



Cobra Weave: Kinetic and Potential Energy

The three essential resources for any nation are food, water, and energy. As a matter of fact, it is energy that helps produce more food and cleaner water for our ever-growing global population. Securing and producing enough energy often becomes critical to economic and social stability throughout the world, so we need to know and understand as much as we can about our energy resources. Understanding where energy comes from and how we use it is more important now than at any time in our past as we want to provide a better and longer life for our global community. The energy concept is fundamentally scientific in nature, but it has tremendous personal and social significance.

Whenever something moves, you can see the change in energy in that system. Energy can make things move or change in the position or state of an object. Energy can be defined as the capacity to cause a change or the ability to do work. Work is done when a force moves an object over a given distance. In scientific terms, energy is classified into two major types: kinetic and potential energy. Kinetic energy is defined as the energy of a moving object. A moving car, a waterfall, or a book falling off a table are examples of objects that have kinetic energy. Potential energy is defined as the energy in matter due to its position or the arrangement of its part.

Topic / Unit: Matter and Energy

Grade Level/ Course:

An understanding of the difference between potential and kinetic energy is an important foundation for understanding energy and has a broad range of applications in elementary, middle, and high school science courses. Sixth grade science, physics, and chemistry have specific applications for this lesson.

Middle School (6-8)

MS-PS3-1 (Kinetic Energy): Construct and interpret graphical displays to describe the relationships of kinetic energy to the mass of an object and to the speed of an object (emphasizing mass and speed separately).

MS-PS3-2 (Potential Energy): Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system (e.g., gravitational, magnetic, or electric fields).

MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

(Particle Energy) 6-PS3-4: Plan an investigation to determine the relationships among energy transferred, mass, and the change in average kinetic energy of particles (temperature). [[1](#), [2](#), [3](#), [4](#), [5](#)]

High School (9-12) Physical Science and Physics:

PS-PS3-1 / PSI-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows into/out of the system are known.

PS-PS3-2 / PSI-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of motion (kinetic energy) and relative position (potential energy) of stored energy.

Physics Standards (PH-PS3-1 & PH-PS3-2): Design, build, and refine a device that works within given constraints to convert energy from one form to another, with a heavy emphasis on analyzing the mathematical relationships between kinetic energy, gravitational potential energy, and mechanical energy conservation

Materials:

- Popsicle sticks
- Forms of Potential Energy Handout
- Forms of Kinetic Energy Handout
- Cobra Weave Directions

I can:

- explain how potential energy becomes kinetic energy.

Scaffolded

scripted

questions

- What is potential energy?
- What is kinetic energy?

Warmup:

5 minutes

Show and discuss an introductory video on the difference between potential and kinetic energy.

Lesson: Activities

Time: 25 minutes

Middle and high school students will create their own cobra weaves in class. This activity can also be completed as a demonstration for elementary students, constructing the cobra weave in advance.

First, explain to students that a mechanical or chemical process will convert potential energy into kinetic energy. In this activity, mechanical energy will be used (removing the stick) to convert the cobra weave from potential to kinetic energy. Use the “Forms of Potential Energy” and “Forms of Kinetic Energy” hand out (attached) to discuss and describe energy transfer.

Next, demonstrate a potential-to-kinetic energy transformation using a “cobra weave.” It is called the cobra weave because when it is detonated in the right direction, the chain lifts itself off the ground like a rearing snake.

1. Create the cobra weave before a class of elementary students. For middle or high school students, group students and have them create a cobra weave chain using the Cobra Weave Directions handout (attached). To make the chain, start by placing one popsicle stick on the ground at a 45-degree angle. Then place a second stick on top of it so that the sticks are perpendicular and intersect at the top third of each stick. Then place a third stick on top of the second so that they intersect at the bottom third of the two sticks. To lock the left end in place, take a fourth stick and weave it under the top end of the first stick, over the middle of the third stick, and under the bottom end of the third. Now just continue the pattern out on the right side. The next stick should go over the bottom end of the third stick and under the first stick. Repeat this process until the chain reaches the desired length. The sticks should all intersect at the ends or the $\frac{1}{3}$ point on the stick. To lock down the end of the chain, insert one last stick between the three end pieces. To detonate the chain, simply pull out the last piece that you added. The chain should lift up off the ground and travel like a

wave until all the pieces have flown apart.

2. Ask the students to predict what they think will happen when you remove the final stick.

3. Remove the stick and have the students observe what happens.

4. The key to the chain reaction comes from the transfer of potential energy to kinetic energy. When you wove the popsicle sticks together, you were continually building potential energy. Each popsicle stick is bent over the stick before it and pinned under the stick before that. This creates tension in the wood. When you let go, it releases the tension, and potential energy is transformed into a chain reaction of kinetic energy.

Assessment 5 minutes:

Ask students to identify examples of potential and kinetic energy in the classroom. Examples may include:

- light switch moving from off to on position.
- a fan being moved from off to on position.
- a pencil from the desk being dropped to the floor.
- students sitting and then walking.
- a water fountain being turned on.

To encourage discussion, refer to the Potential and Kinetic handout used at the beginning of class.

Forms of Potential Energy:

Potential energy is not in motion. It is stored energy. but can become active energy when a force is applied.

Gravitational Potential Energy: The kind of potential energy that results when something is separated from the earth. [EX: A ball on top of a hill](#)

Chemical Potential Energy: The energy stored in the bonds of atoms and molecules. It is the energy that holds these particles together. [EX: petroleum](#)

Elastic Potential Energy: The energy stored in objects by the application of a force that results in the deformation of an elastic object. [Ex: rubber bands](#)

Nuclear Energy: The energy stored in the nucleus of an atom—the energy that binds the nucleus together. [EX: nuclear atoms](#)

Forms of Kinetic Energy:

Kinetic energy is in motion. It is active energy because a force is applied.

Mechanical Energy: The energy associated with the motion or position of an object.
[EX: pump jack](#)

Thermal Energy: The internal energy of substances caused by vibration and movement of atoms and molecules within the substance. [EX:boiling water](#)

Electrical Energy: The energy of moving electrical charges. [EX: plug](#)

Radiant Energy: Electromagnetic energy that travels in waves which possess both electrical and magnetic properties. [EX: sun rays](#)

Sound Energy: The energy that is associated with the vibrations of matter and travels in longitudinal waves through an object (including air and water). [EX: cymbals](#)

COBRA WEAVE DIRECTIONS

The three essential resources for any nation are food, water, and energy. As a matter of fact, it is energy that helps produce more food and cleaner water for our ever-growing global population. Securing and producing enough energy often becomes critical to economic and social stability throughout the world, so we need to know and understand as much as we can about our energy resources. Understanding where energy comes from and how we use it is more important now than at any time in our past as we want to provide a better and longer life for our global community. The energy concept is fundamentally scientific in nature, but it has tremendous personal and social significance.

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be defined as the capacity to cause a change or the ability to do work. Work is done when a force moves an object over a given distance. In scientific terms, energy is classified into two major types: kinetic and potential energy. Kinetic energy is defined as the energy of a moving object. A moving car, a waterfall, or a book falling off a table are examples of objects that have kinetic energy. Potential energy is defined as the energy in matter due to its position or the arrangement of its part.

Today, you will demonstrate a potential-to-kinetic energy transformation using a “cobra weave.” It is called the cobra weave because when it is detonated in the right direction, the chain lifts itself off the ground like a rearing snake.

1. Create the cobra weave before a class of elementary students. For middle or high school students, group students and have them create a cobra weave chain using the Cobra Weave Directions handout. To make the chain, start by placing one popsicle stick on the ground at a 45-degree angle. Then place a second stick on top of it so that the sticks are perpendicular and intersect at the top third of each stick. Then place a third stick on top of the second so that they intersect at the bottom third of the two sticks. To lock the left end in place, take a fourth stick and weave it under the top end of the first stick, over the middle of the third stick, and under the bottom end of the third. Now just continue the pattern out on the right side. The next stick should go over the bottom end of the third stick and under the first stick. Repeat this process until the chain reaches the desired length. The sticks should all intersect at the ends or the $\frac{1}{3}$ point on the stick. To lock down the end of the chain, insert one last stick between the three end pieces. To detonate the chain, simply pull out the last piece that you added. The chain should lift up off the ground and travel like a wave until all the pieces have flown apart.
2. Ask the students to predict what they think will happen when you remove the final stick.
3. Remove the stick and have the students observe what happens.
4. The key to the chain reaction comes from the transfer of potential energy to kinetic energy. When you wove the popsicle sticks together, you were continually building potential energy. Each popsicle stick is bent over the stick before it and pinned under the stick before that. This creates tension in the wood. When you let go, it releases the tension, and potential energy is transformed into a chain reaction of kinetic energy.

ENGAGE: Cobra Weave Instructions

Materials:

- ④ Lots of popsicle sticks (number sticks if you think necessary)

Step 1: Place two popsicle sticks so that they are in the shape of an X. Stick #1 will be on top and stick #2 will be on bottom.



Step 2: Place stick #3 so that one end goes under an end of stick #2 and the rest of it lies on top of stick #1.



Step 3: Place one end of stick #4 under the loose end of stick #2 so that the rest of it lies on top of stick #3.

Step 4: Place stick #5 under the loose end of stick #1 so that the rest of it lies on top of stick #4.



Step 5: Continue adding sticks in the pattern

To end the cobra weave, add a stick under and over the last two sticks. For a handle, tie a string to the middle of the last stick before securing it to the cobra. To release the cobra weave, remove the final stick or pull on the string.

