

Supercharged Science

Unit 5

Workbook for Students

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SUPERCHARGED
SCIENCE

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How to Use this Workbook

I put this workbook together for you to use as you work through the program. There's a lot of whitespace with every experiment, so you have a space to write down your ideas and experiment set up plans as we go through the instructional videos together.

There are also downloadable student worksheets under a number of the experiment videos. They contain additional information, reading, data tables, and exercises for you to use. If you're doing those as well, print those out and insert them in the appropriate section as you go along.

If you hole-punch this workbook and any worksheets you download and stick all of it in a three-ring binder, you'll have an amazing science notebook that journals your entire year of science, all done for you!

Enjoy your science adventure!

Master Materials List for Unit #5: Energy 2

Ramp Races

Several small balls of different weights (golf ball, racket ball, ping pong ball, marble etc.)
Good size container or mixing bowl
Flour or corn starch or any kind of light powder
Pie tin or other shallow container
Tape measure or yard stick
Optional: Spring scale or kitchen scale

Roller Coasters & Bobsleds

3 pieces $\frac{3}{4}$ " pipe insulation (non-adhesive black foam)
20 marbles
1 roll masking tape
Aluminum foil
Scissors
Gift wrap tube or clear fluorescent-lamp tube
Stopwatch, yardstick

Catapult

3 rubber bands
Plastic spoon
9 tongue-depressor size popsicle sticks
Hot glue gun and glue sticks
Wadded up paper sheets or aluminum foil

Pendulums

Yardstick
A washer or a weight of some kind
Stopwatch
4 index cards (any size)
10 Thumb tacks (or brass fasteners)
Big, heavy hex nut
10' string or yarn
6 strong donut-shaped ring magnets

P-Shooter

Mechanical pencil (cheap kind)
2 thin rubber bands
Razor (get adult help)

Additional Items for Grades 9-12:

Baking potato (raw)
Protractor
Straw
String
Rock or key (to use as weight)
Stopwatch
Stiff acrylic tubing (approx 1/2" diameter)
 $\frac{1}{4}$ " wood dowel (should fit inside acrylic tube)
Washer (make sure that the inner diameter of washer smaller than outer diameter of acrylic tube, so the washer cannot slide up the tube)

IMPORTANT!! PLEASE READ!

Before you go out and purchase a lot of items, please use what you already have available!

Part of being a great scientist is using the resources already around you. In the online curriculum, there are step-by-step instructional videos where I will be demonstrating how to build something, design something, create something... and if you don't have the exact same materials, it's usually okay! Part of being a good scientist is getting resourceful and using what you have access to.

For example, if we're making a catapult, and you don't have popsicle sticks, but you do have chopsticks and paper towel tubes, then use those! If we're making a hovercraft, and you don't have motors (this one actually did happen) but you did find an old computer fan, try it and see if it works (one girl did just that – and it worked beautifully!) Re-use and re-purpose discarded or broken items for your projects.

The instructional videos are just “Step One”... just to get you started so you see what we're going for and how the thing is supposed to work. After building your experiment, then your next step is to make it even better. Can you make that rocket go even higher? That airplane go faster? That circuit work in the dark also? We're all about creativity, wonder, exploration, and innovation. Try it and see how it goes!

ABOUT CHEMISTRY: The MAIN exception for this is when it comes to chemistry. We do NOT want you mixing random chemicals or substituting other chemicals to “see what happens”. It is dangerous and not scientific at all. I will have exact and specific instructions for all chemistry experiments. More on this in the actual chemistry section on the website.

Unit 5: Energy 2 - Module 1: Potential Energy

Lesson 1: Mystery Toy

Note: Do the pendulum experiment first, and when you're done with the heavy nut from that activity, just use it in this experiment.

Here's what you can get:

- can with a lid
- heavy rock or large nut
- two paper clips
- rubber band

Unit 5: Energy 2 - Module 1: Potential Energy

Lesson2: Whackapow!

In this experiment, you're looking for two different things: first you'll be dropping objects and making craters in a bowl of flour to see how energy is transformed from potential to kinetic, but you'll also note that no matter how carefully you do the experiment, you'll never get the same exact impact location twice.

Here's what you need:

- several balls of different weights no bigger than the size of a baseball (golf ball, racket ball, ping pong ball, marble etc. are good choices)
- fill a good size container or mixing bowl with flour or corn starch (or any kind of light powder)
- If you're measuring your results, you'll also need a tape measure (or yard stick) and a spring scale (or kitchen scale).

Unit 5: Energy 2 - Module 1: Potential Energy

Lesson 3: Ball Bounce

When you toss down a ball, gravity pulls on the ball as it falls (creating kinetic energy) until it smacks the pavement, converting it back to potential energy as it bounces up again. This cycles between kinetic and potential energy as long as the ball continues to bounce.

Materials

- A ball

Unit 5: Energy 2 - Module 1: Potential Energy

Lesson 4: Elastic Potential Energy

There are many different kinds of potential energy. We've already worked with gravitational potential energy, so let's take a look at elastic potential energy.

Materials:

- A rubber band

Unit 5: Energy 2 - Module 1: Potential Energy

Lesson 5: Pendulums

This is a very simple yet powerful demonstration that shows how potential energy and kinetic energy transfer from one to the other and back again, over and over. Once you wrap your head around this concept, you'll be well on your way to designing world-class roller coasters.

Here's a simple experiment you can do that only needs four simple items:

- some string
- a bit of tape
- a washer or a weight of some kind
- set of magnets (at least 6, but more is better)

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 1: Catapults

When you drop a ball, it falls 16 feet the first second you release it. If you throw the ball horizontally, it will also fall 16 feet in the first second, even though it is moving horizontally... it moves both away from you and down toward the ground. Think about a bullet shot horizontally. It travels a lot faster than you can throw (about 2,000 feet each second). But it will still fall 16 feet during that first second. Gravity pulls on all objects (like the ball and the bullet) the same way, no matter how fast they go.

Here's what you need:

- 9 tongue-depressor size popsicle sticks
- four rubber bands
- one plastic spoon
- ping pong ball or wadded up ball of aluminum foil (or something lightweight to toss, like a marshmallow)
- hot glue gun with glue sticks

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 2: Potato Cannon

This experiment is for Advanced Students. There are several different ways of throwing objects. This is the only potato cannon we've found that does NOT use explosives, so you can be assured your kid will still have their face attached at the end of the day. (We'll do more when we get to chemistry, so don't worry!)

Here's what you need:

- potatoes
- an acrylic tube (clear is best so you can see what's happening inside!)
- wooden dowel
- washer (this is your 'hand-saver')

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 3: P-Shooters

This is a simple, fun, and sneaky way of throwing tiny objects. It's from one of our spy-kit projects. Just remember, keep it under-cover.

Here's what you'll need:

- a cheap mechanical pencil
- two rubber bands
- a razor with adult help

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 4: Bobsleds

Bobsleds use the low-friction surface of ice to coast downhill at ridiculous speeds. You start at the top of a high hill (with loads of potential energy) then slide down a icy hill til you transform all that potential energy into kinetic energy. It's one of the most efficient ways of energy transformation on planet Earth. Ready to give it a try?

Here's what you need:

- aluminum foil
- marbles (at least four the same size)
- long tube (gift wrapping tube or the clear protective tube that covers fluorescent lighting is great)

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 5: Roller Coasters

We're going to build monster roller coasters in your house using just a couple of simple materials. You might have heard how energy cannot be created or destroyed, but it can be transferred or transformed (if you haven't that's okay – you'll pick it up while doing this activity).

Here's what you need:

- marbles
- masking tape
- 3/4" pipe foam insulation (NOT neoprene and NOT the kind with built-in adhesive tape)

Unit 5: Energy 2 - Module 2: Kinetic Energy

Lesson 6: Go Go GO!!

This is a nit-picky experiment that focuses on the energy transfer of rolling cars. You'll be placing objects and moving them about to gather information about the potential and kinetic energy.

Here's what you need:

- a few toy cars (or anything that rolls like a skate)
- a board, book or car track
- measuring tape