Energy Transfer
Lesson 6a: Problem Solving with Energy

Grade 4	**Length of lesson:** 50 minutes	**Placement of lesson in unit:** 6a of 6 two-part lessons on energy transfer
Unit central question: How does the energy of an object move and change?		**Lesson focus question:** How can knowing about energy help us solve problems?
Main learning goal: Energy is transferred and transformed but not created or destroyed.		
Science content storyline: Energy can move and change, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.		
Ideal student response to the focus question: Using ideas about energy, I can design a device that shows energy moving from object to object and changing costumes to make a bell ring.		

Preparation

Materials Needed
- Science notebooks
- Chart paper and markers
- A timer students can see (recommended)
- *For each team of 3 students:*
  - Rulers
  - Marbles
  - Bell
  - Tape
  - String
  - Cups
  - 3–4 rolled-up newspapers
- *Additional supplies as needed:*
  - Dominoes
  - Plastic spoons
  - Paper clips/binder clips

Student Handouts
- 5.2 Mumford and Leroy's Big Crash, Conclusion (for display)
- 6.1 Guidelines for Mumford's Bell Challenge (1 per student)

Ahead of Time
- Review the Energy and Energy Transfer Content Background Document.
- Prepare handout 5.2 (Mumford and Leroy's Big Crash, Conclusion) for display on a document reader or projector.
- **ELL support:** Identify Tier 2 and Tier 3 words in the lesson plan to review in advance with ELL students. Possible terms include *device*, *captions*, *energy transfer*, *energy transformation*, and *energy conservation* (if you anticipate using these terms with students). Review these terms in advance with ELL students.

Lesson 6a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
5 min	**Link to previous lesson:** Students review what they've learned about energy in this unit and share examples of energy transfers and transformations in objects from previous energy-flow diagrams they created.	• Energy transfers and transformations occur in all interactions. • Energy-flow diagrams can track the energy transfers and transformations that occur in interactions.
1 min	**Lesson focus question:** The teacher introduces the focus question, *How can knowing about energy help us solve problems?*	
5 min	**Setup for activity:** The teacher reviews Mumford's paper-delivery problem, and students share their ideas for solving it.	• Energy moves and changes, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.
20 min	**Activity:** Students plan, build, and revise their devices according to the challenge guidelines.	
10 min	**Follow-up to activity:** Students sketch their devices in their science notebooks, and teams discuss questions related to the challenge.	
8 min	**Synthesize/summarize today's lesson:** The teacher revisits the focus question. Then students answer questions in their science notebooks, describing where they see evidence of energy transfers and/or transformations in their devices.	
1 min	**Link to next lesson:** The teacher announces that in the next lesson, students will create diagrams describing the flow of energy in their devices.	

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5 min	**Link to Previous Lesson** **Synopsis:** Students review what they've learned about energy in this unit and share examples of energy transfers and transformations in objects from previous energy-flow diagrams they created. **Main science idea(s):** • Energy transfers and transformations occur in all interactions. • Energy-flow diagrams can track the energy transfers and transformations that occur in interactions.	Ask questions to elicit student ideas and predictions. Ask questions to probe student ideas and predictions. Link science ideas to other science ideas.	**Show slides 1 and 2.** In previous lessons, we created energy-flow diagrams to show how energy moves and changes in different objects. What did those diagrams show us about how energy moves and changes? **NOTE TO TEACHER:** *Encourage students to cite examples of energy transfers and transformations from their energy-flow diagrams or other investigations in this unit. Ask questions to help them relate their examples to energy transfer or transformation.* In this unit on energy, we've observed many examples of energy moving or transferring from one object to another, and energy changing costumes or transforming from one kind of energy to another. As energy detectives, you've done a great job identifying potential energy, kinetic energy, sound energy, light energy, and heat energy in many objects	In our diagrams, we started with one kind of energy and ended up with another kind. In the windup flashlight, we started with kinetic energy from our hands, and we ended up with light energy from the flashlight. So kinetic energy moved from our hands through the flashlight to make light energy.	Can you give an example?

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			and locations. Today we'll pull together all of these ideas about energy to solve Mumford's paper-delivery problem.		
1 min	**Lesson Focus Question** **Synopsis:** The teacher introduces the focus question, *How can knowing about energy help us solve problems?*	Set the purpose with a <u>focus question</u> or goal statement.	**Show slide 3.** Our focus question for this lesson is *How can knowing about energy help us solve problems?* Write this question in your science notebooks and draw a box around it. Figuring out how to solve Mumford's problem will give us some ideas for answering this question.		
5 min	**Setup for Activity** **Synopsis:** The teacher reviews Mumford's paper-delivery problem, and students share their ideas for solving it. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building	Make explicit links between science ideas and activities **before** the activity.	**Show slide 4.** Let's review Mumford's problem from the end of our last lesson. **NOTE TO TEACHER:** *For this review, display handout 5.2 (Mumford and Leroy's Big Crash, Conclusion) on a document reader and/or have students locate their handouts from lesson 5.* Who can describe the problem Mumford is having on his paper route?	When Mumford delivers the Thompsons' paper, their dog, Cotton, chews it up before they can get	

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	devices. Energy transfers away from a system through sound, light, or heat.		What does Mumford want us to help him do? What ideas can you think of for solving Mumford's problem? How could Mumford ring a bell to alert the Thompsons that their newspaper has been delivered? **NOTE TO TEACHER:** *As one student describes a possible way to ring a bell, have a different student describe the energy transfers and transformations that would happen in the proposed device.*	it. He wants to us to help him figure out how to ring a bell that lets the Thompsons know when their paper has been delivered. He could throw the newspaper at the bell so Mr. or Mrs. Thompson could hear it ring and come get their paper. He could use a lever to pull a string that goes under a window and rings a bell in the Thompsons' kitchen.	*Questions to ask regarding each proposed setup:* • What energy transfers and changes would need to happen in order to ring the bell? • Where did the energy come from? • How did the energy transfer from object to object or place to place? • Did the energy change costumes or transform into another kind of energy?

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					• Where did the energy go? Did it eventually disappear?
20 min	**Activity** **Synopsis:** Students plan, build, and revise their devices according to the challenge guidelines. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.	Make explicit links between science ideas and activities **during** the activity. Select content representations and models matched to the learning goal and engage students in their use. Engage students in using and applying science ideas in a variety of ways and contexts.	**Show slide 5.** To help Mumford solve his paper-delivery problem, you'll work in teams of three to design a device that will alert the Thompsons when their paper has been delivered. After you gather in your teams, we'll go over the guidelines for this challenge. **NOTE TO TEACHER:** *Divide the class into teams of three students; then distribute handout 6.1 (Guidelines for Mumford's Bell Challenge) and review the guidelines for this challenge. If your students have learned about systems, feel free to use that terminology throughout the activity.* **ELL support:** To better equip ELL students for this challenge, read the guidelines aloud to the entire class or have a few students take turns reading while ELL students listen and follow along. Do you have any questions about these guidelines?		

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			Remember, your device has to start with a rolled-up newspaper and include a ramp at the beginning and a bell at the end. It also has to include *at least one step* between the ramp and the bell that shows energy *transferring* or moving from one place or object to another or shows energy changing costumes or *transforming* into a different form. You can design two steps between the ramp and the bell, but no more than two. Follow the guidelines on your handout carefully. And make sure to check off each requirement on the list as you complete it. The key to success in this challenge is showing how energy can be used to solve Mumford's problem! Now let's look at the supplies your team can use to build your device. **NOTE TO TEACHER:** *Answer any questions students may have about the guidelines. Then review the supplies each team can use to build their devices. If possible, allow students to handle these materials. This will help them visualize the kinds of devices they can design. If you have enough materials, give each team a set to refer to as they plan their designs. You can limit the planning time and the complexity of the*		

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			designs by limiting the supplies. Make sure to include several rolled-up newspapers that teams can use to start their devices. This will connect the activity to the story. As you plan your designs, keep in mind that your device doesn't have to be complicated. A simple design is best, so make that your goal. Today your team will work on planning, building, and testing your designs. You'll also need to complete the first three requirements on your handouts. Then in the next lesson, you'll work on the final three requirements—creating an energy-flow diagram, adding captions that describe how energy moves and changes in your device, and presenting your diagrams to the class. You'll have [*15 minutes*] to build and test your designs today, so keep an eye on the timer. **NOTE TO TEACHER:** *Emphasize that teams will complete only the first three requirements today. After planning, building, and testing their devices, each team will demonstrate their device for your approval and make sure that all team members can answer your questions about their systems.*		

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		Ask questions to	*Assess student understandings of the science ideas involved in this challenge based on their descriptions and explanations of the energy transfers and transformations that take place in their systems rather than the ingenuity of the design or the device itself. It's most important that students are able to explain the energy transfers and transformations that take place in their systems.* *During the next lesson, teams will create energy-flow diagrams for their devices, and each student will write a caption in their notebooks. Then teams will present their diagrams to the class.* *Following are suggested time limits for each phase of the challenge:* *1. Build, test, and troubleshoot the device: 15 minutes (today's lesson)* *2. Create energy-flow diagrams and captions: 15 min (next lesson)* *Write these times on the board and set a timer to help students stay on track. Circulate among the teams as they work on their designs and help them monitor the time so they don't get behind. Ask*		*Probe questions to*

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		probe student ideas and predictions.	*probe questions (see column 6) to determine whether students understand how to show energy transfers and transformations in their systems. Their answers will also show whether they're beginning to understand the conservation of energy.*		*ask teams during the activity:* • How are you showing that energy transfers from one object to another in your device? • How are you showing that energy changes costumes in your device? • Does all of the energy in your device eventually end up ringing the bell? *[Students should answer no, since some energy will be released as heat.]* • What other energy can you detect in your device? • Why do you think that? • Can you explain why?
10 min	**Follow-Up to Activity**		**Show slide 6.**		

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	Synopsis: Students sketch their devices in their science notebooks, and teams discuss questions related to the challenge. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.	Make explicit links between science ideas and activities **after** the activity.	Before you put away your materials, make a sketch of your devices in your science notebooks so you can set them up the same way next time. **Individual work time.** Now I'd like you to discuss the questions on the slide with your teammates and write your answers in your science notebooks: 1. Does your device include an energy transfer and/or an energy transformation? 2. Does your device ring the bell? If not, what changes can you make so your device will ring the bell? (Think about how energy moves and changes in your device!) 3. Is each member of your team prepared to answer questions about your device?		
8 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** The teacher revisits the focus question. Then students answer questions in their science notebooks, describing where they see evidence of energy transfers and/or	Highlight key science ideas and focus question throughout.	**Show slide 7.** Let's revisit our focus question, *How can knowing about energy help us solve problems?* After today's investigation, you should have a few ideas about how to answer to this question!		

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	transformations in their devices. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. Energy transfers and transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.	Engage students in making connections by synthesizing and summarizing key science ideas.	In our next lesson, you'll continue thinking about this focus question as you work in the same teams to create energy-flow diagrams for your devices. To prepare for this task, I'd like you to answer a few key questions about energy in your science notebooks: 1. Where does energy move from place to place or from object to object in your device? 2. Where does energy change costumes or transform into another kind of energy in your device? 3. Does your device have potential energy? If so, where? You can discuss these questions with your teammates, but write your own answers in your science notebooks.		
1 min	**Link to Next Lesson** **Synopsis:** The teacher announces that in the next lesson, students will create diagrams describing the flow of energy in their devices.	Make explicit links between science ideas and activities.	**Show slide 8.** Today you came up with some very creative ways to solve Mumford's paper-delivery problem! Next time, you'll create diagrams showing how energy moves and changes in your devices. Isn't it fun using what we've learned		

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			about energy to solve everyday problems?		