Energy Transfer
Lesson 6b: How the Energy of an Object Can Move and Change

Grade 4	**Length of lesson:** 50 minutes	**Placement of lesson in unit:** 6b 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)
- Team Devices (from lesson 6a)
- *Additional supplies as needed for device modifications:*
  - Tape
  - String
  - Cups
  - Dominoes
  - Plastic spoons
  - Paper clips/binder clips
  - Miscellaneous items

Student Handouts
- 6.1 Guidelines for Mumford's Bell Challenge (from lesson 6a)

Ahead of Time
- Review the Energy and Energy Transfer Content Background Document.
- Set up a document reader, Smart Board, or overhead project to display each team's energy-flow diagram during the activity follow-up.

Lesson 6b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	**Link to previous lesson:** Students reflect on the devices they designed in the last lesson and consider the energy involved in solving Mumford's problem.	• Energy transfers and transformations occur in all interactions. These transfers and transformations can be useful for building devices.
1 min	**Lesson focus question/unit central question:** The teacher reviews the focus question, *How can knowing about energy help us solve problems?* and the unit central question, *How does the energy of an object move and change?*	
6 min	**Setup for activity:** Teams set up their devices from the previous lesson, make any final modifications, and review the energy transfers and transformations in their systems.	• 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.
15 min	**Activity:** The teacher reviews the challenge guidelines. Then students work in teams to create energy-flow diagrams describing the energy transfers and transformations in their devices. Afterward, students write their own captions for their diagrams.	
15 min	**Follow-up to activity:** Teams present their devices and energy-flow diagrams to the class and answer questions about the energy transfers and transformations in their systems.	
10 min	**Synthesize/summarize today's lesson:** Students write their best answers to the unit central question to summarize everything they've learned about energy in this unit.	• Energy can move and change, but it can't be created or destroyed. The energy of an object can move, or transfer, from place to place or from object to object. Energy can also transform from one form into another. In these transfers and transformations, energy is always conserved.

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3 min	**Link to Previous Lesson** **Synopsis:** Students reflect on the devices they designed in the last lesson and consider the energy involved in solving Mumford's problem. **Main science idea(s):** • Energy transfers and transformations occur in all interactions. These transfers and transformations can be useful for building devices.	Make explicit links between science ideas and activities.	**Show slides 1 and 2.** In our last lesson, you worked in teams to design a device to solve Mumford's paper-delivery problem. Let's think for a moment about how energy moves and changes costumes in your device. Raise your hand if energy moves or transfers from place to place or object to object in your device. Who can give me an example? Now raise your hand if energy changes costumes or transforms from one form of energy to another in your device. Who can give me an example? Today you'll work in the same teams to create energy-flow diagrams that show how energy transfers and transforms in your devices. This is the final lesson in our unit on energy. Are you ready to show what you've learned?		
1 min	**Lesson Focus Question/ Unit Central Question**	Set the purpose	**Show slide 3.** In this lesson, we'll continue thinking		

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	Synopsis: The teacher reviews the focus question, *How can knowing about energy help us solve problems?* and the unit central question, *How does the energy of an object move and change?*	with a focus question or goal statement.	about our focus question from last time, *How can knowing about energy help us solve problems?* In our previous lesson, you used ideas about energy to design a device that solves Mumford's paper-delivery problem, so by now, you should have some ideas for answering this question. But we still have a few steps to complete in our challenge. **Show slide 4.** At the end of today's lesson, you'll use everything you've learned about energy to answer our unit central question, *How does the energy of an object move and change?*		
6 min	**Setup for Activity** **Synopsis:** Teams set up their devices from the previous lesson, make any final modifications, and review the energy transfers and transformations in their systems. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. Energy transfers and	Make explicit links between science ideas and activities **before** the activity.	**Show slide 5.** In a moment, you'll gather in your teams from last time. You'll have 5 minutes to set up your devices, make any final changes, and test them one more time. Then you'll create energy-flow diagrams showing the energy transfers and transformations in your devices. **NOTE TO TEACHER:** *If your students have learned about systems, feel free to use that terminology throughout the activity.*		

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	transformations occur in all interactions and can be useful for building devices. Energy transfers away from a system through sound, light, or heat.	Link science ideas to other science ideas. Highlight key science ideas and focus question throughout.	As you test your devices, pay close attention to where the energy comes from and where it goes. Even if you don't succeed in getting your bells to ring, focus on how energy is involved in your devices. Notice where you see, hear, or feel evidence of energy moving or transferring from place to place or object to object. Also pay attention to where energy changes costumes or transforms from one form of energy to another. **Show slide 6.** Remember what we've learned about heat and energy conservation: *In all interactions, energy ultimately changes to heat, spreads out all around us in the environment, and eventually leaves Earth's atmosphere.* Make sure to include this science idea in your energy-flow diagrams. OK. Gather in your teams and set up your devices one more time. Ring that bell! **NOTE TO TEACHER:** *Allow about 5 minutes for teams to set up their devices, make a few changes, if necessary, and*		

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			perform a final test. Circulate among the teams and remind them to focus on the energy in their systems, not just on whether their devices ring the bell.		
15 min	**Activity** **Synopsis:** The teacher reviews the challenge guidelines. Then students work in teams to create energy-flow diagrams describing the energy transfers and transformations in their diagrams. Afterward, students write their own captions for their diagrams. **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.	Select content representations and models matched to the learning goal and engage students in their use. Engage students in using and applying new science ideas in a variety of ways and contexts.	Before you begin working on your energy-flow diagrams, let's review the guidelines and requirements on the handout from our last lesson. **NOTE TO TEACHER:** *Have students locate handout 6.1 (Guidelines for Mumford's Bell Challenge). Review the guidelines and requirements teams will need to complete.* **Show slide 7.** To complete the challenge, your team will need to work through the final three requirements: 1. Draw an energy-flow diagram for your device showing energy transfers and transformations from the top of the ramp to the bell. Make sure your diagram includes arrows and labels. 2. Write a two- or three-sentence caption that describes the energy transfers and transformations in your device. 3. Fold this paper in half and place it in your science notebooks		

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			between the pages that include your energy-flow diagram. This will tell me you're ready to share your diagrams with the class. You'll have [*8 minutes*] to create your energy-flow diagrams and [*5 minutes*] to work on your captions, so keep an eye on the timer. **NOTE TO TEACHER:** *Have teams set their devices aside during this activity. Now is the time for students to focus on the energy in their devices, not on further modifications and testing. Remind students that you'll be assessing their descriptions and explanations of the energy transfers and transformations in their devices. Emphasize that this is more important than what their device looks like or how it was constructed.* *Following are suggested time limits for each phase of the activity:* 1. *Create energy-flow diagram: 8 minutes* 2. *Write caption (2–3 sentences): 5 minutes* *Write these times on the board and set a timer to help students stay on track.* *Circulate among the teams as they work*		

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		Ask questions to elicit student ideas and predictions.	*on their diagrams. Help them monitor their time so they don't run out of time to work individually on their captions.* *Ask the following questions to determine whether students understand the energy transfers and transformations in their devices:* • *Where does energy transfer from place to place or object to object in your device?* • *Where does energy change costumes or transform from one form to another in your device? (Think about the final picture from Mumford and Leroy's big crash.)* • *How can you show these energy transfers and transformations in your energy-flow diagram? (Think about the diagrams we drew in lesson 5.)*		
15 min	**Follow-Up to Activity** **Synopsis:** Teams present their devices and energy-flow diagrams to the class and answer questions about the energy transfers and transformations in their systems. **Main science idea(s):** • Energy can move and		Once again, you've done a great job as energy detectives and trackers! Now let's have a representative from each team come up and describe your device and the energy-flow diagram you created. **NOTE TO TEACHER:** *Have one member of each team display their energy-flow diagram on an overhead*		*Questions to ask as students present their diagrams:* • How do you detect that energy? • You say the energy leaves X.

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	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.	Ask questions to probe student ideas and predictions. Engage students in constructing explanations and arguments.	*projector, document reader, or Smart Board.* *The team representative should describe the energy-flow diagram and read the caption. Even if teams didn't quite get their devices to ring the bell at the end, they can still describe the energy transfers and transformations in the system. Listen for the connections between the actions and interactions in their devices and the energy transfers and transformations. Ask questions to clarify their thinking (see sample questions in column 6).* **Show slide 8.** First, explain how your device works and the energy transfers and transformations involved in each step. Walk us through what happens from the beginning to the end. Even if your device doesn't ring the bell at the end, show us where energy comes from and where it goes in your diagram. **NOTE TO TEACHER:** *Ask every student on each team one of the following questions about the energy involved in the device.* Where does energy transfer from place to place or object to object in your device?		What do you mean by "leaves"? Do you mean it goes away? • You mention that X starts moving. Where did the energy come from for X to start moving? • Why do you think that? • How do you know that?

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			Where does energy change costumes or transform into another form in your device? Does your device have potential energy? If so, where? Do you think there are energy changes in your device that you can't detect? Why? **NOTE TO TEACHER:** *The purpose of the question above is to see whether students understand that they can't detect all energy transfers and transformations. Energy always escapes as heat, and often this is difficult to detect.* Does all of the energy in your device eventually end up ringing the bell? Why? **NOTE TO TEACHER:** *The purpose of the question above is to determine whether students are beginning to grasp the concept of energy conservation. They should have at least an initial understanding that some of the energy in the device will be released into the environment as heat.*		
10 min	**Synthesize/Summarize Today's Lesson**	Highlight key	**Show slide 9.** Today we explored the focus question,		

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	Synopsis: Students write their best answers to the unit central question to summarize everything they've learned about energy in this unit. **Main science idea(s):** • Energy can move and change, but it can't be created or destroyed. The energy of an object can move, or transfer, from place to place or from object to object. Energy can also transform from one form into another. In these transfers and transformations, energy is always conserved.	science ideas and focus question throughout. Engage students in making connections by synthesizing and summarizing key science ideas.	*How can knowing about energy help us solve problems?* So did we succeed in solving Mumford's paper-delivery problem by using science ideas about energy? You certainly had some creative solutions! **Show slide 10.** Now I'd like you to summarize everything you've learned about energy in this unit by writing your *best* answer to our unit central question, *How does the energy of an object move and change?* Write four or five complete sentences in your science notebooks using the sentence starters on the slide: *The energy of an object can transfer (move) or transform (change costumes) when _____. My evidence is _____.* Also try to describe how energy is conserved in every interaction. Think about heat energy! **Individual work time.** **Whole-class discussion:** So how did you answer our unit central question? Let's	*Possible answers to the*	

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		Ask questions to challenge student thinking. Engage students in communicating in scientific ways.	hear your ideas and evidence. **NOTE TO TEACHER:** *If students' ideas are incorrect, ask challenge questions to clarify and correct their thinking. If time allows, encourage students to communicate in scientific ways by agreeing or disagreeing with each other's ideas, asking questions, adding ideas to the discussion, or respectfully offering an alternative explanation.*	*unit central question:* An object starts off with potential energy at the top of a hill, and then the potential energy changes to kinetic energy as the object starts moving down the hill. You might start with the potential energy in the food you ate for breakfast, and that energy changes to motion energy or kinetic energy when you crank a flashlight. Then the kinetic energy turns into the sound of the crank and the light from the flashlight. The light and sound energy eventually turn to heat energy when you can't see the light or hear the sound anymore. Then the heat energy just floats away into the atmosphere and eventually into space.	Can you provide evidence from our investigations in this unit?