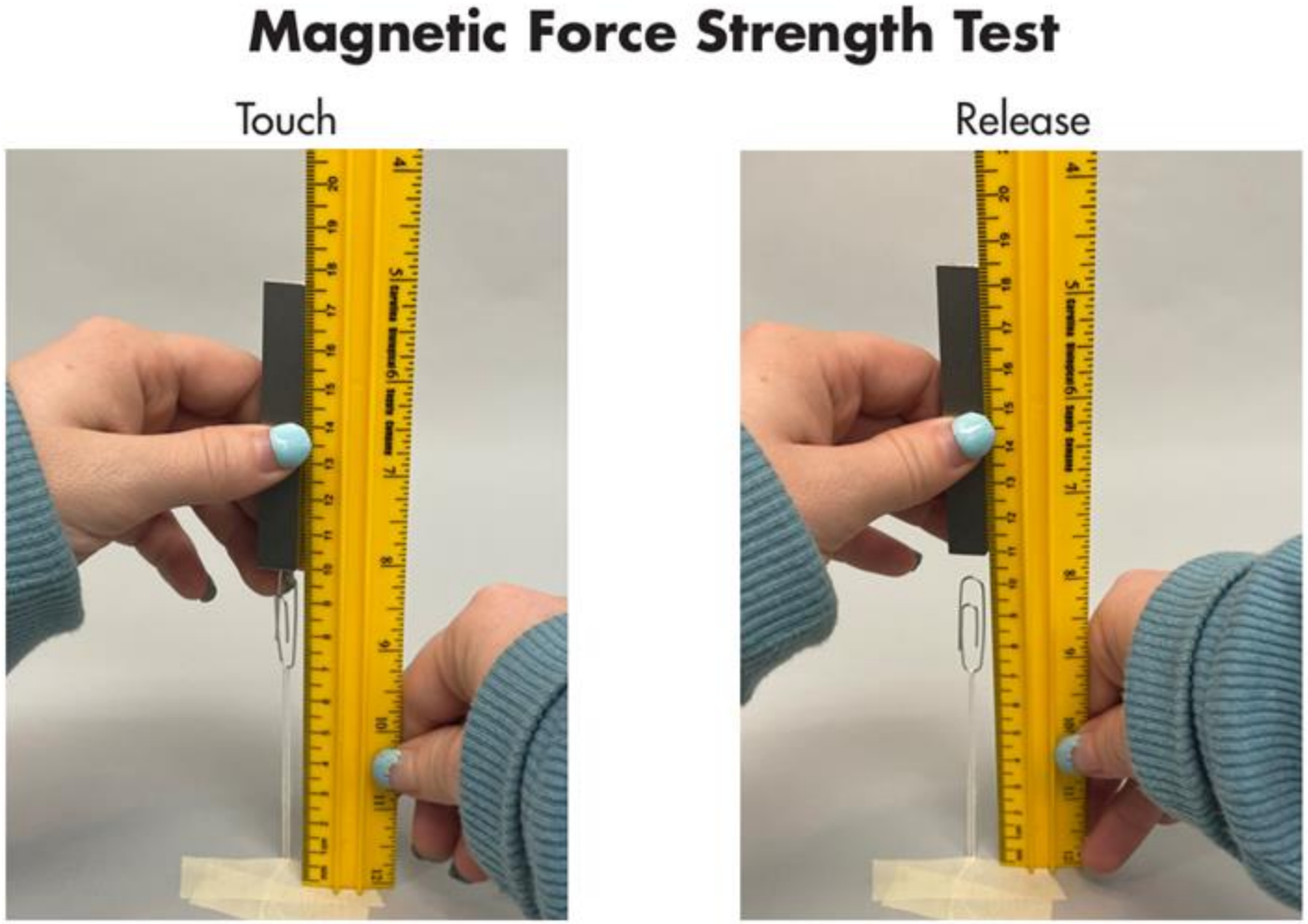
Engineers Investigate: Magnetic Force

Groups of 4

Materials Manager
Organizer
Questioner
Tester



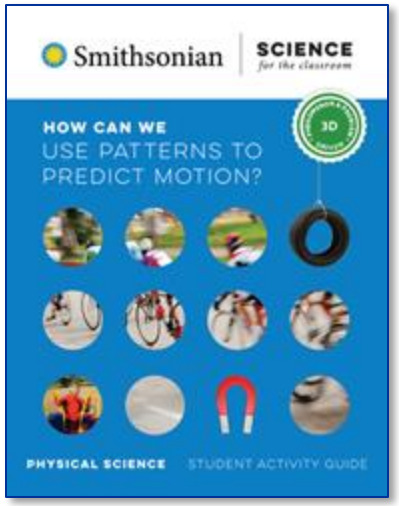
Engineers Investigate: Magnetic Force



What does this test tell you about magnetic force?

How can you tell if the magnetic force is stronger or weaker for different magnets?

Student Activity Guide: Review Materials



Lesson 10: **Can Magnets Help?**

Materials

For each student

- STEM notebook

For each group of four students

- 1 Lesson 10 Activity Sheet A
- 1 Lesson 10 Activity Sheet B

For the Small Bar Magnet station

- 2 Small bar magnets
- 1 Magnetic force strength tester
- 1 Metric ruler

13

For the Large Bar Magnet station

- 2 Large bar magnets
- 1 Magnetic force strength tester
- 1 Metric ruler

For the Horseshoe Magnet station

- 2 Horseshoe magnets
- 1 Magnetic force strength tester
- Metric ruler

For the Ring Magnet station

- 2 Ring magnets
- 1 Magnetic force strength tester
- 1 Metric ruler

For the Cow Magnet station

- 2 Cow magnets
- 1 Magnetic force strength tester
- 1 Metric ruler

For the Electromagnet station

- 1 Electromagnet
- 1 Magnetic force strength tester
- 1 Metric ruler

14

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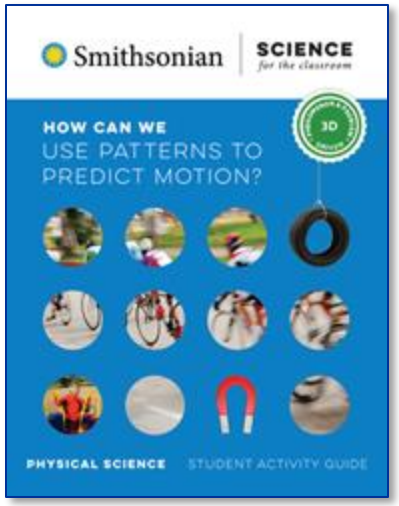
Student Activity Guide: Complete Steps 1–4



Stay Safe! The electromagnet nail and wire may get hot. Disconnect the wire from the battery when you are not testing this magnet.

Procedure

1. Is the paper clip attracted by a magnetic force? Record your results on Activity Sheet A.

Group Work Everyone should try a different test at a new station.

2. Do the TOUCH part of the magnetic force strength test. Record your results on your activity sheet.
   - Touch one magnet to the free end of the paper clip.
   - Lift the magnet until the string is stretched up.
   - Hold a ruler behind the string with the 0 cm end on the desk.
   - How far is the magnet from the desk?

3. Do the RELEASE part of the magnetic force strength test. Record your results in the notebook table.
   - Slowly pull the magnet higher.
   - How far away from the desk is the magnet when the paper clip is no longer attracted to the magnet?

Group Work You may need to test the magnet height a few times to get a good measurement.

Stay Safe! Magnets can snap together quickly and pinch you. Keep your fingers away from magnet edges.

4. Move to a new station when your teacher tells you to. Leave the Student Activity Guide for the next group.

Stop & Think Does each part of the magnet have the same magnetic force?

5. Compare the magnets you tested. Answer Question 1 on Activity Sheet B.
6. Test how two magnets act near each other.
   - Place one magnet on the desk.
   - Slide a second magnet along the desk, bringing it closer to the one at rest.
   - What happens to the magnet at rest?
   - Can you change what you do with the second magnet to make the magnet at rest act differently?
   - Discuss what happens.
   - Answer Question 2 on Activity Sheet B.

15 16

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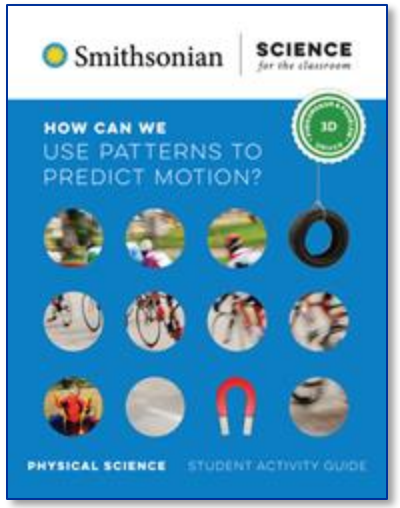
Student Activity Guide: Complete Steps 5–7



7. Discuss magnetic force.
   - What evidence do you have that the force of a magnet can act without touching an object?
   - How could you learn more about magnetic force?
   - Answer Question 3 on Activity Sheet B.

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Lesson 10 Activity Sheet A

Magnets at a Distance

Type of Magnet	Does it attract a paper clip?	Magnetic Force Strength Test (cm)	
Cow magnet	Y N	Touch _____	Release _____
Electromagnet	Y N	Touch _____	Release _____
Horseshoe magnet	Y N	Touch _____	Release _____
Large bar magnet	Y N	Touch _____	Release _____
Ring magnet	Y N	Touch _____	Release _____
Small bar magnet	Y N	Touch _____	Release _____

286 How Can We Use Patterns to Predict Motion?

Lesson 10 Activity Sheet B

Magnets at a Distance

1. How are the magnets you tested alike? How are they different?

   Alike Different

2. You moved a magnet close to a stationary magnet. What happened? Include force diagrams in your answer.

3. You need to define solution goals for the trash problem. Investigating forces might help. Ask a testable question about an effect of a force that acts on a piece of trash without touching the trash.

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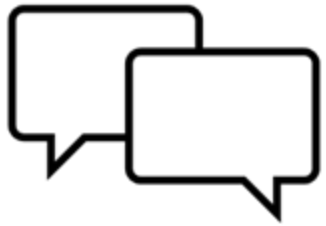
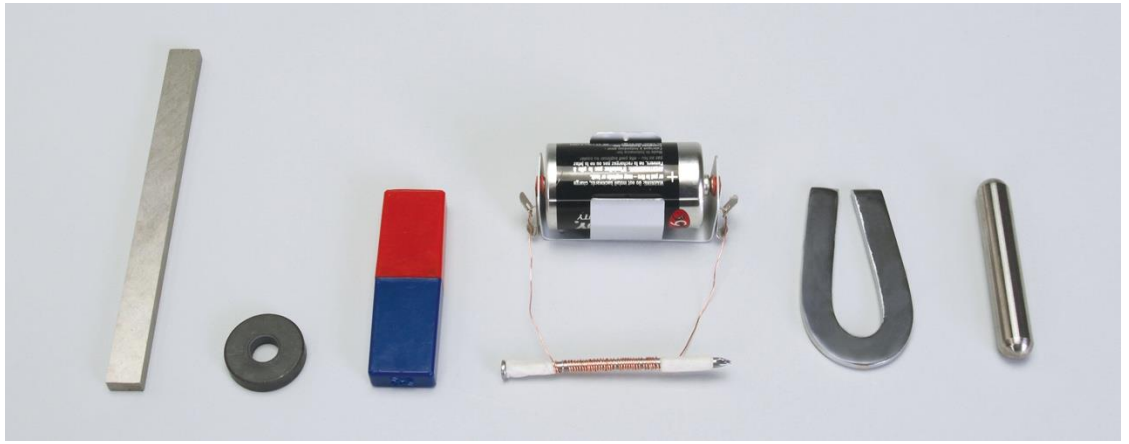
Engineers Explain: Magnetic Force



Do two magnets always act the same way when they are close to each other?

How does the electromagnet compare to the other magnets?

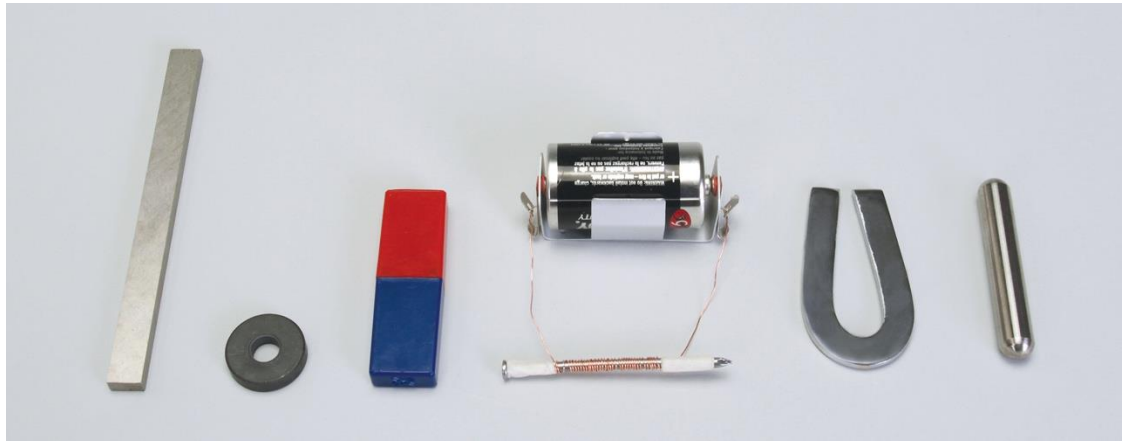
What do you mean by “turn it on and off”?



Most of the magnets you have been studying, such as bar magnets, horseshoe magnets, and ring magnets, are called **permanent magnets.**

They always have magnetic properties.

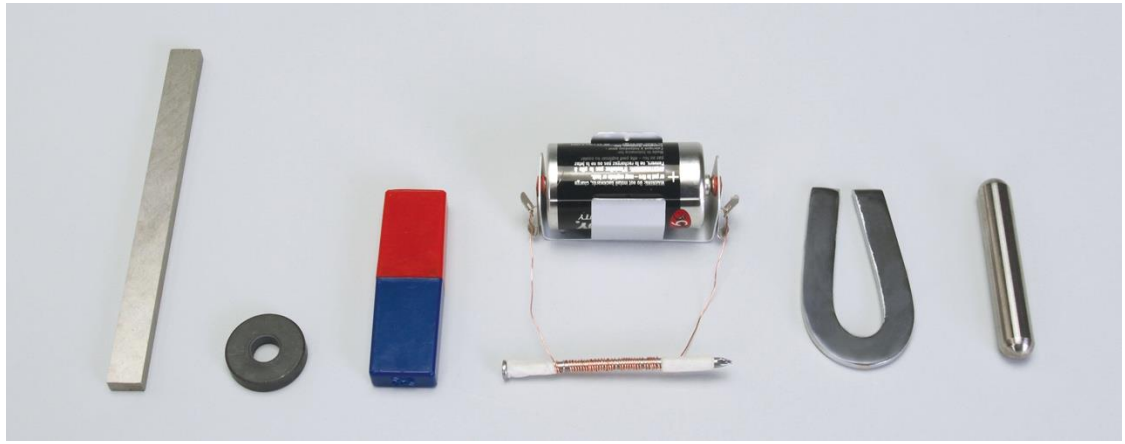
Engineers Explain: Magnetic Force



The **magnetic force** is strongest at parts of a magnet called **magnetic poles**. Magnets have two poles, often called a north pole and a south pole. Sometimes these are labeled N and S, or marked by different colors, usually red for north and blue for south.

When different, or opposite, poles point toward each other, they pull or attract. When like poles point toward each other, they push or repel.

Engineers Explain: Magnetic Force

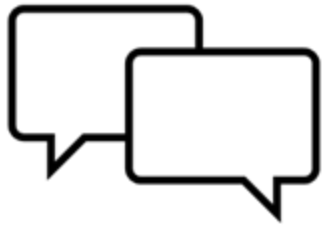


Electromagnets are made from materials that do not have magnetic properties.

The parts can be put together, like the wire wrapped around the nail. When the wire is attached to the battery, it magnetizes the nail.

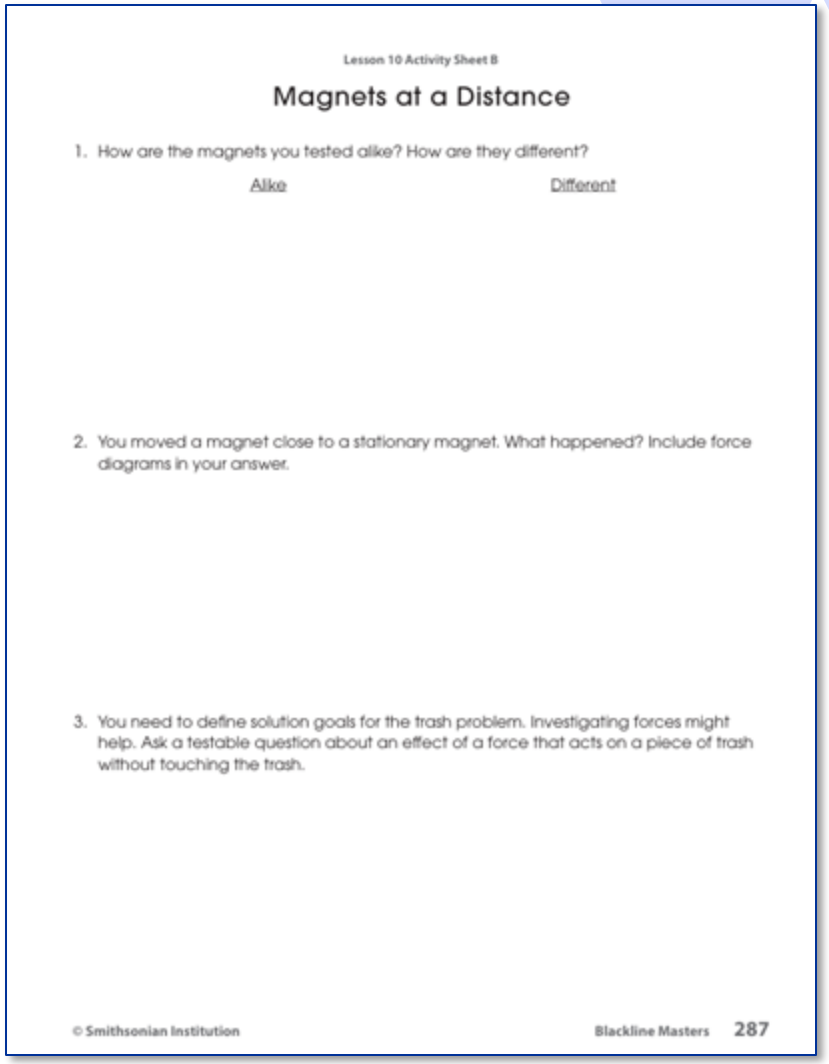
Sometimes, when the connection to the battery is broken, the nail remains magnetized for a short period of time.

Engineers Ask Testable Questions



Did anyone write a testable question about electromagnets?

Did anyone ask a testable question about a force that can act at a distance that isn't a magnetic force?



Lesson 10 Activity Sheet B

Magnets at a Distance

1. How are the magnets you tested alike? How are they different?

Alike Different

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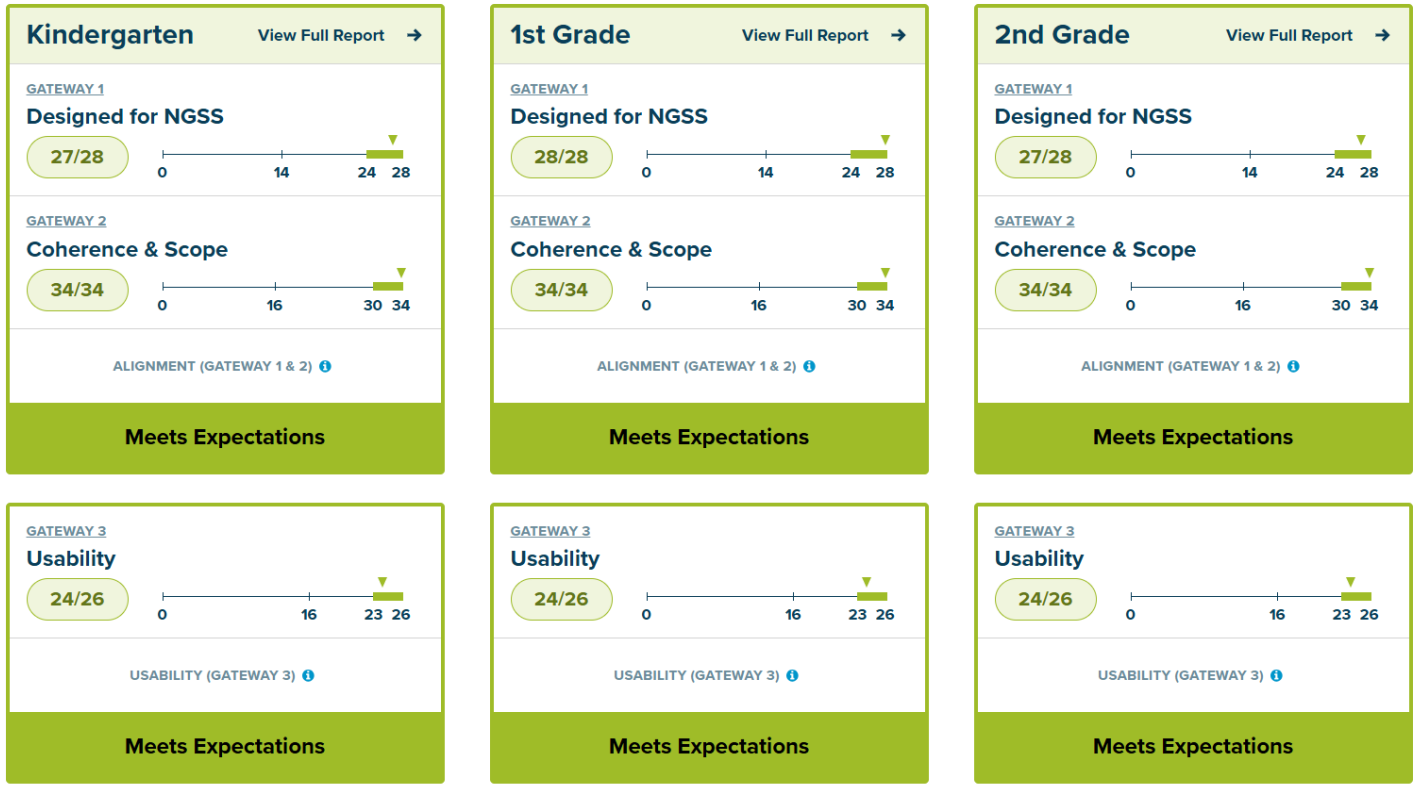
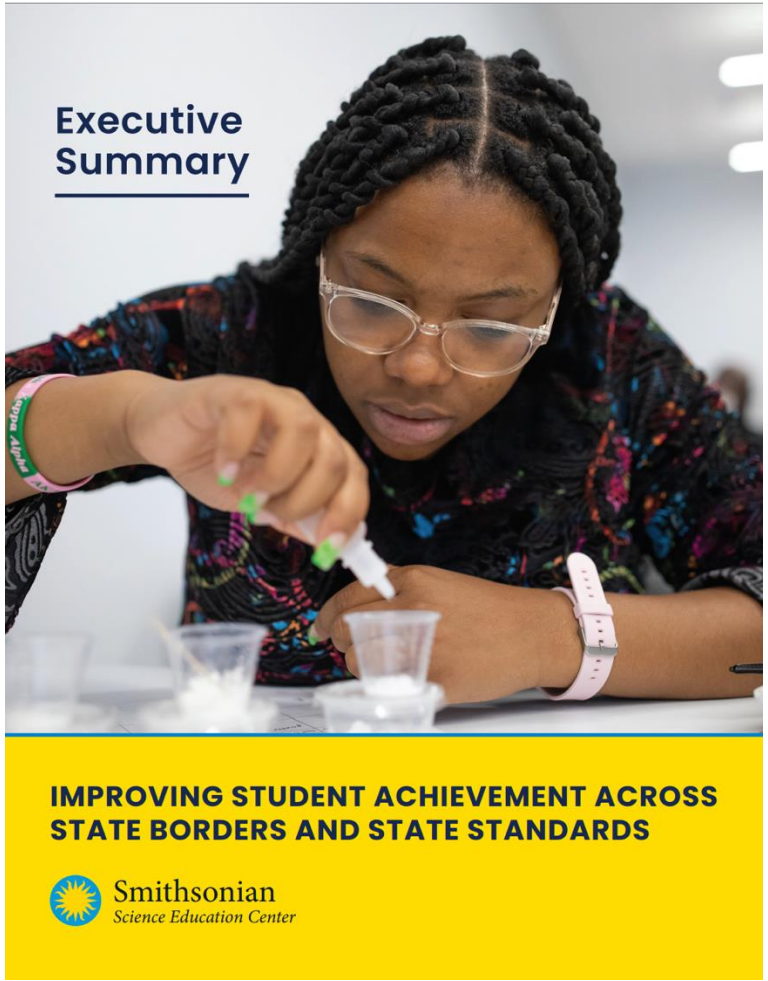
All Green Rating from EdReports.org



Improving Student Achievement Across State Borders and State Standards



- 5-year longitudinal study of the *Smithsonian Science for the Classroom* curriculum 2019–2024
- Funded by Education Innovation and Research (EIR) Grant
- Externally evaluated by the Center for Research in Educational Policy (CREP) at the University of Memphis
- In collaboration with NC SMT Center led by Dr. Sam Houston

www.ncsmt.org/perspective-smithsonian-brings-power-of-science-to-nc-schools/

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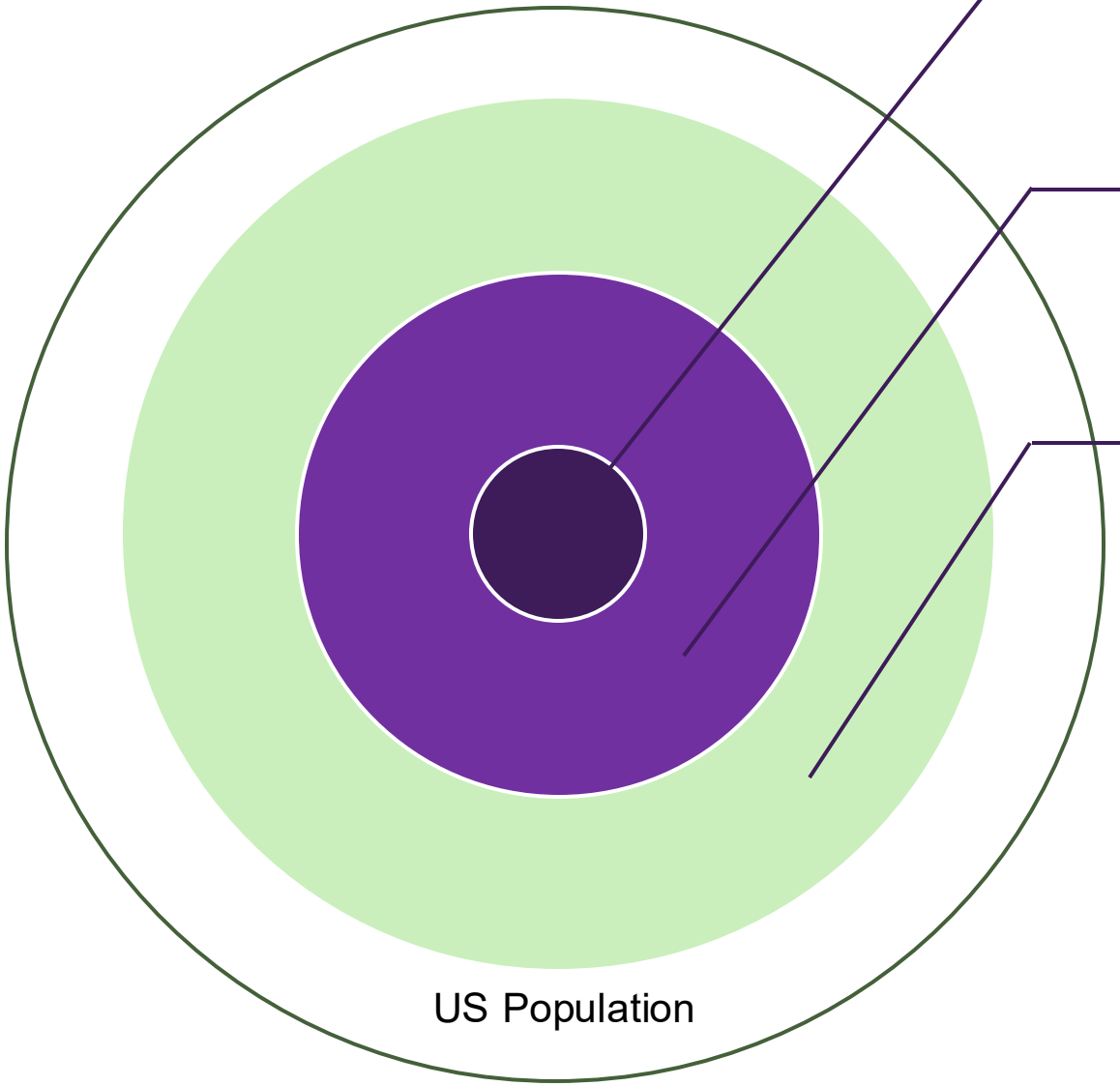
Research Question

Does implementation of *Smithsonian Science for the Classroom* with supporting professional learning improve **student achievement**, particularly achievement of high needs students, in **science**, **math**, and **reading** to a statistically significant extent, relative to “business as usual”?

Proven Results



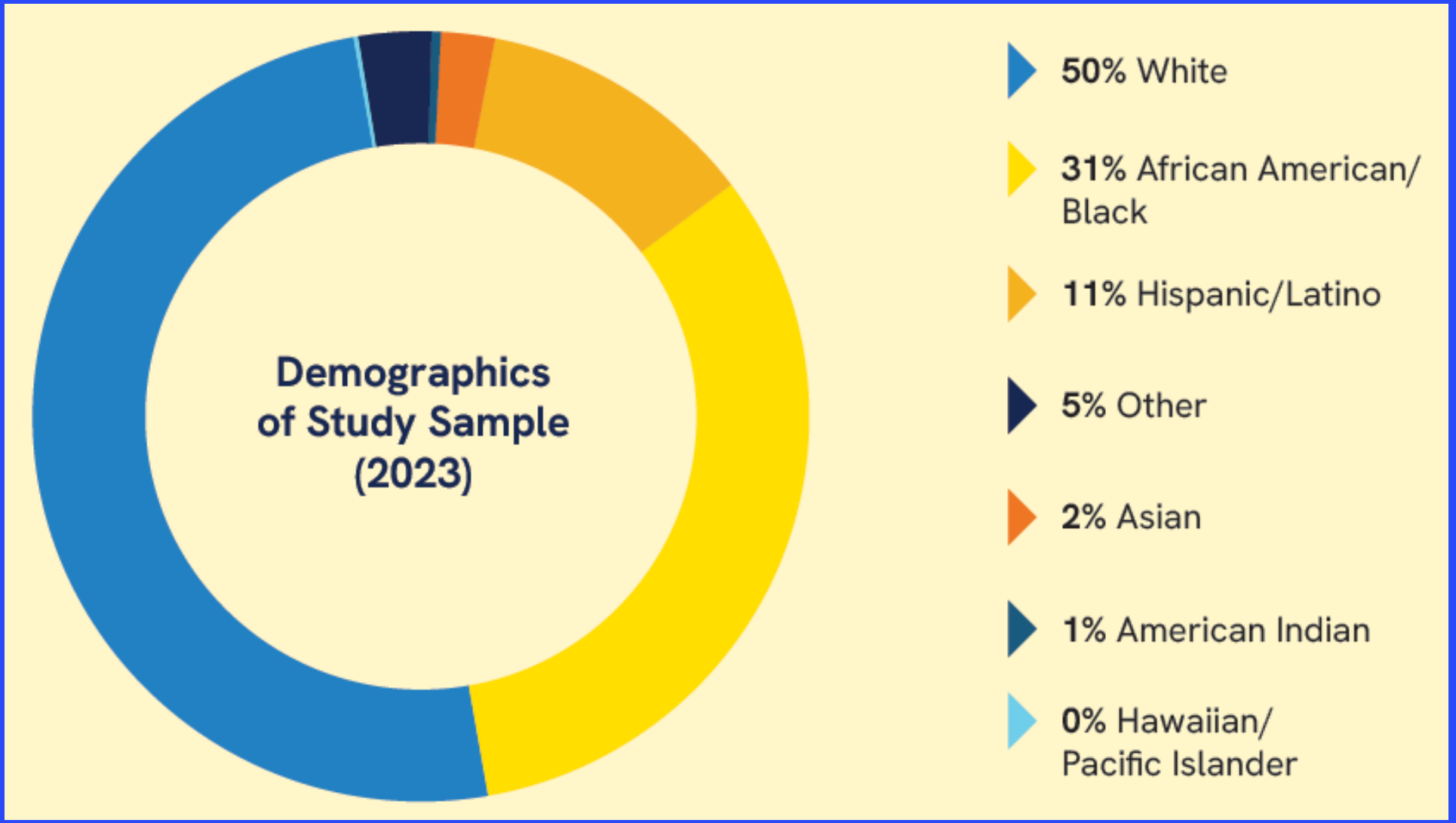
37 high-need/rural schools

7 school districts

2 states in US (NC & SC)

1,600+ students
Grades 3, 4, 5

Demographics



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HIGH-QUALITY INSTRUCTIONAL MATERIALS (HQIM) ARE:

- Aligned with state science standards
- Research-based and/or externally validated
- Comprehensive to include engaging texts, tasks, and assessments
- Based on fostering vibrant student learning experiences
- Culturally relevant, free from bias
- Accessible for all students

HIGH-QUALITY PROFESSIONAL LEARNING (HQPL) CHARACTERISTICS:

- Content focused
- Incorporates active learning
- Supports collaboration
- Models effective practice
- Provides coaching
- Offers opportunities for reflection
- Sustained duration

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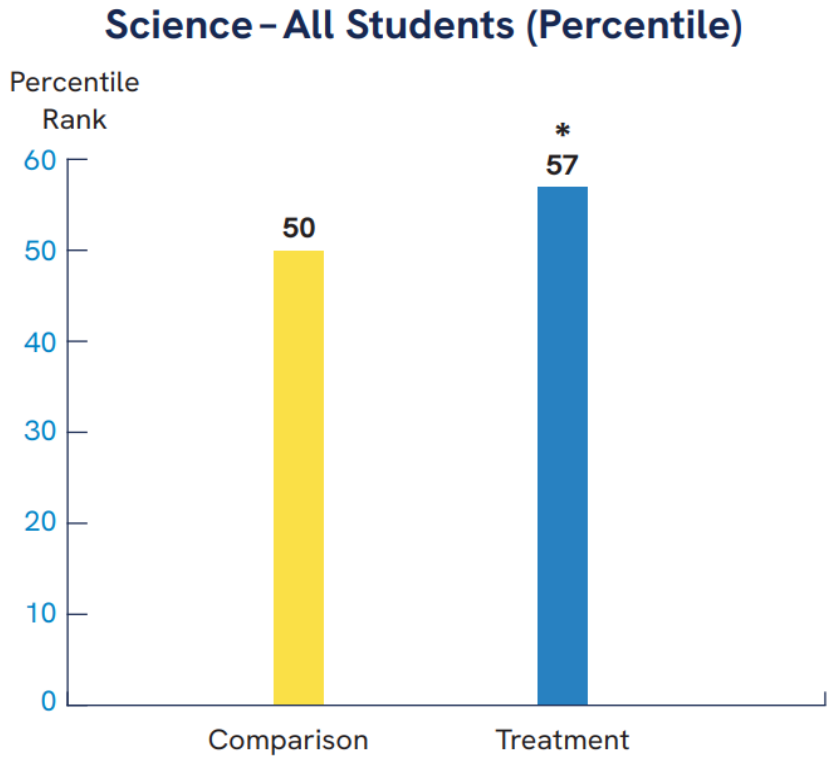
Positive and Statistically Significant Findings: Stanford-10 Science



Comparison *N* = 838

Treatment *N* = 913

Smithsonian Science for the Classroom curriculum improved outcomes in the treatment group by **7 percentile points.**

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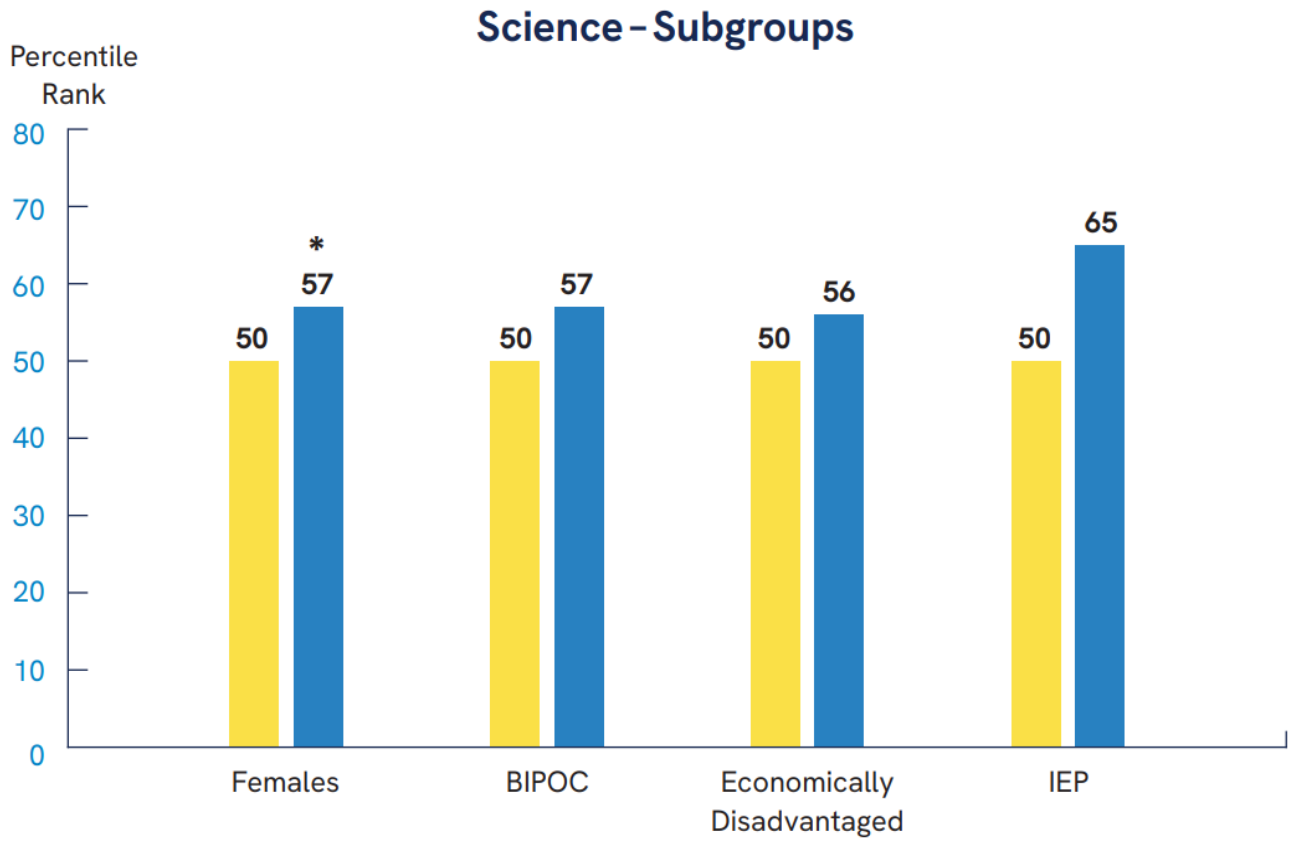
Positive Subgroup Findings: Stanford-10 Science



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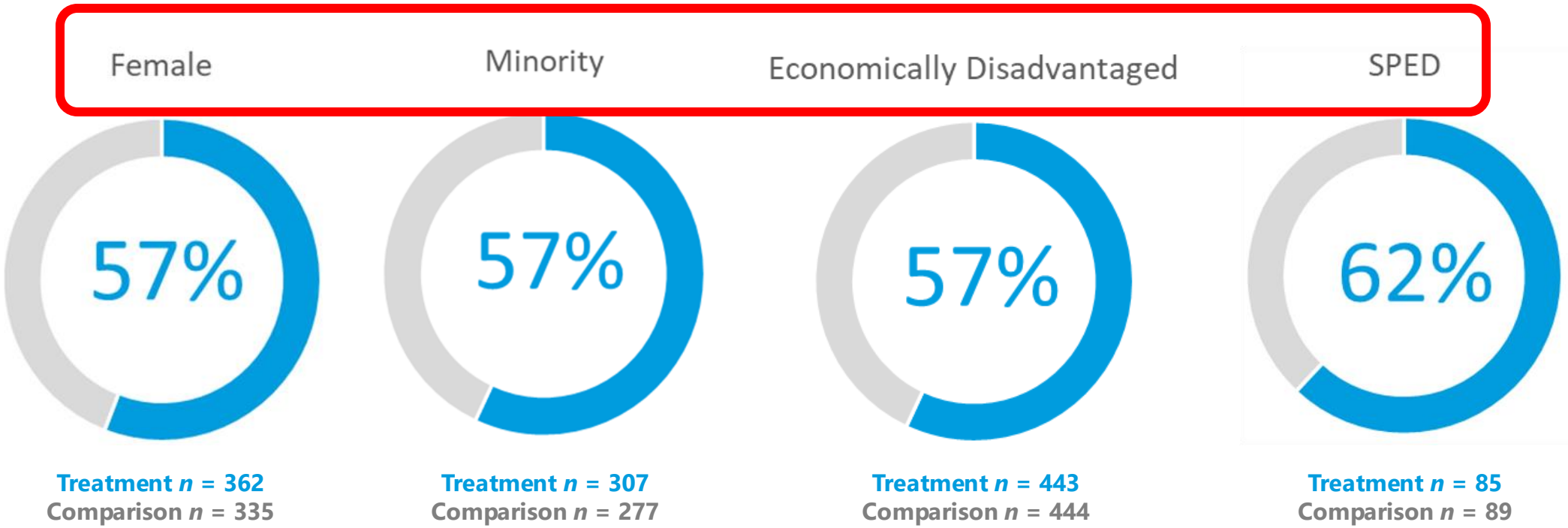
Positive Subgroup Findings: Stanford-10 Science



Treatment *n* = 362
Comparison *n* = 335

Treatment *n* = 307
Comparison *n* = 277

Treatment *n* = 443
Comparison *n* = 444

Treatment *n* = 85
Comparison *n* = 89

Average treatment student (50th percentile) percentile rank in the comparison group.

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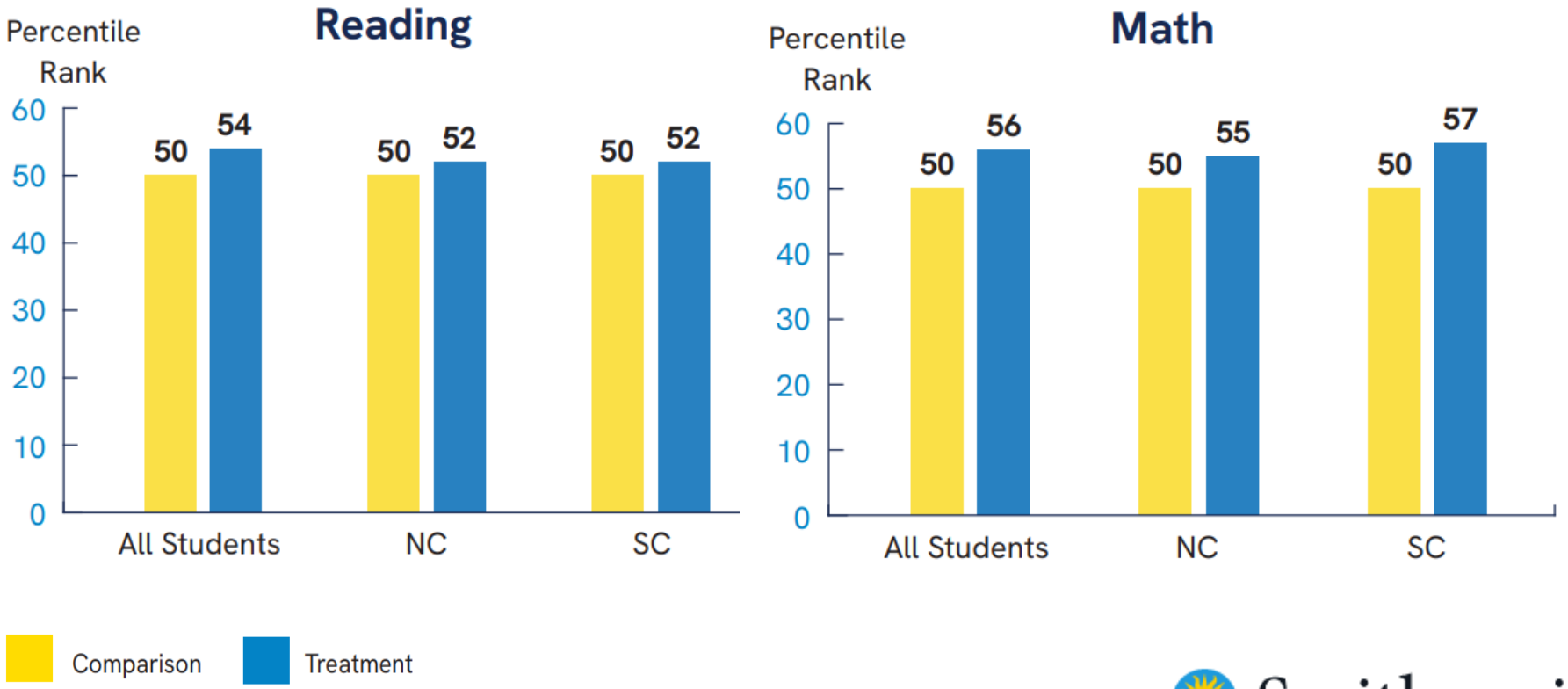
Positive Findings: State Reading and Math



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From Conference to Classroom

Resources

Explore workshop materials online, pacing and buying guides, safety resources, free class activities, and more!

Carolina_Workshop_Materials