SCIENCE:

GRADE 4–ENERGY

Energy

Electrifying Energy

TEKS

4 (6) Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems.

(A) The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal.

(B) The student is expected to differentiate between conductors and insulators.

(C) The student is expected to demonstrate that electricity travels in a closed path, creating an electrical circuit . . .*

**"and explore an electromagnetic field" not addressed by this lesson*

Content Objective

I can differentiate among forms of energy. I can also differentiate between conductors and insulators while demonstrating how an electrical circuit works.

Science

Science Process Skills

4 (2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations.

(B) The student is expected to collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawing, writing, and concept maps.

4 (3) Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions.

(C) The student is expected to represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size.

Mathematics

4 (16) Underlying processes and mathematical tools. The student uses logical reasoning.

(A) The student is expected to make generalizations from patterns or sets of examples and nonexamples.

English Language Arts and Reading

4 (11) Reading/comprehension of informational text/expository text. Students analyze, make inferences and draw conclusions about expository text and provide evidence from text to support their understanding.

(A) Students are expected to summarize the main idea and supporting details in text in ways that maintain meaning. (orally)

4 (18) Writing/expository and procedural texts. Students write expository and procedural or work-related texts to communicate ideas and information to specific audiences for specific purposes.

(A) Students are expected to create brief compositions that:

(ii) include supporting sentences with simple facts, details, and explanations.

(B) Students are expected to write letters whose language is tailored to the audience and purpose (e.g., a thank you note to a friend) and that use appropriate conventions (e.g., date, salutation, closing).

4 (27) Listening and speaking/listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity.

(A) Students are expected to listen attentively to speakers, ask relevant questions, and make pertinent comments.

4 (28) Listening and speaking/speaking. Students speak clearly and to the point, using the conventions of language. Students continue to apply earlier standards with greater complexity. Students are expected to express an opinion supported by accurate information, employing eye contact, speaking rate, volume, and enunciation, and the conventions of language to communicate ideas effectively.

Energy

4 (29) Listening and speaking/teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in teacher- and student-led discussions by posing and answering questions with appropriate detail and by providing suggestions that build upon the ideas of others.

Figure 19.

Reading/comprehension skills. Students use a flexible range of metacognitive reading skills in both assigned and independent reading to understand an author's message. Students will continue to apply earlier standards with greater depth in increasingly more complex texts as they become self-directed, critical readers.

(C) The student is expected to monitor and adjust comprehension (e.g., using background knowledge, creating sensory images, re-reading a portion aloud, generating questions).

(D) The student is expected to make inferences about text and use textual evidence to support understanding.

English Language Proficiency Standards

1 (C) Cross-curricular second language acquisition/learning strategies. The student is expected to use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary.

Language Objective

I can compare conductors and insulators using a table.

Response to Intervention/Tier 1 Differentiation

All science lessons support students in receiving quality Tier 1 instruction. Using the 5E model, knowledge is taught in a variety of contexts, integrating math, science, and ELA content, thus supporting the active engagement of students with the content. Lesson-specific differentiation strategies for addressing diverse student needs can be found throughout each lesson in sections titled "Differentiation Strategy."

Energy

Differentiation should

- focus on skills students did not understand and extend the lesson for advanced students;
- be conducted in small groups or embedded in whole-group instruction; and
- provide students with a variety of strategies to process the information, such as
  - allowing for additional opportunities for verbal brainstorming of words associated with a topic (with teacher taking dictation);
  - making clear connections of new and more complex concepts to foundational aspects and prior knowledge;
  - participating in more tangible experiences, such as experiments, investigations, and active exploration;
  - sorting academic vocabulary words into categories by common attributes—process words or science content vocabulary;
  - organizing brainstorming into semantic maps or creating graphic organizers;
  - discussing the meaning of a graphic organizer with a partner; and
  - creating a visual representation to demonstrate understanding.

See the handout in the Content Resources section that addresses instructional strategies.

College and Career Readiness Standards

I.C2 Collaborative and safe working practices. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms.

I.E1 Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic.

I.E2 Use essential vocabulary of the discipline being studied.

V.E1 Measurements and models. Use models to make predictions.

Energy

Vocabulary Focus

conductor
electrical circuit
electrical energy
heat/thermal energy
insulator
light energy
mechanical energy
sound energy

Prerequisite Science Knowledge

K (6)(A) The student is expected to use the five senses to explore different forms of energy such as light, heat, and sound.

1 (6)(A) The student is expected to identify and discuss how different forms of energy such as light, heat, and sound are important to everyday life.

2 (6)(A) The student is expected to investigate the effects on an object by increasing or decreasing amounts of light, heat, and sound energy such as how the color of an object appears different in dimmer light or how heat melts butter.

3 (6)(A) The student is expected to explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life.

Energy

5E Lesson Summary

Engage
Students observe different forms of energy in an energy ball.

Explore
Students demonstrate that electrical energy travels in a closed path.

Explain
Students explain how electricity flows through a circuit and how conductors and insulators interact with the circuit.

Elaborate
Students investigate conductors and insulators in a circuit.

Evaluate
Students write a letter explaining how to build a working circuit.

Energy

Engage

Materials

For teacher

- energy ball

Teacher Note

Energy balls can be purchased from science suppliers or teacher supply stores.

Teacher Instruction

- Hold the energy ball for all students to observe. Do not display or touch the two metal strips at this time.
- Ask the following: What are some physical properties of the energy ball? *The energy ball is white, small, smooth, hard, and made of plastic.*
- Touch both metal strips and allow students to observe the flashing light and siren sound.
- Instruct students to discuss within their groups what they think is happening and why.

Facilitation Questions

- Why did the energy ball light up and make noise? *Answers will vary.*
- What forms of energy did you observe? *We observed light and sound energy. Depending on prior knowledge, some students may mention electrical energy.*

Explore

Teacher Note

If the light bulb is not glowing or lighting up, make sure the batteries are both turned in the same direction. The batteries should be placed positive (+) to negative (–). The small, black, circular buzzers work best. They will have one red wire and one black wire attached to them. If the buzzer is not buzzing when connected to the energy source, try reversing the black and red wires. Buzzers, small light bulbs, and motors can be purchased at electronics stores. Generators can be ordered from science supply companies. Generators can also burn out the small light bulbs if the handle is turned too fast and too much energy is supplied to the bulbs.

Use wire from a strand of holiday lights. This type of wire will be easier for elementary students to use.

The abbreviation RM stands for reproducible master. RMs include activity cards with instructions for students to follow or pages on which they can record observations and data.

Differentiation Strategy

RtI Tier 1: Guide small groups of students through the Explore activities and scaffold the facilitation questions to better assist students with their answers.

ELL: Draw and label pictures on *RMs 2–3*.

Advance Preparation

Place all of the items except for the light bulbs in the resealable plastic bag.

Store the light bulbs in a small container to prevent breakage.

Use wire strippers to strip short sections of wire for each group.

Teacher Instruction

- Pass one bag of materials and one light bulb to each group.
- Review items in the bags as they relate to *RM 1: Exploring Energy*.

Materials

For teacher

- a pair of wire strippers

For each student

- RM 2
- RM 3

For student groups

- RM 1
- 2 D-cell batteries
- battery holders
- flashlight bulb or small car headlight bulb
- light bulb holder
- buzzer
- small motor with gear
- short sections of wire with ends stripped
- handheld generator with hand crank
- quart-size resealable plastic bag
- small container

Energy

- Instruct students to follow the directions on *RM 1*.
- Instruct students to fill in the tables on *RM 2: Energy Source—Batteries* and *RM 3: Energy Source—Generator* as they work through activities 1–3.
- Write and display the following sentence stems on chart paper or a white board:
  - When we disconnected the wires, we noticed _____.
  - When we connected the wires, we noticed _____.
- Ask students to complete the sentences above after completing all three activities.

Facilitation Questions

Activity 1

Use a SMART™ or Mimio® interactive whiteboard or journaling app to have students draw their circuit designs.

- How did you make the light bulb light up using the batteries as an energy source? *We connected the batteries to the light bulb with wires.*
- How did you make the light bulb light up using the generator? *We connected the wires from the generator to the light bulb and turned the hand crank.*
- Were there any differences between using the batteries and the generator in making the light bulb light up? *Yes. The generator made the light bulb's light dimmer or brighter depending on how fast the hand crank was turned.*
- What forms of energy did you observe? *We observed light energy when the bulb glowed and mechanical energy when we turned the hand crank to make the generator work. The batteries became warm when left connected to the wires. We observed heat/thermal energy when that happened. Depending on prior knowledge, some students may mention observing the effects of electrical energy.*

Activity 2

- How did you make the buzzer produce sound using the batteries? *We connected the batteries to the buzzer, making sure the wires were connected correctly.*

- How did you make the buzzer produce sound using the generator? *We connected the wires from the generator to the buzzer and turned the handle.*
- Were there any differences between using the batteries and the generator to make the buzzer produce sound? *It may have been harder to hear the buzzer when it was connected to the generator.*
- What forms of energy did you observe? *We observed sound energy when the buzzer produced sound. We observed mechanical energy when we turned the hand crank. The batteries became warm when left connected to the wires. We observed heat/thermal energy when that happened.*
- Did anyone try to connect the buzzer and the light bulb to the batteries or the generator at the same time? If so, what happened? *Answers will vary.*

Activity 3

- How did you make the motor run using the batteries? *We connected the batteries to the motor using the wires.*
- How did you make the motor run using the generator? *We connected the wires from the motor to the generator and turned the hand crank.*
- Were there any differences between using the batteries and the generator to make the motor run? *Answers will vary and may include that the generator made the motor run faster.*
- What forms of energy did you observe? *We observed mechanical energy when the motor ran and the gear turned. We observed sound energy when we could hear and feel the motor vibrating. The motor and batteries became warmer the longer they stayed connected. We observed heat/thermal energy when that happened.*
- Did anyone try to connect the buzzer, light bulb, and motor to the batteries or the generator at the same time? If so, what happened? *Answers will vary.*

Use these apps to allow students to practice with or extend their knowledge of circuits.

Android™: The Electrical Circuit, DIY KIT, Every Circuit

iPad®: Building Serial Circuits, Exploriments: Simple Circuits

Refer to the Mobile Technology Integration document in Drop Boxes in your Science Academies for Grades K–4 Project Share group.

Energy

Explain

Materials

For teacher

- *The Three-Ring Circuit Circus* book
- energy ball
- wooden spoon
- metal spoon

Teacher Instruction

- Read and discuss *The Three-Ring Circuit Circus*.
- Instruct student pairs to take turns summarizing what they learned from the book.

Facilitation Questions

- What had to happen before the animals could perform? *The circus rings had to be closed before the animals could perform.*
- What had to happen before the light bulb would light up, the buzzer would make noise, or the motor would run? *The circuit had to be closed.*
- What is a circuit? *A circuit is a path through which electrical energy can flow.*
- What happens when wires are not connected in a circuit? *The circuit is open, which means electrical energy cannot flow through it. Light bulbs will not glow, buzzers will not make noise, and motors will not run when this happens.*
- What are open circuits also called? *Open circuits are also called incomplete or broken circuits.*
- What do you think happens when you turn a light off at home or school? *The circuit is opened, which keeps the light from receiving electrical energy.*
- What happens when everything in a circuit is properly connected? *The circuit is closed, which means electrical energy can flow through it. Light bulbs will light up, buzzers will make noise, and motors will run when this happens.*
- What are closed circuits also called? *Closed circuits are also called complete or working circuits.*
- What do you think happens when you turn the television on at home? *The circuit is closed, which allows electrical energy to flow to the television to turn it on.*

Energy

Teacher Instruction

- Ask students to stand in a circle close enough to hold hands.
- Hold the energy ball while standing between two students.
- Show students the metal strips on the energy ball.
- Instruct students to hold hands or to touch the tips of their index fingers with those of students on either side of them.
- Touch one of the metal strips and ask the student next to you to touch the other metal strip. The energy ball should light up and produce sound if the class has successfully created a closed circuit.
- Ask two students to disconnect their hands or fingers. The energy ball should go dark and stop making noise because the circuit is now open.
- Ask the same two students to hold a wooden spoon between them. The energy ball should still be dark and silent because the wooden spoon is an insulator that does not allow electrical energy to flow.
- Instruct the students to put the spoon down and to rejoin hands. The energy ball should be glowing and making sound again.
- Ask a different pair of students to disconnect hands and to hold the metal spoon between them. The energy ball should begin glowing and making sound because the metal is conducting electricity.
- Ask those students to lay the metal spoon down and to join hands again.

Facilitation Questions

- What forms of energy does the energy ball demonstrate? *The energy ball demonstrates light, sound, and electrical energy.*
- What did the circle of students model? *The circle of students modeled an electrical circuit.*
- What happened when someone was not touching the hand of the person next to them? *The circuit was open, incomplete, and broken, which means the energy ball did not light up or make noise.*
- What happened when everyone was touching the hand of the person next to them? *The circuit was closed, complete, and working, which means the energy ball lit up and made noise.*

Energy

- What happened when two students held a wooden spoon between them? Why? *The energy ball went dark and silent because the wooden spoon is an insulator that stopped the flow of electrical energy.*
- What are conductors? *Conductors are materials that allow electrical energy to easily flow through them, such as metals and people.*
- What kinds of circuits are created when conductors are placed in them? *Conductors create closed, complete, and working circuits because electrical energy can flow through them.*
- What happened when two students held a metal spoon between them? Why? *The energy ball lit up and made noise because the metal spoon is a conductor that allows electrical energy to flow through it.*
- What are insulators? *Insulators are materials that reduce or prevent electrical energy to flow though them, such as glass, plastic, wood, cloth, and rubber.*
- What kinds of circuits are created when insulators are placed in them? *Insulators create open, incomplete, or broken circuits because electrical energy cannot flow through them.*

Elaborate

Safety Alert

Stress the importance of safety when working with electrical energy. Remind students to avoid exploring electrical outlets with conductors and insulators.

Advance Preparation

Find a strand of holiday lights and cut the light bulbs apart so that they have the maximum length of wire on either side. Use the light bulbs in between (with no wire left after cutting them apart) for replacement bulbs.

Additional items may be used or substituted for those on the materials list. Place the materials in a plastic resealable bag.

Teacher Instruction

- Pass one bag of materials to each group.
- Instruct students to follow the directions on *RM 4: Conductors and Insulators*.

Facilitation Questions

- Which items caused the light bulb to light up? *Answers will vary depending on the materials used but may include metal items such as the nail, screw, coin, paper clip, foil, or metal BB.*
- What kind of circuit did these items create? How do you know? *These items created a closed, complete, or working circuit because they allowed the light bulb to light up.*
- What would you call the items that allowed the light bulb to light up? Why? *The items that allowed the light bulb to light up are conductors because they allowed electrical energy to flow though the circuit, causing the light bulb to light up.*
- Which items did not allow the light bulb to light up? *Answers will vary depending on the materials used but may include foam, plastic, glass, magnetic bead, and cloth.*

Materials

For teacher

- strand of holiday lights

For each student

- RM 4

For student groups

- D-cell battery
- bulb with wires attached
- small pieces of various kinds of plastic
- foam
- toothpick
- cloth
- pencil-top eraser
- round magnet
- magnetic bead
- horseshoe magnet
- marble
- paper clip
- coin
- nail
- screw
- metal BB
- aluminum foil
- plastic resealable bag

Energy

- What kind of circuit did these items create? How do you know? *These items created an open, incomplete, or broken circuit because the light bulb did not light up.*
- What would you call the items that did not allow the light bulb to light up? Why? *These items are insulators because they stopped the flow of electricity, which kept the light bulb from lighting up.*
- Where else in your life do you use open and closed circuits? *Student responses will vary and may include that flipping light switches in a room can turn a light or fan on or off.*
- Why do we need to be able to open and close circuits? *Student responses will vary and may include that we can conserve energy by turning lights off that we are not using.*

Science Notebook Entry

Download Grade4_Elaborate_Energy from Drop Boxes in your Science Academies for Grades K–4 Project Share group to use on a SMART™ or Mimio® interactive whiteboard.

Differentiation Strategy

G/T: Provide the second question and a screwdriver (optional) to G/T students.

1. What is the difference between conductors and insulators and how do they affect circuits? What are some examples of conductors and insulators?
2. Explain the design of a screwdriver. Be sure to use vocabulary words including circuit, conductor, and insulator.

Science Notebook Entry Answer Key

1. *Conductors allow electrical energy to flow through a circuit, and insulators greatly reduce the flow of electrical energy through a circuit. Some examples of conductors include metal and people, and some examples of insulators include glass, plastic, wood, rubber, and cloth.*
2. *Student responses will vary and may include that a screwdriver has a metal tip used to turn screws and a plastic handle for people to hold. If a person was using a screwdriver in an area with electricity and the metal tip came into contact with an electrical circuit, the metal tip would act as a conductor and electrocute the person. The plastic handle acts as an insulator and greatly reduces the flow of electricity, preventing the person from being electrocuted.*

Evaluate

Teacher Instruction

- Instruct students to use their knowledge of the forms of energy, electrical circuits, conductors, and insulators to complete *RM 5: Electrifying Energy Assessment*.

Materials

For each student

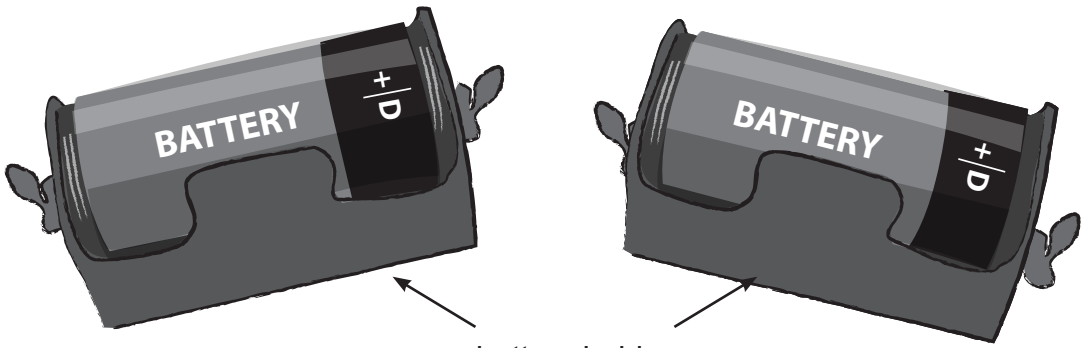
- RM 5

Grade 4

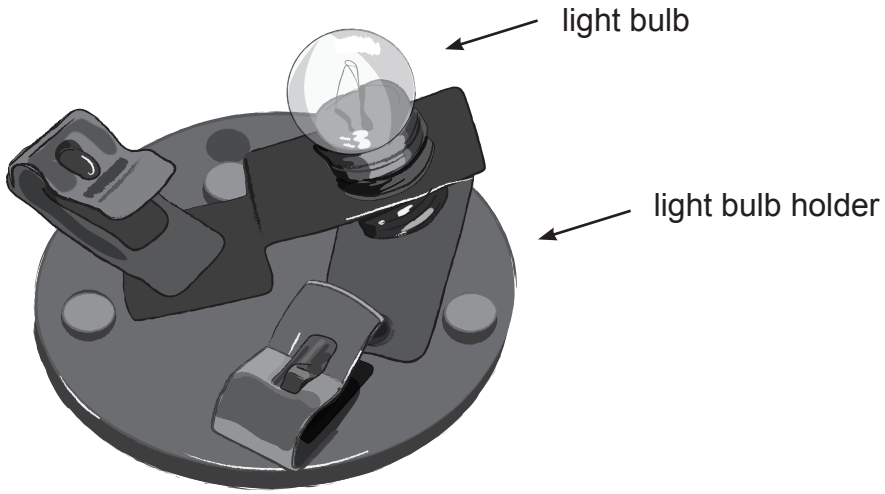
RM 1: Exploring Energy

Instructions

- Place the batteries in the battery holders.
- Connect the battery holders with one wire.
- Attach wires to the other ends of the battery holders.



- Place the light bulb in the light bulb holder.

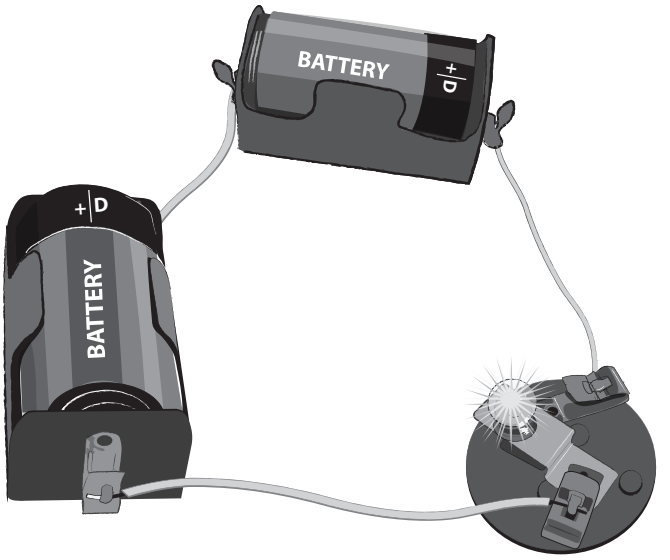


Grade 4

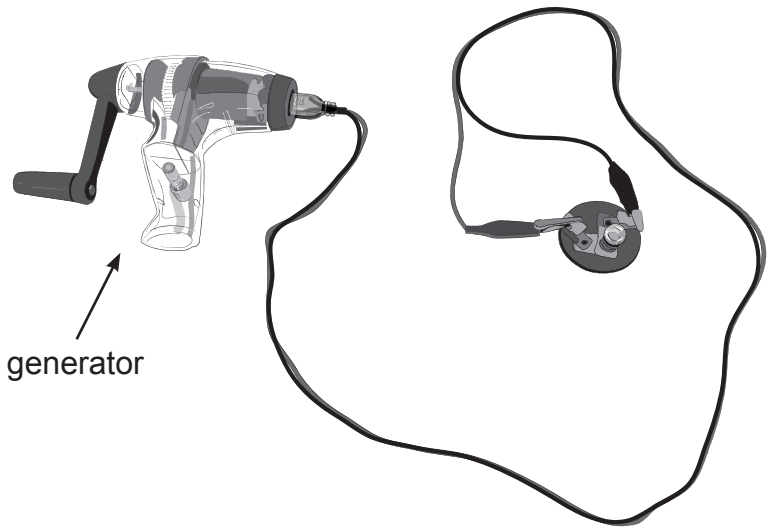
RM 1: Exploring Energy continued

Activity 1

1. Connect the wires from the batteries to the light bulb and observe. Make sure your batteries are aligned with a positive (+) end facing a negative (–) end.



2. Detach the light bulb from the batteries.
3. Connect the generator to the light bulb and observe. Start by slowly turning the handle on the generator. Continue to slowly increase the speed with which you are turning the handle. Be careful not to burn out the light bulb by turning the handle too fast.

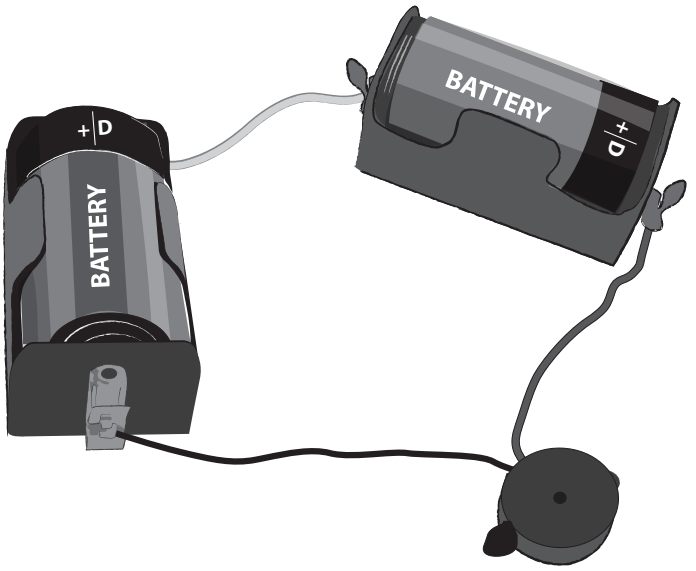


4. Detach the light bulb from the generator.

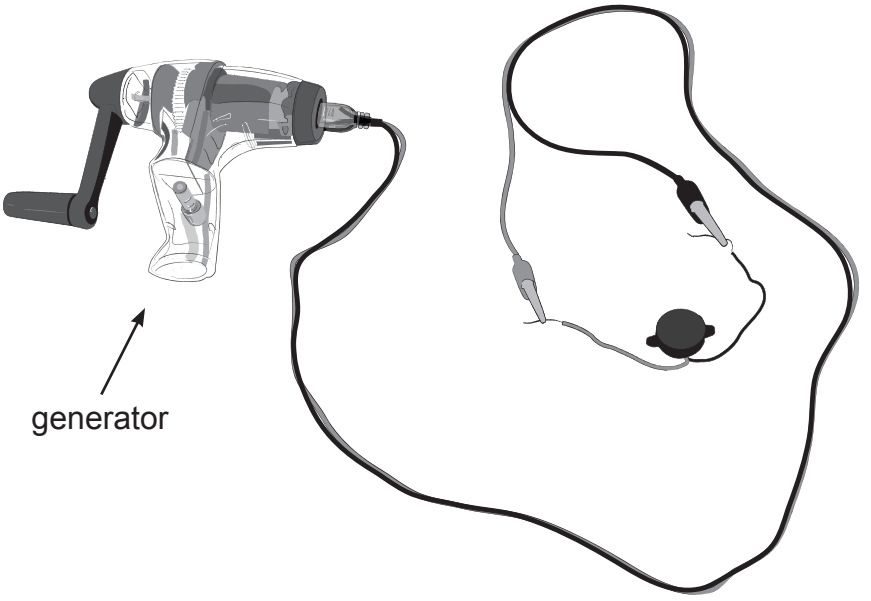
RM 1: Exploring Energy continued

Activity 2

1. Connect the wires from the batteries to the buzzer and observe. If the buzzer does not work, try reversing the red and black wires.



2. Detach the buzzer from the batteries.
3. Connect the generator to the buzzer and observe.



4. Detach the buzzer from the generator.

RM 1: Exploring Energy continued

Activity 3

1. Tape a small piece of paper to the gear on the motor.
2. Connect the wires from the batteries to the motor and observe.

3. Detach the motor from the batteries.
4. Connect the generator to the motor and observe.

5. Detach the motor from the generator.

Grade 4

RM 2: Energy Source–Batteries

	Activities		
	1. Light Bulb	**2. Buzzer**	**3. Motor**
Draw and label a picture of your circuit in the box.			
Label the drawings using the following words:	energy source, circuit, light bulb, light energy	energy source, circuit, buzzer, sound energy	energy source, motor, circuit, mechanical energy, sound energy
Does the circuit produce **light**?			
Does the circuit produce **sound**?			
Does the circuit produce **heat**?			
Does anything in the circuit **move**?			

- Begin by turning the handle. Slowly increase the speed and observe what happens.
- **Be careful not to burn out your light bulb. If you see the bulb becoming very bright, turn the handle more slowly.**

	Activities		
	1. Light Bulb	**2. Buzzer**	**3. Motor**
Draw and label a picture of your circuit in the box.			
Label the drawings using the following words:	energy source, circuit, light bulb, light energy	energy source, circuit, buzzer, sound energy	energy source, motor, circuit, mechanical energy, sound energy
Does the circuit produce **light**?			
Does the circuit produce **sound**?			
Does the circuit produce **heat**?			
Does anything in the circuit **move**?			

Grade 4

RM 4: Conductors and Insulators

1. Connect the light bulb and the battery to make the light bulb light up.
   - What kind of circuit have you made?
2. Stop the light bulb from lighting up.
   - What kind of circuit have you made?
3. Disconnect a wire from between the battery and the light bulb.

4. Observe the items in the bag and predict whether each one is an insulator or conductor.
5. Place the items on the table according to your predictions.
6. Insert each item between the wire and the battery one at a time.
7. Rearrange the items on the table according to actual results to show which items are conductors and which items are insulators.
8. Record the names of the items in each column.

Conductors	Insulators

Complete the sentences:

- I was surprised _____.
- Conductors and insulators are different because _____..

Grade 4

RM 5: Electrifying Energy Assessment

Write a letter to your best friend explaining how to put a circuit together. Your circuit must have an energy source, wires, and generate energy for a light bulb, buzzer, or motor. Make sure you include the following vocabulary words in your letter:

- open, incomplete, broken circuit
- closed, complete, working circuit
- sound energy
- light energy
- electrical energy
- mechanical energy
- heat/thermal energy
- conductor
- insulator

Your letter also needs to include a date, salutation, closing, and a labeled drawing of the setup.

Date _____

Dear _____,

_____

_____

_____

_____

_____

Sincerely,

_____

NOTES

NOTES

Grade 4 Lesson Debrief

Energy

Support Frameworks	Strategy/Evidence in Lesson
English Language Proficiency Standards 1.C Cross-curricular second language acquisition/learning strategies. The student is expected to use strategic learning techniques such as concept mapping, drawing, memorizing, comparing, contrasting, and reviewing to acquire basic and grade-level vocabulary.	
Response to Intervention: Tier 1 Where was evidence of differentiation?	
College and Career Readiness Standards I.C2 Collaborative and safe working practices. Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms. I.E1 Effective communication of scientific information. Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic. I.E2 Effective communication of scientific information. Use essential vocabulary of the discipline being studied. V.E1 Measurements and models. Use models to make predictions.	

Lesson Summaries

Energy

Grade	TEKS	Lesson Summaries
4		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
3		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
2		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
1		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**
K		**Engage:** **Explore:** **Explain:** **Elaborate:** **Evaluate:**