**Energy in Motion:**  
Grades 5-8 Saturday Science Lesson Plan

**Objectives:**

* After seeing a demonstration with “bouncy balls” made of two different materials, students will be able to describe the differences between potential and kinetic energy. Students will be responsible for writing two accurate definitions – one for potential energy (energy of place or position) and one for kinetic energy (energy of motion).
* After experimenting with changing the variables acting on their own “bouncy balls”, students will be able to identify characteristics of both potential and kinetic energy. Students will be responsible for listing two different characteristics of both potential energy and kinetic energy in their journals.
* After experimenting with water droplets to explore the energy found in them and comparing their individual results to the attributes of a water wheel, students will be able to describe how water can be used as an energy resource. Students will be responsible for naming the energy of water (hydropower) and listing at least three different characteristics of hydropower in their journals.
* After building their own sailboats from simple materials and using wind energy to try to move their boats across water, students will be able to describe how wind can be used as an energy resource. Students will be responsible for listing at least three different characteristics of wind power in their journals.
* After a group discussion of the results of the activities, students will be able to connect the concepts of potential energy and kinetic energy to both hydropower and wind power. Students will be responsible for constructing a graphic organizer (whatever version they choose) describing how both hydropower and wind power display potential energy and kinetic energy.
* After completing the activities and brainstorming as a class about how the sun contributes to the production of hydropower and wind power, students will begin to make connections between solar energy and other forms of energy, beginning with hydropower and wind power. Students will be responsible for taking notes on the connections but the final assessment strategies will occur during the final lessons when students construct a flow chart showing how the energy from the sun is used for many different purposes and how it is transformed to different forms of energy.

**Standards:**

* 5.3.6 - Demonstrate that things on or near the Earth are pulled toward it by the Earth's gravity. **(Core Standard)**
* 5.3.11 - Investigate and describe that changes in speed or direction of motion of an object are caused by forces. Understand that the greater the force, the greater the change in motion and the more massive an object, the less effect a given force will have. **(Core Standard)**
* 6.3.17 - Recognize and describe that energy is a property of many objects and is associated with heat, light, electricity, mechanical motion, and sound. **(Core Standard)**
* 7.3.15 - Describe how electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy, such as light or heat. **(Core Standard)**
* 8.3.15 - Identify different forms of energy that exist in nature. **(Core Standard)**

**Teacher Content Knowledge:**

Teachers should have a strong understanding of:

* Wind energy –
  + Wind energy is an inexhaustible source of kinetic energy, primarily captured from the motion of wind through turbine blades to generate electricity. Wind energy has its origins in solar energy, as winds on Earth are produced by the uneven heating of oceans and other surfaces, creating convection currents in the air.
* Hydropower –
  + Hydropower is a source of renewable kinetic energy, created through the motion of water. This energy is normally captured through the motion of water through turbine blades to generate electricity or to move objects. Solar energy also contributes to hydropower through the sun’s role in the water cycle – evaporating water from the Earth’s surface to form clouds.
* Kinetic energy –
  + Kinetic energy is produced by motion – the motion of waves, electrons, atoms, molecules and substances. Specific types of energy that are kinetic in nature are thermal, radiant, sound, electrical and motion energy. Solar energy (radiant) and wind energy (motion) are types of kinetic energy.
* Potential energy –
  + Potential energy is energy stored in an object or energy that an object has because of its position. Specific types of energy that are potential in nature are chemical (through chemical bonding), nuclear, mechanical (through the application of force such as compression), and gravitational energy (energy of position).
  + Gravity –
    - Gravity is the natural force of attraction between all objects in the universe. Gravity provides a bridge between potential and kinetic energy; for example, gravity causes loose objects to fall and release their potential energy as kinetic energy on impact.
  + Energy transformation –
    - Energy transformation is the process of changing energy from one form to another. Chemical energy in food is changed after the food is eaten into mechanical energy to move muscles, for example; the change from potential to kinetic energy by the action of gravity is also a form of transformation.

**Materials List:**

* 1 Set of Happy/Sad Balls – the “Happy” ball is made of neoprene rubber; the “Sad” ball is made of polynorbornene rubber
* 5 Superballs
* 5 rulers
* 5 meter sticks
* 6 measuring cups
* 6 spoons
* Carpeted surface OR 5 carpet squares
* 5 water bottles, filled
* Long plastic container
* Source of water to fill container, refill bottles, etc.
* Closed container of very hot water
* Container of ice
* Container of water
* 80 sheets of construction paper (color is not important)
* 15 pencils
* Small 2-speed electric fan
* 16 Small oval- or rectangular-shaped pieces of wood (about 6 inches long)
* 30 plastic drinking straws
* 30 crayons (assorted colors)
* Modeling clay (large enough to divide into 16 pieces)
* 5 pairs of safety scissors
* Transparent tape

**Lesson:**

This unit will consist of three activities that will be used to introduce students to the differences between potential energy and kinetic energy, hydropower, and wind power. The activities will provide students with a chance to see how potential energy and kinetic energy are connected to both hydropower and wind power. Students will begin to see how solar energy contributes to all other energy sources. The students will begin the day by filling out the “Know” portion of a Know, Want to Know, and Learned (KWL) chart. The students will be asked to write anything they know about potential energy, kinetic energy, hydropower, and wind power.

**Engage:**

Students will begin to see how solar energy contributes to all other energy sources. The students will begin the day by filling out the “Know” portion of a Know, Want to Know, and Learned (KWL) chart. The students will be asked to write anything they know about potential energy, kinetic energy, hydropower, and wind power. They will then move on to filling out the “Want to Know” portion of the chart. Here, students can ask questions about potential energy, kinetic energy, hydropower, and wind power that they hope to have answered during the activities. Once the students have completed the first two portions of the chart, they will share their questions with the class. The teacher should list the questions on the board for all students to see. As the class completes the activities, they will revisit the questions on the board to see if they have answered any of them and if so, discuss how they were answered. Students should record the answers in their journals or on the back of their charts.

**Explore and Explain:**

**Activity 1: Beware the Bouncing Ball**

To begin this activity, teachers should have their students share any information from the “Know” portion of their charts that is related to potential energy and kinetic energy. These ideas should be written on the board. Then the teacher will use one “Happy” ball which is made of neoprene rubber and one “Sad” ball which is made of polynorbornene rubber to demonstrate what happens when one object collides with another object. The teacher will drop each ball while the students observe what happens. The students will find that the “Happy” ball bounces higher than the “Sad” ball (this will be measured using a meter stick. The teacher will then explain that the “Happy” ball retained more of it’s kinetic energy than the “Sad” ball because it bounced higher. The “Sad” ball’s kinetic energy was converted into different forms of energy such as heat energy and sound energy. The teacher will then demonstrate what happens when he or she adds energy to the ‘Sad” ball by soaking it in hot water. The ball will bounce higher but as time goes on, the ball will cool off making it not bounce as high.

The students will then complete a similar activity using superballs. They will be divided up into groups of three and follow these steps.

1. On a hard surface, such as a tile floor, raise the ball to a height of 50 cm and drop it.
2. Observe and record the height of the ball’s bounce. Repeat Step 1 four times.
3. Raise the ball to a height of 1 m and then repeat Steps 1 and 2.
4. Repeat Steps 1-3 on a carpeted surface.
5. Discuss their findings with the entire class.

* Which surface did the ball bounce higher on? Why?
* What happened to the ball’s energy as it collided with the floor? Why didn’t it bounce all the way back up?
* What other forms of energy did the ball’s energy convert into when it collided with the floor?

1. If time permits, the students can see what happens when they soak their superballs in hot water or ice water.

The students will then rethink their definitions of potential energy and kinetic energy. Once students have shared, the teacher will explain exactly what potential energy and kinetic energy are. Now that the activity is complete, return to the questions taken from the KWL charts hat are listed on the board. Did this activity help answer any of the questions? How so? Have students keep track of any new questions they may have. These will be shared at the end of the day.

**Activity 2: What’s in a Drop?**

For this activity students will begin by sharing any information they have written in the “Know” portion of their KWL charts about hydropower. The students should be divided into five groups again and follow these steps:

1. Place a piece of construction paper on the floor.
2. Hold the water bottle about 20 cm above the construction paper.
3. Squeeze one drop of water onto the paper.
4. Using a pencil, draw a circle around the wet area that the water drop made on the paper.
5. Label the circle with the height at which the water was dropped from.
6. Raise the bottle to 40 cm and repeat Steps 3-5 on a different area of the paper.
7. Repeat for 60 cm.
8. Repeat Steps 1-7 using two drops of water making sure both drops of water hit the same spot of the paper.
9. Repeat Steps 1-7 using four drops of water making sure both drops of water hit the same spot of the paper.
10. Discuss findings with the entire class.

* How did changing the height of the bottle affect the energy in the moving water?
* How does the amount of water dropped affect the energy in the moving water?
* Show students a picture of a water wheel or a dam and connect their experiment with the functions of either one of these objects (the wheel will spin faster when more water is flowing or more electricity will be produced when there is more water flowing as compared to a bigger wet area when more drops are used.)

The students will rethink their definitions of hydropower. The teacher will then explain exactly what hydropower is. Once this activity is complete, return to the questions taken from the KWL charts hat are listed on the board. Did this activity help answer any of the questions? How so? Have students keep track of any new questions they may have. These will be shared at the end of the day.

**Activity 3: Sailing with the Wind**

For this activity students will begin by sharing any information they have written in the “Know” portion of their KWL charts about wind power. The student should follow these steps for the activity:

1. Make a sailboat to capture the energy in the wind. Be creative and imaginative when designing and decorating a sailboat that will capture the wind.
2. Test the design.
3. Make changes to the sailboat and test it again (if necessary).
4. Discuss observations.

* How did the sailboats make use of the energy found in wind?
* How would changing certain variables such as the size of the sail, the position of the sail on the boat, etc. affect how the boats use the wind for energy?

The students will rethink their definitions of wind power. Afterwards, the teacher will explain exactly what wind power is (it might be useful to explain this idea using an image of a windmill, wind turbine, or pinwheel and to have students think about how these objects use wind energy). Once this activity is complete, return to the questions taken from the KWL charts hat are listed on the board. Did this activity help answer any of the questions? How so? Have students keep track of any new questions they may have. These will be shared at the end of the day.

At the end of the activities, students will have time to share any new questions they may have had about specific energy sources or about energy in general. They will be recorded on the board. Then the entire class will discuss which questions they think will be the most interesting to answer in the future and those questions will be used to plan future lessons.

**Elaborate:**

The students will further their understanding of hydropower and wind power by brainstorming ideas about how both types of energy display the qualities of potential energy and kinetic energy. Also, students will think of ways in which the sun contributes to the production of each type of energy. These ideas will be shared with the entire class and recorded on the board for everyone to see. The teacher will then explain the connections and clear up any misconceptions students may have had.

**Evaluate:**

The students will be evaluated based on their KWL charts. The students will fill in the “Learned” portion of their KWL charts. The charts will make it obvious which students retained the information they learned about during the activities because their charts will be more complete and detailed than others. The teacher should look for the items listed in the objectives at the beginning of this lesson plan. It would also be nice if students put some of the information they found most interesting to them instead of only including what is expected of them.

**Sources:**

Discovery Communications, LLC. (2009). *The Search for Gravity Waves: What is Gravity?* Retrieved from <http://science.howstuffworks.com/the-search-for-gravity-waves-info.htm>

NEED Project. (2009). *ENERGY FROM THE WIND Teacher Guide*. Retrieved from <http://www.need.org/needpdf/Energy%20from%20the%20Wind%20Teacher%20Guide.pdf>

NEED Project. (2007). *ENERGY OF MOVING WATER Teacher Guide.*  Retrieved from <http://www.need.org/needpdf/Energy%20of%20Moving%20Water%20Teacher.pdf>

NEED Project. (2007). *EXPLORING WIND ENERGY Teacher Guide*. Retrieved from <http://www.need.org/needpdf/ExploringWindTeacher.pdf>

NEED Project. (2009). *WATER & ENERGY Teacher Guide and Backgrounder*. Retrieved from <http://www.need.org/needpdf/Water%20and%20Energy%20Teacher.pdf>

Pestka, Jessica. (2010). *wiseGEEK: What is Energy Transformation?* Retrieved from <http://www.wisegeek.com/what-is-energy-transformation.htm>

Union of Concerned Scientists. (2009). *Clean Energy: How Solar Energy Works.* Retrieved from <http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-solar-energy-works.html>