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| **Title** | What is Energy? |
| **Introduction** | In this exploratory lesson, will allow students to investigate the following questions: What is energy? How is energy used? What are two different types of energy? What happens to energy as it is used? Students will discover the following scientific explanations: Energy is the ability to do work. Energy is used to do work. Work is done whenever force is used to move an object. Two specific types of energy include potential energy and kinetic energy. Potential energy is stored energy. Kinetic energy is energy of motion. Energy can’t be created or destroyed it just changes forms. In the spool experiment, potential energy is demonstrated through the winding of a rubber band, and kinetic energy is demonstrated when the spool is allowed to move across the floor once the rubber band or stored energy is expended. The concept of energy transference is at the core of this activity. |
| **Curriculum Alignment** | Grade 6 Science:  Objective 1.01  Identify and create questions and hypotheses that can be answered through scientific investigations.  Objective 1.02  Develop appropriate experimental procedures for:   * Given questions. * Student generated questions.   Objective 1.03  Apply safety procedures in the laboratory and in field studies:   * Recognize potential hazards. * Manipulate materials and equipment. * Conduct appropriate procedures.   Objective 1.05  Analyze evidence to:   * Explain observations. * Make inferences and predictions. * Develop the relationship between evidence and explanation.   Objective 1.06  Use mathematics to gather, organize, and present quantitative data resulting from scientific investigations:   * Measurement. * Analysis of data. * Graphing. * Prediction models.   Objective 1.08  Use oral and written language to:   * Communicate findings. * Defend conclusions of scientific investigations.   Objective 6.01   * Determine how convection and radiation transfer energy.   Objective 6.02   * Analyze heat flow through materials or across space from warm objects to cooler objects until both objects are at equilibrium.   Objective 6.04  Evaluate data for qualitative and quantitative relationships associated with energy transfer and/or transformation. |
| **Learning Outcomes** | Students will:   1. be introduced to the basic concept of energy. Energy is defined as the ability to do work. 2. demonstrate comprehension of two types of energy: potential energy and kinetic energy. Potential energy is stored energy. Kinetic energy is energy in motion. 3. construct an understanding of how the two types of energy relate to each other. The relationship is that potential energy is necessary to produce kinetic energy. 4. Understand the concept of the Law of conservation of energy.   The students will demonstrate science understandings by:  1. explaining how energy is related to making the spool racer work,   2. giving a thoughtful hypothesis explaining how the "Returning Can" works and its  potential and kinetic energy, and   3. providing appropriate answers to journal questions and close activity. |
| **Time Required and Location** | Two class periods |
| **Materials Needed** | 1 Newton’s Cradle  Come Back Can   * Lab notebook (1 per student) * 1 coffee can with plastic lids (or large plastic jar) * 1 rubber band (you will have to experiment to find out which kind of band works best) * 3 metal nuts (as in nuts and bolts) * 2 toothpicks   Spool Racers   * Spools - 1 / every two students * rubber bands - 1 / every two students * washers * toothpicks - 2 / every two students * masking tape * ball * tape measure * pencil (students) |
| **Participant Prior Knowledge** | Students should have completed the lab activities on energy transfer and have a basic understanding of the concepts of conduction, convection, convection currents and radiation. |
| **Facilitator Preparations** | * Teacher should have already constructed a “Come Back Can/Jar.” * Pre-organize materials into baggies ahead of time so they are easy to distribute and students can handle one item at a time. * Set up work partners prior to lab. * Assigning or setting up of lab groups or [Cooperative](http://edtech.kennesaw.edu/intech/cooperativelearning.htm) grouping is critical as you need to put students together that can work together and support each other’s learning. |
| **Activities** | **HOOK:**  1. Hold up a ball and ask: Do you think this ball has energy? Tally the answers on the board. Why or why not? What if I drop it or throw it? Do you think it has energy now? Tally the answers on the board. Have students explain their answers. Do you think that the energy the ball has when I am holding it is the same as when I throw it or drop it? Tally the answers on the board. Explain.  2. Have students create theories about the ball's energy. Write theories on the board to come back to later.  **ACTIVITY:**  1. Pass out all materials to groups and demonstrate how to put the racer together. Have students construct their racers.  Constructing the spool racer:  1. Pull the rubber band through the spool so there is a loop on either end.  2. Put a toothpick through one loop of the rubber band. Pull tightly and tape with masking  tape. Break off the ends of the toothpick so it does not hang over the edge of the spool.  3. Pull the other loop of rubber band through the hole in the metal washer.  4. Put the other toothpick through the nontaped loop.  5. Twist the rubber band. Set spool on floor. Watch it go! (Allow students to discover this  step)  2. Have students play with racers and discover what it can do. Guide students to discover a solution that allows the spool racer to roll across the floor independent of manual assistance (i.e. pushing with finger or throwing).  3. Encourage student to think about how the rubber band affects the movement of the spool.  4. Have students think about and explain to peers how they perceive their spool racer to work. Ask questions such as: Describe the first step of the process to make the spool move. What effect does this step have towards the movement of the spool? Will the spool roll across the floor in the same manner without the first step?  5. Allow students the opportunity to compete in spool races with other students to decipher if variables such as size of the spool, weight of the washer, or tension of the rubber band effect how far or how fast the spool will go.  1. Have students share results from the challenge phase with class. Have students describe and demonstrate how their spool racers work.  2. Using the students' results and understandings from the challenge phase, explain/define energy, potential energy, and kinetic energy. Go back to students' initial theories from the board and incorporate them into the definitions.  3. Discuss how the definitions and the relationship between the two types of energy pertain to the spool racers.  Ask students to journal answers to three specific questions:  1) Describe the potential energy of the spool racer.  2) Describe the spool racer's kinetic energy.  3) Define the relationship between the two types of energy by describing how potential energy effects kinetic energy.  4. Bring out the “Come Back Can/Jar” and put it on the floor and give it a nudge. It will roll forward, stop, and then come back!   * The rubber band is winding as it rolls forward and unwinding as it rolls back. * It is because of the weight that it is able to do this.   5. Have students watch the movement of the can several times.  **CONTENT WRAP-UP**:  Have students illustrate in their notebook how they think the "Come Back Can" is constructed and then allow students the opportunity to share their thoughts.  Ask questions such as:   * Remembering how the spool racer works, what do you think starts the motion of the "Come Back Can"? * What material allows for this motion to happen? * Remembering our definitions of kinetic and potential energy, what can we assume is happening inside of the can during movement? * What is one thing the "Come Back Can" does that the spool racers did not do? (It comes back) * What do you think is inside of the can that allows it to perform that different task? (A weight) * Have the students guess what is inside the can and then show them one at a time to see if their predictions were correct.   Readdress the vocabulary and make sure the students have a complete understanding of energy, potential, kinetic and mechanical energies, how they interact and understand the principle of energy conservation.  **GUIDED PRACTICE:**  After the class has gone over the lab results and the vocabulary, each student should be given the following sheet for guided practice. Teacher can check in with students as they complete the close activity and questions clearing up any misunderstandings.  **What is Energy?**  potential kinetic mechanical energy work power joules  energy elastic potential gravitational potential mass \_\_\_\_\_\_\_velocity  The ability to do work or cause change is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. And when an object or living thing does work on another object, some of its energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to that object. So you can think of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When energy is transferred, the object upon which the work is being done \_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Energy is measured in \_\_\_\_\_\_\_\_\_\_\_\_\_\_ -- the same units as work. If the transfer of energy is work, then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the rate at which energy is transferred, or the amount of energy transferred in a unit of time. The two basic kinds of energy are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. The energy an object has due to its motion or movement is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_. The kinetic energy of an object relies on both the object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Kinetic energy increases as the object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_ increases. Kinetic energy also increases as the object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ increases. An object does not have to be moving in order to have energy. Some objects have stored energy as a result of their position or shape. This kind of energy is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy an object has related to its height is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. The type of energy an object has due to its shape or ability to be stretched or compressed is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. The form of energy that is associated with the position of an object AND the motion of an object is called \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_. You can find an object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ by adding the object’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.  **Questions:**   1. What is energy? 2. How are energy, work and power related? 3. What is kinetic energy? What is potential energy? 4. What factors effect an object’s kinetic energy? 5. How are elastic and gravitational potential energy different? 6. What is Mechanical energy? How do you find it? 7. If an object’s mechanical energy is equal to its potential energy, how much kinetic energy does that object have? How do you know? |
| **Assessment** | Bring out the Newton’s cradle and set it in motion.  Through diagrams and written explanation, they should be able to explain how the Newton’s cradle works. |
| **Critical Vocabulary** | **Energy –** The ability to do work**.**  **Potential energy –** The energy related to an objects position, shape or make up.  **Elastic potential energy** – The energy due to an objects ability to be stretched or compressed.  **Gravitational potential energy –** The energy an object has due to its height.  **Mechanical energy** – The form of energy that is made up of an object’s potential and kinetic energies.  **Conservation of energy** – A principle stating that energy cannot be created nor destroyed, it just changes form. |
| **References** | Cooperative Learning - <http://edtech.kennesaw.edu/intech/cooperativelearning.htm>  Spool Racer - <http://pbskids.org/zoom/activities/sci/spoolracer.html>  Spool racer video - <http://www.teachersdomain.org/resource/phy03.sci.phys.mfe.zsplcar/>  Come Back Can video - <http://www.dailymotion.com/video/x948bk_come-back-can-kids-craft-toy_school> |
| **Supplemental Information** | Assigning or setting up of lab groups or [Cooperative](http://edtech.kennesaw.edu/intech/cooperativelearning.htm) grouping is critical as you need to put students together that can work together and support each other’s learning. |
| **Comments** | Constructing the "Come Back Can" (differs slightly from video)   * Cut the ends off of one of the coffee cans * Poke a hole in the middle of each of the plastic lids * Place one end of the rubber band through the hole of one of the lids * Secure rubber band with a toothpick on the outside of the lid * Tie the nut in the middle of the rubber band * Place lid number one on the can * Stretch the rubber band through the can to the other lid * Pull the end of the rubber band through the hole of the second lid * Secure rubber band with the other toothpick on the outside of the can |
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