EXPEDITIONARY LEARNING

Grade 4: Module 3A: Unit 2: Lesson 10

Reading a Scientific Experiment: The Pulley and Wheel and Axle

Long-Term Targets Addressed (Based on NYSP12 ELA CCLS)	
I can explain the main points in scientific text, using specific details in the text. (RI.4.3) I can describe the organizational structure in an informational text (chronology). (RI.4.5) I can write informative/explanatory texts that convey ideas and information clearly. (W.4.2) I can effectively engage in discussions with diverse partners about fourth-grade topics and texts. (SL.4.1)	
Supporting Learning Targets	**Ongoing Assessment**
• I can explain what happens before, during, and after a scientific experiment. • I can explain how the directions in a scientific experiment help me understand what a pulley and wheel and axle are and how they work. • I can document what I observe during a scientific experiment. • I can construct a conclusion statement that describes what I learned about pulleys or wheels and axles. • I can follow our class norms when I participate in a conversation.	• Simple Machines Science journal: Science Experiment note-catcher (pages 18 or 19) • Four Corners Teacher observations

Agenda	Teaching Notes
1. Opening A. Engaging the Reader and Writer: Mix and Mingle and Reviewing Learning Targets (5 minutes) 2. Work Time A. Reviewing Procedures: Reading a Science Experiment (15 minutes) B. Rereading Scientific Text while Conducting a Science Experiment (15 minutes) C. Writing a Conclusion (10 minutes) 3. Closing and Assessment A. Forming an Opinion: Four Corners strategy (15 minutes) 4. Homework A. Continue reading in your independent reading book for this unit at home.	• In this lesson, the class divides into two experiment groups. Each group conducts a different experiment—one on the pulley and one on the wheel and axle. These groups can either be strategically or randomly chosen, depending on the needs of your students. • Further divide students into smaller groups of three or four students within each experiment. This is because experiments are best conducted with smaller groups of students so everyone can participate. Plan these smaller groups in advance. • In advance: Prepare materials for both experiments. See pages 32–33 for the pulley experiment and pages 38–39 for the wheel and axle experiment in *Simple Machines: Forces in Action*. Some suggestions for alternate materials and logistics: • Pulley: – If empty thread spools are not available, try either empty toilet paper rolls or cutting a wooden dowel, such as a closet rod, into two-inch sections. Wrap rubber bands around each end of the dowel/roll to keep the string of the pulley from slipping off. – If small buckets are not available, try plastic cups with string handles. – A possible fixed point on which to hang the pulleys could be the leg of a desk chair on its side on a flat surface (i.e., table or desk). To ensure that the chair does not fall off the flat surface, there would need to be some kind of anchor weight (i.e., heavy books, one of the students holding it, or tie the chair down) holding it securely on the surface. • Wheel and Axle: – If roller skates are not available, try any smaller toy on wheels (i.e., cars, trucks). Make sure that the toys weigh enough to cause friction when on their sides. Consider securing a small bag of gravel to the wheeled object. • As in Lessons 2 and 4, for the first read, be sure to cover up the "How Does It Work?" box on pages 33 and 38 before students conduct the experiments.

Agenda	Teaching Notes (continued)
	• To prepare for the debrief, create four signs, one for each of the simple machines the students have learned about in depth (inclined plane, lever, pulley, wheel and axle). In advance, post one sign in each corner of the room. • Review the steps of the Scientific Method (first described in Lesson 2). • Review Mix and Mingle (Unit 1, Lesson 4). • Post: Learning targets.

Lesson Vocabulary	Materials
Review: force, effort, work, load New: spool	• Simple Machines Science journal (one per student) • Conducting an Experiment anchor chart • *Simple Machines: Forces in Action* pages 32–33 and 38 (book; one per student) • Scientific Method anchor chart (from Lesson 2) • Document camera • Four Corners (for teacher reference; see supporting materials) • Equity sticks

Opening	Meeting Students' Needs
A. Engaging the Reader and Writer: Mix and Mingle and Reviewing Learning Targets (5 minutes) • Tell students that in a moment they will share the captions they wrote on the cover of their **Simple Machines Science journal** for the pulley and wheel and axle, as well as any examples of a wheel and axle they found around them. • Remind students that they used Mix and Mingle discussion (in Unit 1, Lesson 4) to practice sharing their opinions about whether fiction is a good teacher of facts. Say that Mix and Mingle is similar to Think-Pair-Share, but instead of sharing with a single partner they get to move around and share their thinking with several peers. • Review the following directions for the Mix and Mingle: 1. Stand up and find a partner. 2. Share your captions for the pulley and wheel and axle with each other. Be sure to explain why your captions clearly describe how these simple machines are important in helping people do work. Be respectful speakers and listeners. 3. Thank your partner and find another partner. 4. Share any examples of a wheel and axle you found around you. • Address any clarifying questions about Mix and Mingle. • Give students 4 minutes to participate in the Mix and Mingle. Listen to students' conversations for scientifically accurate facts about the pulley and wheel and axle. (For example, some students may say that the pulley helps people lift very heavy loads—the heavier the load, the more pulleys need to be used. Or they may say that the wheel and axle help people move heavy loads from one place to the next easily by not causing friction.) • Tell students that today the class will conduct two experiments: one on the pulley and one on the wheel and axle. Each student will conduct just one of the two experiments. • Tell students the process they follow today are similar to how they conducted the experiments on the inclined plane and lever in Lessons 2 and 4. Invite them to read the learning targets. Remind them these are the same learning targets they've had for each of the experiments they conducted in this unit. Ask if they have any questions about the learning targets. Clarify as needed. • Tell students they are getting really good at reading about and conducting science experiments, so today they'll work with less teacher support. They should rely on their group. Reassure them that you will still circulate and support as needed, but encourage them to "step up" to more independence today.	

Work Time	Meeting Students' Needs
A. Reviewing Procedures: Reading a Science Experiment (15 minutes) • Tell students they will do an experiment either on the pulley or on the wheel and axle. The class will be divided into two groups. Each large group will be broken into smaller "experiment groups" of three to four students. • Ask students to move to their predetermined experiment groups. Review the process of preparing to conduct an experiment. Post the **Conducting an Experiment anchor chart**. • Invite the students to silently read to themselves the four steps they need to follow to prepare to conduct the experiment. Then ask each experiment group to read the steps aloud together. 1. Read the list of materials needed for the experiment. 2. Read through the entire procedure for conducting the experiment. Try to visualize what is being described in each step. 3. Reread the steps, pausing after each step to discuss with your partners what you are being asked to do. 4. If there are vocabulary words that are unfamiliar, refer to the Vocabulary Strategies anchor chart, focusing on the first strategy "reading on in the text and infer" to figure out the meaning of the word(s). • Address any clarifying questions. • Distribute the Simple Machines Science journals and ***Simple Machines: Forces in Action***. – Ask the pulley groups to turn to pages 32–33 in the text. – Ask the wheel and axle groups to turn to page 38 in the text. • Give students 5 minutes to complete the four steps listed on the Conducting an Experiment anchor chart.	• The smaller experiment groups can be predetermined based on student readiness or learning styles, or they could be heterogeneous. Alternatively, they could be randomly grouped. It will depend on what is best for your students' needs. • Consider partnering an ELL student with a student who speaks the same L1 for discussion of complex content. • The experiment on the wheel and axle is not as complex as the experiment on the pulley. Consider assigning students who struggle with language or complex concepts to the wheel and axle experiment.

Work Time (continued)	Meeting Students' Needs

B. Rereading Scientific Text while Conducting a Science Experiment (15 minutes)
• Remind students to keep the "How Does It Work?" box on the bottom half of page 33 and the bottom left section of page 38 covered.
• Ask students to turn to page 18 in their Science journals for the pulley experiment and page 19 for the wheel and axle experiment. Remind students that scientists often use the Scientific Method to guide them through experiments. Review the **Scientific Method anchor chart** from Lesson 2. Remind them that the question for each of the experiments they have conducted in this unit is: "How can this simple machine make work easier?"
• Ask students to tell their experiment group the next thing they need to do before conducting the experiment. You should hear: "We need to write a hypothesis, or prediction about what we think is going to happen."
• Ask the experiment groups to discuss:
  * "What might be a possible hypothesis?"
• Ask students to write their hypothesis in their Science journals.
• Also ask them to list the materials needed for the experiment.
• Give students 10 minutes to conduct the experiment.
• Circulate and assist as needed. When students have procedural questions, push them back into the text to see if they can answer their own question: "Where might you look for that answer?" or "What does the text tell you?"
• ***Pulley Experiment***: Ask probing questions that push them to connect the terms *effort* and *force*. For example:
  * "If force is the ability to push, pull, or twist, what is the force in this experiment?" (Answer: It's pulling down on the string in order to lift the pail up.)
  * "How would you describe the effort that is being used?" (Answer: It takes less effort to lift a heavy pail up if you use force to pull down in a pulley.)
	• To further support students add visual cues to your anchor chart or provide copies of the chart for certain students to use at their desk.
	• Consider allowing students to draw their observations, ideas, or notes when appropriate. This allows all students to participate in a meaningful way.

Work Time (continued)	Meeting Students' Needs

• ***Wheel and Axle Experiment***: Ask probing questions that push them to connect the terms *effort* and *force*. For example:
  * "If force is the ability to push, pull, or twist, what is the force in this experiment?" (Answer: It's pulling on the rubber band).
  * "How would you describe the effort that is being used?" (Answer: If a load is pulled on wheels, it reduces the friction, which makes the effort easier. The less friction, the easier it is to move a load.)
• Reinforce vocabulary: Point out to students when you hear them using scientific vocabulary in their discussions. Encourage them to use it as they write their observations.	

C. Writing a Conclusion (10 minutes) • Remind students that the last step in the Scientific Method is to analyze the data and draw a conclusion. This means that they need to synthesize their findings by writing a *conclusion* statement. This statement explains the main idea of what happened during the experiment and what they learned from it. Tell them in the next lesson they will share their conclusions with students from the other experiment as a way of teaching them what they learned. Reinforce that writing is one way scientists share their new learning with the scientific community. • After students have written their conclusion, ask them to unveil the "How Does It Work?" box on pages 33 and 38 that has been covered. Invite students to read it, checking to see if they reached the same conclusions as the author did. If their findings were different from the author's, tell them to NOT change their hypothesis or their conclusion. Ask them to add to their conclusions by explaining how their conclusion is different from the author's. • Remind them to hold on to their writing; they will share these conclusions at the start of Lesson 11.	

Closing and Assessment	Meeting Students' Needs

A. Forming an Opinion: Four Corners (15 minutes)
• Ask the students to gather in the middle of the room with their Science journals.
• Use a **document camera** to show students the directions for the **Four Corners**. Read the protocol description aloud as the students follow along silently. To check for understanding, ask two or three students to explain the protocol in their own words.
• Conduct the protocol.
• Debrief the protocol by using **equity sticks** to cold call students. Ask questions such as:
  * "Was it easy or hard for you to choose one simple machine? Why?"
  * "If you moved corners, what made you change your mind?"
  * "Did you find it easy or challenging to form an opinion and articulate why you chose the simple machine that you did? Why?"
	• Using sentence frames can help ELLs articulate their learning. Using the word "because" in the sentence frame helps all students support their thinking with evidence. For example: "I chose _____ simple machine because I think it benefits people by _____."

Homework	**Meeting Students' Needs**
• Continue reading in your independent reading book for this unit at home. *Note: For Lesson 11, students will need specific feedback from their last Science Talk (Lesson 6). Write feedback on the bottom section of page 15 in students' Simple Machines Science journals. Focus the feedback on the learning targets that were emphasized in that lesson: "I can prepare for the Science Talk by using evidence from scientific texts," "I can ask questions about the topic being discussed," and "I can build on others' ideas when responding to their statements and questions." Also give suggestions to any students who may need more coaching in order to follow the class norms. Keep feedback focused, brief, and encouraging.*	•

EXPEDITIONARY LEARNING

Grade 4: Module 3A: Unit 2: Lesson 10
Supporting Materials

Conducting an Experiment Anchor Chart

1. Read the list of materials needed for the experiment.
2. Read through the entire procedure for conducting the experiment. Try to visualize what is being described in each step.
3. Reread the steps, pausing after each step to discuss with your partners what you are being asked to do.
4. If there are vocabulary words you don't know, refer to the Vocabulary Strategies anchor chart. Focus on the first strategy "reading on in the text and infer" to figure out the meaning of the word(s).

Four Corners
(For Teacher Reference)

Purpose: Four Corners provides students with a structure to engage in conversation with their peers about a topic. They are asked to form opinions and state their reasoning to support their opinion.

Procedure:

1. Post a sign in each corner of the room with the name of one simple machine (inclined plane, lever, pulley, and wheel and axle).
2. Ask the students to choose which simple machine they think is the most beneficial to people in their everyday lives. They must choose one corner.
3. Once they have decided on their simple machine, instruct them to move to that corner.
4. Give the students 2 to 3 minutes to talk as a "corner group" about why they chose that particular simple machine. Encourage them to use the notes in their Science journals to support their opinions.
5. They need to choose a spokesperson to report to the whole group the top two reasons why they think that simple machine is the most beneficial based on the texts they've read and the experiments they have conducted (1 minute per corner).
6. Each "corner group" shares their two reasons.
7. After each group has shared, give the students an opportunity to change if they wish. Make sure to ask them what made them change their minds.

Option: The Caucus

- If students can't choose one corner, give them the option of standing in the middle of the room.
- As the corners are discussing why they chose that particular simple machine, the students in the middle are discussing why they couldn't choose one.
- After each corner has shared the reasons their simple machine is the most beneficial, the students in the middle can move to a corner if they have made a decision.
- If there are any students left in the middle, each corner group has 1 minute to use evidence from the texts and experiments to convince the "undecided" to join their corner.