Lesson Topic: Conservation of Energy

Objective:
Students will be able to:

1. Define the Law of Conservation of Energy
2. Explain the relationship between potential energy and kinetic energy.
3. Discuss energy "loss" as heat within the confines of the Law of Conservation of Energy.
4. Describe the energy conversions that occur in a battery-powered flashlight.

Time Required: 75 minutes

Materials Needed:

- Battery-operated flashlight
- Battery or batteries to operate the flashlight
- Teacher computer with internet access
- Projector/Smartboard/interactive whiteboard
- 1 computer/laptop/iPad per student with internet access
- Conservation of Energy Worksheet (attached)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional – Middle School – Conservation of Energy
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review – Middle School – Conservation of Energy
- Make copies of Conservation of Energy Worksheet (1 per student)

Engage (10 minutes):

1. Hold up the flashlight and the battery or batteries for the class. Turn the flashlight on and explain to students that they will witness a series of energy transformations, which results in the operation of the flashlight.
2. Explain to students that although energy will change form or transform from the battery or batteries to the lightbulb, the total amount of energy involved in the operation of the flashlight will remain the same.
3. Write the Law of Conservation of Energy on the board.
    a. Law of Conservation of Energy – states that energy cannot be created or lost; the total amount of energy in a closed system stays the same.
    b. Explain that the flashlight they will observe is an example of a system.
4. Place the battery or batteries in the flashlight. You may ask a student to dim the lights in the room for effect.
5. Turn on the flashlight.
6. Ask students to identify what changed to illuminate the flashlight.
    a. Answer: adding the battery or batteries
7. Explain to students that a battery or batteries contain chemical energy that is

converted to electrical energy when the flashlight is turned on.
    a. Write the following information on the board:
        i. Energy Transformation #1: Chemical Energy → Electrical Energy
8. Reinforce to students the concept of conservation of energy by explaining that the total amount of energy is the same; only a transformation has occurred.
9. Explain to students that the lightbulb receives electrical energy, which excites electrons in the filament of the lightbulb, producing light energy.
    a. Draw a simple lightbulb with a filament on the board. Label the filament. Draw lines representing heat coming from the lightbulb.
    b. Write the following information on the board:
        i. Energy Transformation #2: Electrical Energy → Light Energy + Thermal Energy
10. Comment to students that the area around the lightbulb is warmer. The air around the lightbulb warms due to thermal energy transferring heat to the surroundings.
11. Explain to students that the phrases “heat loss” or “energy lost as heat” may be used to describe this phenomenon, but energy is never lost, as stated by the Law of Conservation of Energy. Energy is only converted or transformed. Energy transformed to a form that is no longer considered usable may be described in this manner.
12. Remind students that the three energy transformations they witnessed can be divided into either potential (stored energy) or kinetic energy (energy of motion), and they will learn more about energy transformation and conservation during the lesson.
    a. Chemical energy is an example of potential energy because energy is stored in chemical bonds.
    b. Electrical energy is an example of kinetic energy because it involves the movement of electrons.
    c. Light energy is an example of kinetic energy that involves the movement of particles as waves.

Explore (30 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
2. As students complete the assigned games, students will complete the Conservation of Energy Worksheet.
3. Circulate as students work through the playlist and complete the handout. Listen for evidence of understanding and use this opportunity to correct any misconceptions.

Explain (20 minutes):

1. Review the answers to the Conservation of Energy Worksheet by drawing both the spring diagrams and the lightbulb on the whiteboard or interactive whiteboard.
2. Relate student knowledge to the demonstration at the beginning of the lesson.
    a. Ask for a student volunteer to operate the flashlight.
    b. What are some examples of energy transfer that you witnessed when the flashlight was turned on? (battery has potential energy, chemical energy; chemical energy converts to electrical energy; electrical energy converts to light energy)
    c. Have the student pass the flashlight around the classroom.
    d. Why does the air temperature surrounding the lightbulb increase? (thermal

energy transfers heat)

e. What are some types of kinetic energy observed in the operation of the flashlight? (electrical energy because electrons move; light energy because excited particles are moving in the filament; thermal energy causes air particles to move; heat is moving from high temperature to low temperature)
f. How does the operation of the flashlight follow the Law of Conservation of Energy? (energy is not created or loss in the process; it transforms into different forms)

Elaborate (5 minutes):

1. Explain to students that there are many types of energy transformations occurring in the natural world.
2. Show this video of a series of lightning strikes as an example of energy transfer from the atmosphere to the surface.
    a. Lightning strikes three of the tallest buildings in Chicago at the same time!
3. Have students explain what they are seeing in this video. What kinds of energy transfer are occurring?
    a. Answer: Electrical energy converts to light energy and thermal energy.

Evaluate (10 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Content Review playlist.
2. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

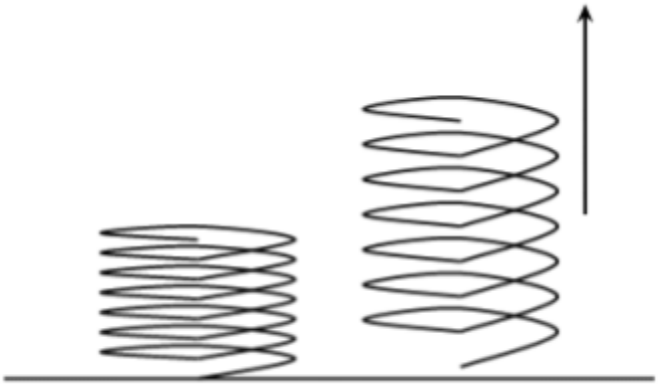
- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Conservation of Energy

Name:_____

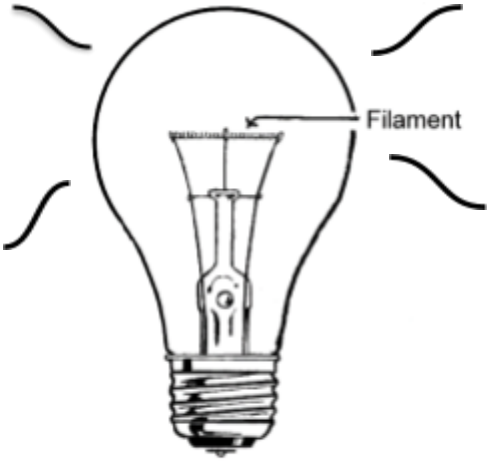
Directions: While playing the games in Legends of Learning, use what you learn to answer the questions below.

Part 1. Conservation of Energy in a Spring. Observe the change in the spring and write a description of the energy transformation in the box. (Hint: Potential and Kinetic Energy are involved.)



Answer:

Part 2: Consider the lightbulb below. Imagine you have placed it into a battery-operated circuit. Identify the energy transformations that will occur. Write your answer in the box.



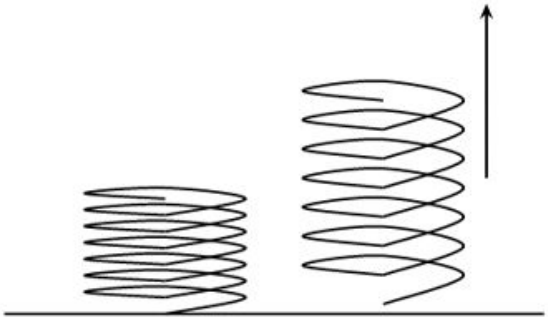
Answer:

Conservation of Energy

Name:_____*KEY*_____

Directions: While playing the games in Legends of Learning, use what you learn to answer the questions the below.

Part 1. Conservation of Energy in a Spring. Observe the change in the spring and write a description of the energy transformation in the box. Hint: Potential and Kinetic Energy are involved.

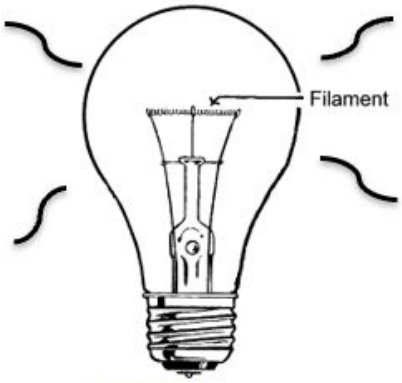


Answer:

On the left, the compressed spring contains stored energy, known as potential energy.

On the right, the spring is expanding, which means the potential energy is converted to kinetic energy since the spring is in motion.

Part 2: Consider the lightbulb below. Imagine you have placed it into a battery-operated circuited. Identify the energy transformations that will occur. Write your answer in the box.



Answer:

When placed in a battery-operated circuit, the stored chemical energy in the battery is converted to electrical energy. The electrical energy is converted to light energy in the filament as the particles in the filament are excited.

The waves around the lightbulb represent thermal energy transferring heat to the surroundings.

Note: No energy is lost or gained.