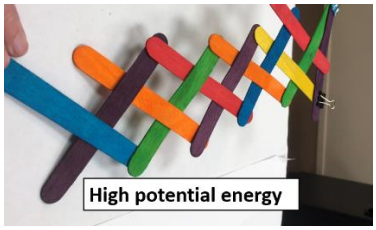
GYSTC
GEORGIA YOUTH SCIENCE & TECHNOLOGY CENTERS



Title: Converting Potential to Kinetic Energy STEM Challenge

Estimated Time: 1-2 periods

Core Ideas (GSE Standard and elements):

S8P2. Obtain, evaluate, and communicate information about the law of conservation of energy to develop arguments that energy can transform from one form to another within a system.

a. Analyze and interpret data to create graphical displays that illustrate the relationships of kinetic energy to mass and speed, and potential energy to mass and height of an object.

b. Plan and carry out an investigation to explain the transformation between kinetic and potential energy within a system (e.g., roller coasters, pendulums, rubber bands, etc.).

Literacy Connections: Books	**Literacy Connections: Close Reads**
Pancakes, Pancakes, Eric Carle	Converting Your Potential Close Read
Science and Engineering Practices: **Asking Questions and Defining Problems:** Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. **Constructing Explanations and Designing Solutions:** Use evidence to construct or support an explanation or design a solution to a problem.	**Crosscutting Concepts:** **Structure and Function:** The way an object is structured/designed determines many of its properties and functions. **Stability and Change:** For designed systems, conditions that affect stability and factors that control rates of change are critical to consider and understand.

STEM Challenge Overview:

In this STEM Challenge, your task is to design, create and test a model of a system that converts potential energy into kinetic energy.

Ask	Ask students if they know how to describe the difference between potential and kinetic energy. After discussing their ideas, introduce the STEM Challenge of creating a system that changes potential energy into kinetic energy. If time permits, here is cool 2 minute video of a science project that covers potential to kinetic energy conversions. https://www.youtube.com/watch?v=9ZpV2T4P7RY
Imagine/Brainstorm	Students **brainstorm** ideas for how they could design a simple system that can convert potential (stored) energy into kinetic energy. After brainstorming, they should consider the strengths and weaknesses of each idea.
Plan/Design	In order to learn more about energy in general, let students read***, Converting Your Potential (Energy)***.

	After researching types of energy, have students **plan** and **design** a model of a high potential energy system. They should also plan a method for initiating a change so that the stored energy can be converted into kinetic energy.
Create/Test	Students follow their plan, and **create** their high potential energy system. Once it is created, students **test** their system in a measureable way to evaluate its effectiveness. Their results should be recorded, organized, and analyzed.
Improve	After discussing and evaluating their results, students should **improve** their solution, redesign their system and find at least one additional thing to make it particularly excellent.

Teacher Notes:

As you may have seen, this STEM Challenge can also be used to discuss the nature of chemical chain reactions. However, the best content match for this super fun challenge is really as an exploration of basic energy conversions. The challenge provides a great change for the students to feel the potential energy build up in a system as they construct their chain of bending sticks. In addition, the resulting kinetic energy explosion when the craft stick chain is released is super fun and exciting, especially when students can see and hear it again in slow motion video. The slow motion video is super easy to do with almost any type of device and it helps kids to realize how fast some things actually happen in real time.

When students are constructing their chain, it really helps if you hot glue a 4 stick template for them to help get them started (see pictures and videos). This keeps the first sticks stable and it is much easier to build the chain using the template. Secondly, it helps if each group can use a spring clamp to clamp down the template to the table or desk when they begin to build. The clamp also stabilizes the chain and makes it much easier to build.

While we focus primarily on the craft stick chain, it is also good to have students use dominoes (or wood blocks) and paper cups to design a high potential energy system. If time permits, they can combine the sticks, dominoes, and cups to make a colossal energy conversion system. . If you teach at the high school level, it is also a great lesson to discuss how systems naturally tend toward low energy and high entropy.

While **matter** is the stuff of the universe of which all things are made, **energy** provides the ability to move or change matter. In other words, energy provides the ability to do work on the stuff of the universe. While energy comes in many different forms, the two fundamental types of energy are potential energy and kinetic energy.

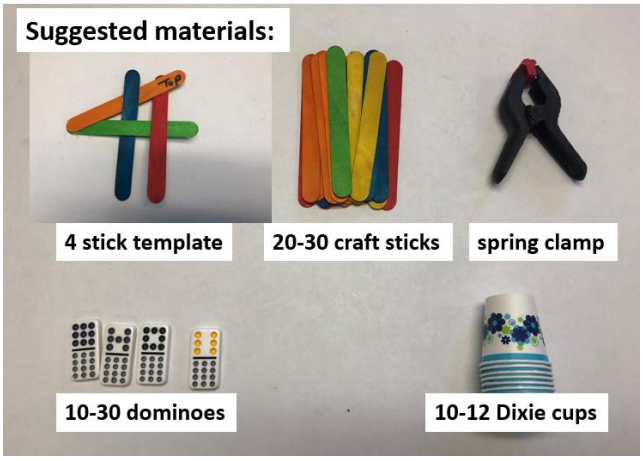
The **potential (stored) energy** of an object is the energy that the object has due to its **position**. Types of potential energy include gravitational potential energy, magnetic potential energy, and elastic potential energy. A large round rock on the top of a hill is loaded with gravitational potential energy. Bent craft sticks waiting be launched are loaded with elastic potential energy.

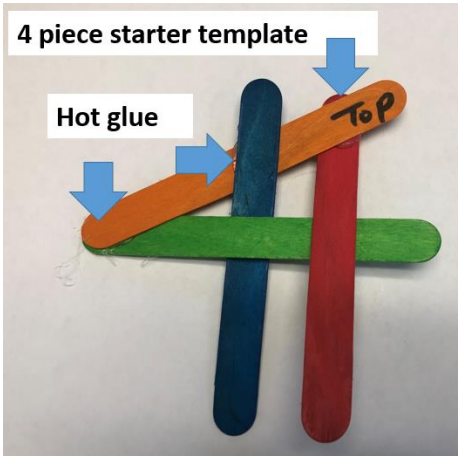
The **kinetic energy** of an object is the energy that an object has due to its **motion**. Any object that is moving contains some kinetic energy. A baseball flying through the air, a car speeding down the highway, and a fish swimming through the water all possess kinetic energy. The faster an object moves, the more kinetic energy it has.

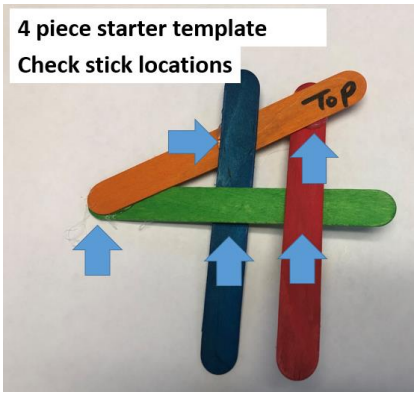
One of the coolest things about energy is that it can change from one form to another within a system. If the power goes out in your home, the potential energy in a battery can be converted into light energy

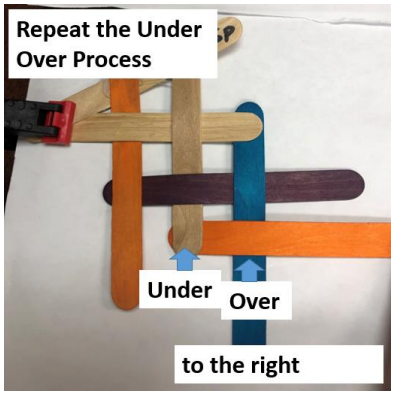
for a flashlight. Similarly, the chemical energy from gasoline can be converted into kinetic energy to power your car down the road.

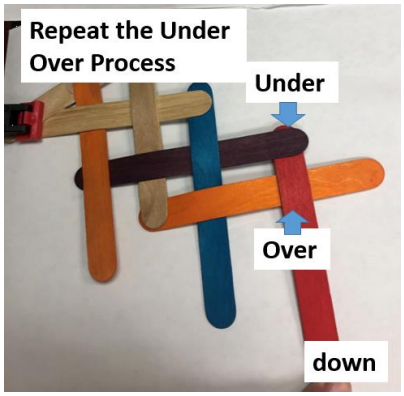
In this **STEM Challenge**, the students' first task is to build a system that is high in stored elastic potential energy. Their second, and easier task, is to initiate a change so that the stored energy can be converted into kinetic energy is a demonstrable manner.

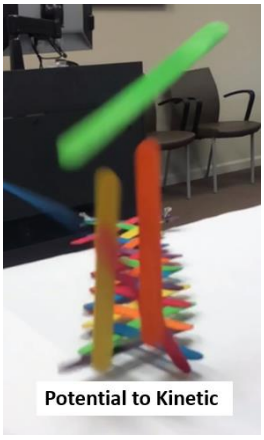




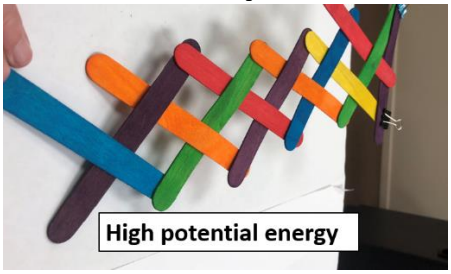
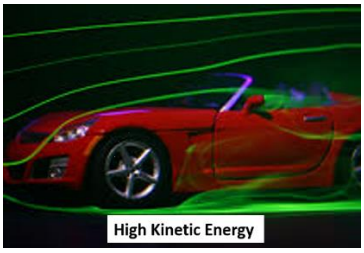








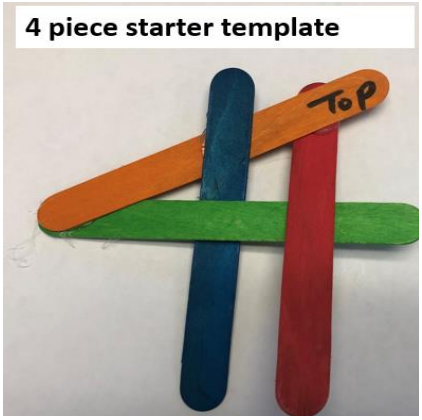
Vocabulary Cards:

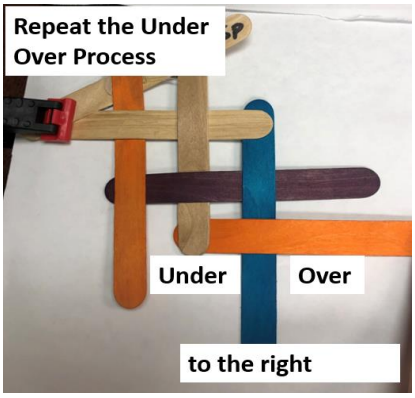
matter **the stuff of the universe of which all things are made** 	**energy** **the ability to move or change matter** 
potential energy **stored energy in an object due to its position** 	**kinetic energy** **the energy of an object due to its motion** 
energy efficient **uses less energy to provide services** 	**engineer** **to design, build, and improve things** 

Converting Potential to Kinetic Energy STEM Challenge:

Can you design and build a system that is high in potential energy and then convert the potential energy into kinetic energy in a demonstrable manner?

Designing and constructing your system:





1. After learning about potential and kinetic energy, **plan** and **design** a system with high potential energy.
2. Using the materials provided and your plan, **construct** your system. You can use a starter template for your sticks to get going or build your own.
3. If possible, use a clamp to hold down your template to a desk or table.
4. The first stick that you add goes across, the next stick goes down.
5. Each stick that you add should go **under** the first stick and **over** the second. Repeat the **over-under** process for each stick that you add.
6. You should be able to feel the potential energy in your system as you bend each stick into position.
7. Make sure to push and hold down on the last stick that you add each time. Otherwise, you will start the reaction.
8. You can place a weight on the end of the chain to keep it from releasing while you complete other parts of your system.
9. Try to add other things to your system that are high in potential energy. For example, dominoes in a line or a paper cup pyramid both have lots of potential energy. Be creative with your ideas. See if you can get all parts of your system to work together.
10. When you're ready, release the last stick or topple your first domino and observe carefully what happens.
11. If possible, **videotape** the reaction in **slow motion**. This is very cool and it allows you to observe what happens in detail.

Evaluating and Improving:

As a group, **evaluate** the effectiveness of your design and discuss how you would change your design moving forward to **improve** the energy release in your system. If time permits, make these improvements and re-test.