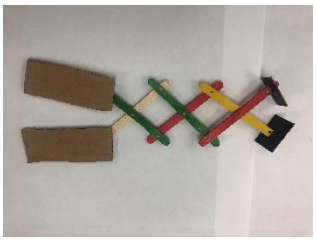
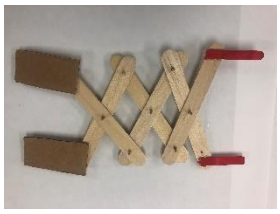




Title: A Simply Amazing Simple Machine STEM Challenge

Estimated Time: 1-2 periods

Core Ideas (GSE Standard and elements):

S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces. a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results. c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks. (Clarification statement: The use of mathematical formulas is not expected.)

S8P3. Obtain, evaluate, and communicate information about cause and effect relationships between force, mass, and the motion of objects. b. Construct an explanation using Newton's Laws of Motion to describe the effects of balanced and unbalanced forces on the motion of an object.

Literacy Connections: Books	**Literacy Connections: Close Reads**
Roll, Slope, and Slide, Michael Dahl Zombies and Forces and Motion, Mark Weakland	Simple Machines Close Read ES Simple Machines Close Read MS
Science and Engineering Practices: **Planning and Carrying Out Investigations:** Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. **Constructing Explanations and Designing Solutions:** Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.	**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, the student's task is to build a pair of pliers that grab and hold an object of their choice. In doing so, the pliers should carry out some sort of useful function.

Ask	Ask students if they know how the invention of simple machines (tools) have helped us to be successful as a species. As needed, mention that they help us to do certain jobs that would be difficult or impossible without them. If time permits, let them consider how they think a lever, pulley, inclined plan, wheel and axel, wedge and a screw all function to make work easier for humans.

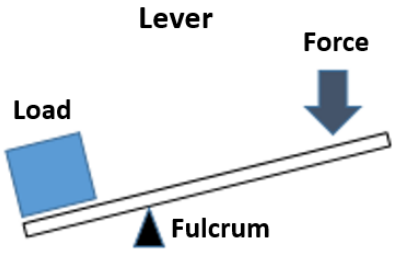
Imagine/Brainstorm	Students **brainstorm** ideas for how they could design a pair of pliers that could be used to grab and hold an object of their choosing. After brainstorming, they should consider the strengths and weaknesses of each idea.
Plan/Design	In order to learn more about simple machines, have them read the article ***A Simply Amazing Simple Machine.*** If time permits, you can also show and 3 minute video on levers called Super Simple Machines: Levers. After researching, have students **plan** and **design** an expanding pliers designed to grab and hold the object of their choice. Since the body of the pliers is pre-planned, they should focus on the design of the jaws and handle. Students can choose a simple pliers made with two craft sticks or an extending pliers made with six craft sticks. Depending on the level of your students and the time you have for this challenge, you can make this open-ended or more of a guided inquiry for your students.
Create/Test	Students follow their plan, and **create** their expanding pliers. Once they are created, students **test** their pliers in a measureable way to evaluate their effectiveness. Their results should be recorded, organized, and analyzed.
Improve	After discussing and evaluating their results, students improve their solution, redesign their system, and re-test if possible.

Teacher Notes:

Simple machines are tools that help us do work. The invention of these tools have helped humans to become very successful as a species. Simple machines allow us to accomplish tasks that would be impossible using our bodies alone. For example, the invention of the bow and arrow allowed humans to start hunting prey that were much too strong to kill using our own strength.

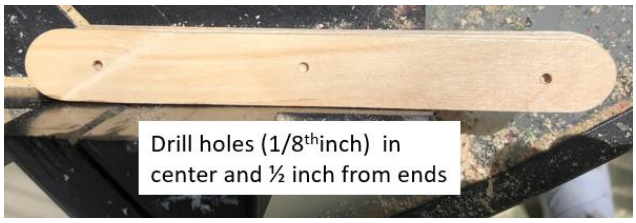
Simple machines make work easier for us changing the amount of force (pushing or pulling) needed to do certain kinds of work. Since human bodies are designed more to move than they are to push or pull, most machines take advantage of our ability to move easily. They are usually designed to combine long human movements with a little bit of force and convert them into a short movements with a stronger force. We can't push worth a darn but we can cover distances easily.

One type of simple machine is a lever. A lever can make work easier by decreasing the amount of force needed to move or grab an object. If we move the fulcrum (pivot point) close to a heavy object, we can lift it using less force than before. The lever gives us what we call a mechanical advantage. We just have to push down a longer distance to make it move just a little ways up.



One super useful kind of lever are pliers. Pliers consist of two levers that work in opposite directions. By exerting forces in opposite directions, you can use pliers to grab and hold objects firmly. You can use them to turn things, tighten things, bend things, or just hang on tightly.

In setting up this STEM Challenge, the trickiest part may be drilling the holes in the craft sticks. For most skewer sticks, you want to drill 1/8th inch holes. Once you measure and drill the holes for the first stick, you can stack them about 10 high or so and use the first stick as a template for drilling the rest. Once you get the hang of it, it goes quickly. The holes do not have be in perfect position. Make sure to drill some extra sticks as they have a tendency to crack. You need two craft sticks per group to build the simple pliers and six craft sticks per group for the extending pliers.

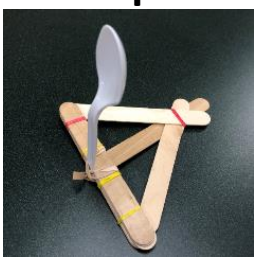
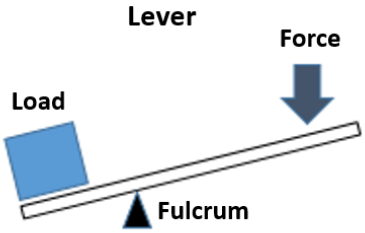
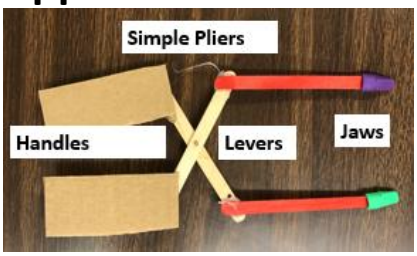
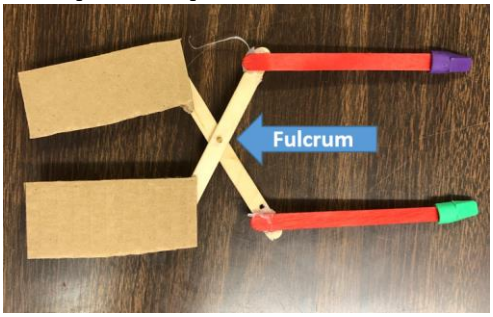
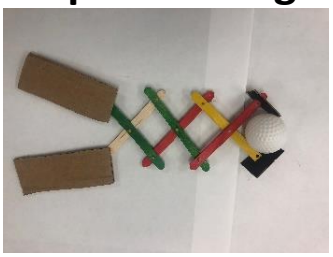


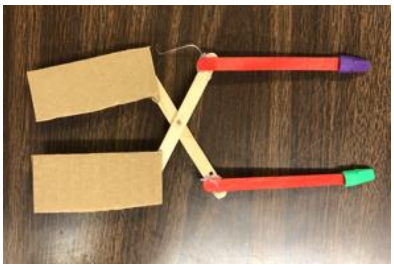
To provide the pivots, cut each skewer stick into about six pieces using the cutting portion of a long nosed pliers or a wire cutter. If your students are old enough, they can do this cutting. Some skewer sticks are thinner than others and won't fit snugly. Try to avoid the thin ones.

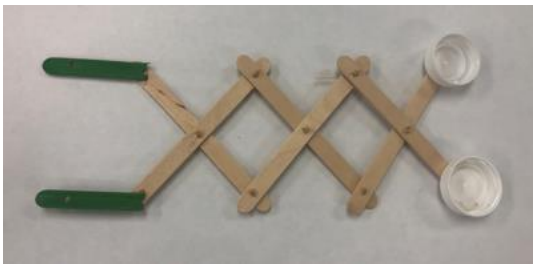
Suggested materials for students to use: (per group)

2 or 6 craft sticks (or popsicle sticks), 1-2 skewer sticks, long nosed pliers (Dollar Store), piece of cardboard, assorted caps, grips, erasers, popsicle sticks, craft rubber bands (optional but helpful), assorted light objects, 3-4 glue guns per class.

Vocabulary Cards:

force a push or pull 	**simple machine** a tool that helps us do work 
lever simple machine makes work easier by decreasing force needed 	**pliers** two levers that work in opposite directions 
fulcrum the pivot point for a lever 	**engineer** to design, build, and improve things 



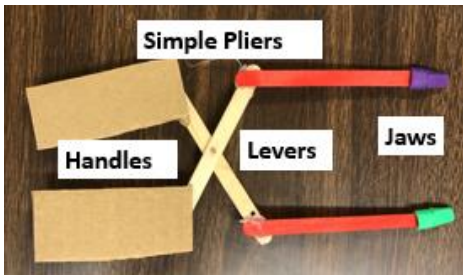


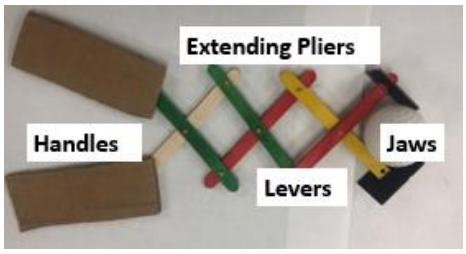
Simple Machine STEM Challenge:

Can you design, build, and test a pair of pliers that can be used grab and lift an object in a useful manner?

Designing and constructing your pliers:

1. After learning about pliers, **plan** and **design** a pair of pliers that can grab and lift an object. You can choose a simple or extending design.
2. Using the materials provided and your plan, **construct** your pliers. Your pliers should include handles, levers, jaws, and a pivot (fulcrum).
3. To begin construction, push a piece of skewer stick through the middle hole of a pair of craft stick until they are equal of both sides.
4. (Extended only) Push the skewer sticks through the remaining holes on the each pair of craft sticks. Trim sticks as needed to about ½ inch on each side.
5. (Optional) Stretch a craft rubber band onto the end of each skewer. This makes the pivot stronger.
6. As time permits, decorate your pliers.
7. Once the pliers are constructed, carefully **test** them by grabbing lifting various light objects. Observe and record how it responds.





Evaluating and Improving:

1. As a group, discuss how you were able to construct your pliers and explain how this simple machine made it easier for you to the work of grabbing and lifting an object.

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