STEM EXTENSION PACK

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SOLAR POWERED OVEN

Overview

A solar power oven can be made quite simply by using conductive materials to transmit heat that is coming from a heat source. Obviously the most typical and available heat source would be the sun, but feel free to substitute indoor heat lamps, as long as you caution students not to reach within the metal shade.

Science

Students should understand that the law of conservation of energy is in play here; no energy can be created or destroyed, only transferred. The heat that is emitted from the sun (or other heat source) is energy. This radiant energy can travel through empty space, and is absorbed and lost at varying levels and speeds depending on the receiving object. Students should note that air is made of molecules and can therefore retain and transfer heat, and even be used as insulation.

Technology

Discuss with students the benefits of a solar powered oven over a gas or wood burning oven, Discuss environmental impact, sustainability, and efficiency.

Engineering

Students will be challenged to build a functioning oven that is powered only by a heat source, using only the materials available. Students will need to identify a scientific concept which will allow them to harness the heat energy, and then students will exploit that knowledge in their building design. Encourage students to use the design process.

Math

Encourage students to build thermometers into their design so that they can create graphs of how much heat builds up in their ovens over time.

MAIN OBJECTIVE

Students will have hands-on experience solving real world problems. The applicable science ideas include conductivity, the law of cooling, and the transfer and conservation of energy. Students will also identify appropriate materials for a selected purpose.

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STUDENT HANDOUT 1: CHALLENGE

Help! Dave and sally are vacationing in their family cabin. The cabin is old and rustic, so Dave and Sally made sure to bring along lots of supplies. However, when they got to the cabin, Dave and Sally were surprised to find that their electricity was no longer working. “Great”, exclaimed Sally, “I guess we will be making a cook-out every single night”!

Dave looked around. “You know Sally, I actually think we might have enough materials here to build an oven”. Sally looked confused. “But, we don’t have any electrical power-how can we make an oven”?

“Just trust me”, said Dave, “We can build an oven that is powered by HEAT”.

IS DAVE CORRECT?

Using the materials provided, can you build an oven that uses no electricity?

Suggested Materials:

Sun/ Heat Lamp

Aluminum Foil

Tape

Cardboard

Thermometers

Black paper

White paper

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STUDENT HANDOUT 2: DESIGN PROCESS

Solar Powered Oven

Research:	What do I need to cook an egg?	What energy sources are available?	How can I harness that energy?

↓

Brainstorm: Every Possible Solution

↓

Draft, Collect Materials, Build!

↓

Test! How will you measure the efficiency of your oven? (Hint: Thermometers available)

↓

Summary of Results

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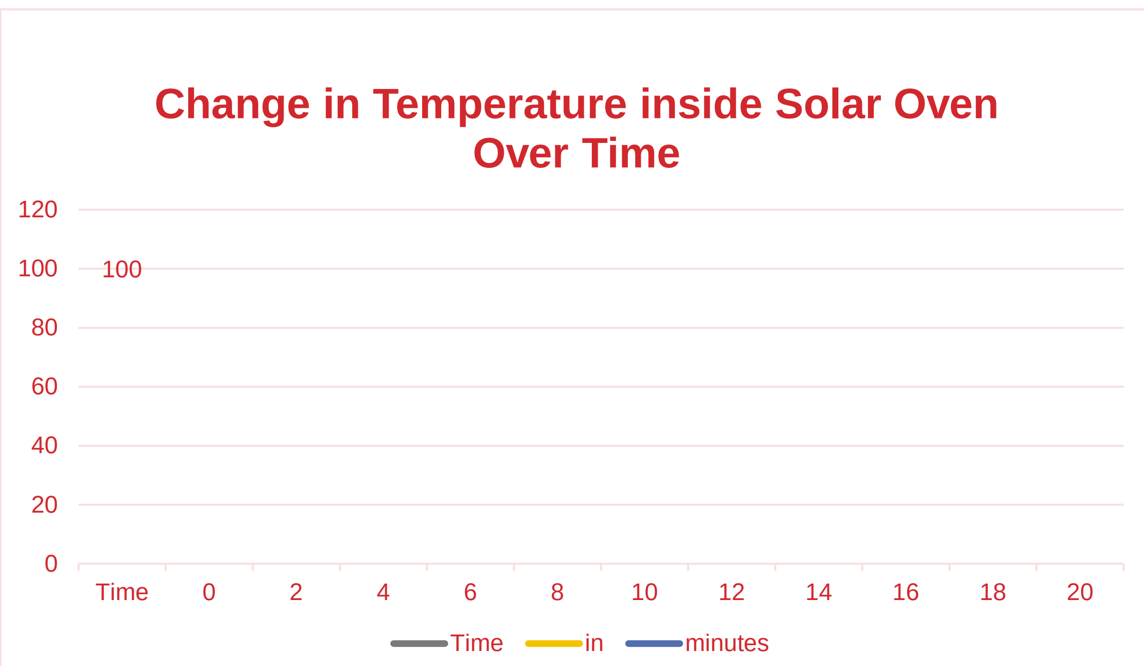
SOLAR POWERED OVEN

STUDENT HANDOUT 3: TEMPERTAURE GRAPH

TIME (MINUTES)	TEMPERATURE IN SOLAR OVEN (DEGREES CELCIUS)
0	0



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SAND PENDULUMN

Overview

A pendulum can be made by hanging an object from a string, and allowing it to swing back and forth. In this activity, students will fill a cup with colored sand and attach the cup to a long string. Students will them poke a small hole in the cup, and as the pendulum swings, sand will pour out of the cup, leaving a visible trail. Students can make predictions about the path of the pendulum due to gravity, and the sand will help them identify results and reach clear conclusions.

Science

A pendulum swings back and forth in a “U” shape. I like to show my students a video of snowboarders in a halfpipe, as their movement mimics the movement of the pendulums. The pendulum swings from the point of release the pendulum is directly straight (half-way), based on the pull of gravity alone. The swinging of the pendulum back upwards is due to the momentum, the force that built up in the pendulum as it swung.

Technology

Anti-Quake technology uses heavy duty pendulums. Have students research how this can work.

Engineering

Use the periodic swinging of the pendulum to measure time, spin a wheel and axle, or create a swing set. Students can also experiment with changing different variables (length of pendulum, weight at the end of the string, force used) and observing changes in the periodic motion of the pendulum.

Math

Have students measure how many periods a pendulum makes in 10 seconds, and then have them extrapolate that data to figure out how many swings the pendulum makes in one minute.

MAIN OBJECTIVE

In this activity students will be creating a 3-D image representing the path a pendulum makes as it swings due to the pull of gravity. Students can further experiment with pendulums and with which factors affect their movement.

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STUDENT HANDOUT 1: TIMING A PENDULUM

Directions: Using a timepiece, measure each full swing a pendulum makes in ten seconds. Repeat this at least three times, and take the average number of swings. Use your information to figure out how many swings your pendulum would make in one minute (hint: one minute is sixty seconds). This measurement can serve as your control for any other pendulum experiments you make.

How many swings The pendulum makes in 10 seconds measurement #1	How many swings The pendulum makes in 10 seconds measurement #2	How many swings The pendulum makes in 10 seconds measurement #3	Average number of swings in 10 seconds	Assumed number of swings in one minute.

Note: A “Swing” is considered the movement of the pendulum forwars and then back; a complete period.

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STUDENT HANDOUT 2: DRAWING THE PATH OF A PENDULUM

In the space below, please draw the pattern left by the sand that spilled out from your cup as it swung from the bottom of the pendulum.

What could you do to change the shape the pendulum moves in?

Now try it!

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STUDENT HANDOUT 3: DESIGNING YOUR OWN PENDULUM EXPERIMENT

In this experiment you will chose a variable to change and observe if it changes the number of swings the pendulum makes in sixty seconds.

List Possible Independent Variables:
1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Chose one variable, and using the results from STUDENT HANDOUT 1 as the control, perform your experiment and fill in the lab sheet as you go along.

1. Problem

How does (independent variable) ____________ affect (dependent variable) the number of swings a pendulum makes in one minute.

2. Hypothesis

Hypothesis– an educated guess about the outcome of an experiment based on prior knowledge

My Hypothesis is ____

____.

3.Materials

List all of your materials here:

1.____________________________

2.____________________________

3. ____________________________

4. ____________________________

Etc…

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STUDENT HANDOUT 4: DESIGNING YOUR OWN PENDULUM EXPERIMENT PAGE 2

4. Procedure

Write the experimental procedure like a step-by-step recipe for your science experiment. A good procedure is so detailed and complete that it lets someone else duplicate your experiment exactly! (Like recipe in a cookbook!)

1.______________________________

2.______________________________

3. ______________________________

4. ______________________________

5. Variables

Independent Variable: The factor the scientist purposely changes in the experiment. (what you are testing)

My independent variable is _________________.

Dependent Variable: The factor the scientist observes or measures in the experiment. (How you are measuring what you test)

My dependent Variable is __________________.

Control Group- the group that is not manipulated or changed and serves as the standard of comparison in the experiment.

My control group is ___________________.

Constants: Factors that are the same in both the experimental group and the control group, factors that are **not** changed.

My constants are: ____

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STUDENT HANDOUT 4: DESIGNING YOUR OWN PENDULUM EXPERIMENT PAGE 3

7. Data/Graphs

Data: Information collected by the experiment should be presented in a chart or graph format. Repeating an experiment will give accuracy to your results. If you are making a graph, make sure to put the independent variable on the "y axis" and the dependent variable on the "x axis".

8. Results

The results of my experiment were ____

____

____

____

9. Conclusion

Based on your results, draw a conclusion that explains your data. Your **claims** should state a relationship between your independent and dependent variables. Your claims should be backed up by **evidence**, data from your experiment that supports your claim. Finally, you should include your **reasoning**, which is where in research your claims are supported. You should state if your hypothesis was proven correct or proven incorrect. You will need to do some research to determine the phenomenon or law of science that explains your results.

My conclusion is ____

____

____

10. Recommendations

- Now that your experiment is finished and you have researched and developed a conclusion, You can suggest changes in the experimental procedure (or design) and/or possibilities for further study, which we call your next steps.

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ELECTRONIC ARCHERY

Overview

In this challenge, students are asked to create an electronic target. Students can accomplish this by creating an open buzzer circuit, with each end of the circuit attached to separate pieces of conductive material-such as aluminum foil. The two layers of foil are separated by a sponge. When pressure is placed on the area above the sponge (by an arrow, per say!) the sponge contracts and the two layers of foil touch-connecting the circuit and sounding the buzzer.

Science

Students will essentially build a pressure circuit, where when pressure is applied to a surface (i.e., the target) a circuit is connected and a buzzer sounds. A discussion of open and closed circuits for beginners and a discussion of resistance or circuit sensitivity for advance students is definitely called for.

Technology

The applications of this technology are boundless. Think of touchscreens, alarms, and sensors. Pressure sensors have a wide range of applications, including weighing docked freight to prevent smuggling, alarms that sound when an object is removed, etc

Engineering

Sometimes, actually, often, the best engineering is the simplest design. Teaching students to accomplish a goal with a simple mechanism is the meat and potatoes of engineering.

Math

Have students calculate the surface area of the target that will actually cause the buzzer to sound. Additionally, students can experiment with how much pressure to place on the sensor in order to activate it.

MAIN OBJECTIVE

Manipulating simple electronics principles to create an interactive activity, game, or competition is one of the most beautiful aspects of STEM. Stduents will love the interactivity and creativity inherent in this design be sure to practice caution when aiming at the targets; whether with arrows, baseballs, darts, or other projectiles. Many interesting applications are highlighted on this page, feel free to have students attempt to understand and replicate these designs! Or better yet, come up with their own!

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ELECTRONIC ARCHERY

STUDENT HANDOUT 1: CHALLENGE

Tyler the Tailor was importing a huge shipment of sewing machines. Each sewing machine weighed exactly 50 kg with its box, and there were 200 of them in the container. Tyler went to the docks expecting to pick up his shipment, but when he arrived at the docks, the Anti-Smuggling Guards had confiscated his shipment. When Tyler expressed his extreme displeasure, the head of the ASG explained that there was a hidden shipment of priceless gems in the same container as the sewing machines, Tyler was Livid- he wanted to know how the AGS could know what was inside his container-the container wasn't even opened! The head of the AGS explained that they used a special scale to weigh the container. According to Tyler's records, the shipment should have weighed 10,000 kg – but when they placed the container on the scale, it weighed 10,645 kg. The AGS immediately knew that the 645 extra kilograms were coming from a stolen shipment of 645 kg of gems.

Tyler thought for a moment and broke out into a huge smile. He knew it would take a while to get his sewing machines back, but the pressure scale the AGs used to measure his containers gave him a great idea. Tyler decided to build an electronic target that worked using the same mechanism. Can you do it to?

Using the materials provided, can you build a target that sounds when you shoot an arrow (or throw a ball) at it?

Suggested Materials:

sponges

Aluminum Foil

Tape

Paper towels

Alligator wires

batteries

buzzer