chirping crickets

how can little crickets make such big noise?

What Do You Need?

- *A rubber band*
- *Your Pop Bottle without the top*
- *A playing card or index card*

What Do You Do?

1. Stretch the rubber band over the bottle opening and under the bottom. Make sure the rubber band is tight.

2. Pluck the rubber band with your finger, and with your other hand, touch the rubber band with the edge of the card. You should hear a buzzing sound.

3. Experiment and make different sorts of sound. Saw on the rubber band with your card. Pluck the rubber band with your card.

4. Now hold a different rubber band between your thumb and index finger. Pluck it with the card. What do you notice about the difference in the volume of sound?

What's Going On?

The sound of the rubber band is amplified when it is stretched across the bottle opening. The bottle amplifies sound just like the body of a guitar or violin does.

When crickets chirp, they drag their rough upper wing across their lower wing, much as you scrape the rubber band with the card. For crickets, this action produces a vibration that is amplified by the membranes of the wings.

big idea

make a bottle magnifier.

What Do You Need?

- *A plastic pop bottle*
- *Water*
- *Small printed text*

What Do You Do?

1. Fill the bottle completely with water.

2. Tighten the cap.

3. Hold the bottle sideways directly on top of the text. What do you notice?

4. Move the bottle slowly away from the small print. You'll see the print flip upside down!

What's Going On?

The water turns the bottle into a lens, and a lens can do interesting things. When light passes through a lens, an image can twist, bend, curve, and even turn upside down.

EXCERPTED FROM
Pop Bottle Science
ISBN: 978-0-7611-2980-6
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raisin water ballet

Watch the dancing raisins do their stuff.

What Do You Need?

- *Your Pop Bottle with the top part removed*
- *Water*
- *Vinegar*
- *Baking soda*
- *10 raisins*

What Do You Do?

1. Fill your Pop Bottle about halfway with water.
2. Pour in 4 tablespoons of vinegar.
3. Add 3 tablespoons of baking soda. (The mixture will begin to fizz.)
4. Drop in the raisins. They may sink initially, but will soon bounce around in the bottle.

What's Going On?

The vinegar and baking soda create carbon dioxide bubbles, the same gas that carbonates soda pop. Bubbles will gather under the raisins until there's enough fizz to raise the raisins to the surface. There, the bubbles burst, and the raisins sink back down.

Have Some Cleaning to Do?

The vinegar and baking soda mixture makes a super cleanser. Try it (without the raisins) on the kitchen or bathroom sink and see.

hard to change

A heat trick

What Do You Need?

- *An index card*
- *Your Pop Bottle with the top removed*
- *A quarter*

What Do You Do?

1. Place the index card on top of your Pop Bottle.
2. Place a quarter on the index card.
3. Flick the card with your finger so that the card flies out from under the quarter. The quarter should fall into the bottle.
4. Now invite someone else to try it. Say that they can have the quarter if they can flick the card and make the quarter fly across the room. Don't tell them exactly how it's done. It's fun to watch them figure it out!

What's Going On?

You demonstrated inertia, a property of all matter. Inertia is matter's tendency to remain at rest (even when the matter is made of billions and billions of moving molecules). The energy source (your moving finger) acted upon the card but not the quarter. This experiment works because an index card is smooth and does not create much friction under the coin.

EXCERPTED FROM
Pop Bottle Science
ISBN: 978-0-7611-2980-6
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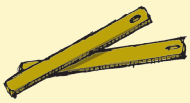
Potato Battery

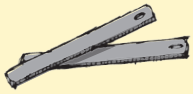
Getting a Charge Out of Spuds

FIELD: ELECTRONICS
CONCEPT: ELECTROCHEMISTRY

MATERIALS

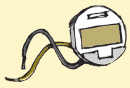


2 copper electrodes
(included in kit)

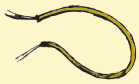


2 zinc electrodes
(included in kit)

2 potatoes
(the bigger, the better)



Clock
(included in kit)



Wire connector
(included in kit)

Sound chip
(included in kit)

Chip tube

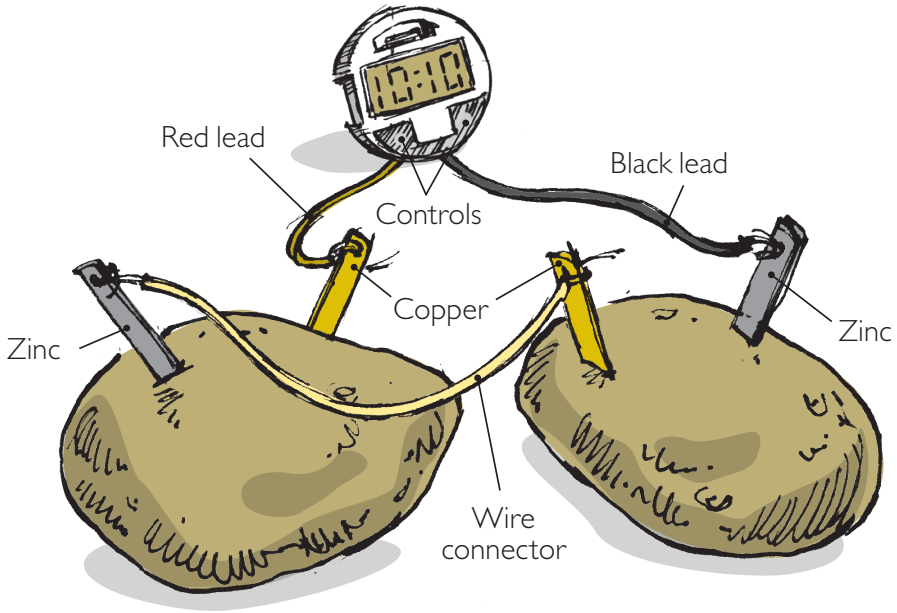
METHOD – To Make a Tater Clock

1. Jab one copper electrode and one zinc electrode into each potato. Keep the copper and zinc far away from each other.

2. Attach the clock leads (wires) to the electrodes in the following manner: Twist the red (positive) lead around the copper electrode of the first potato, and twist the black (negative) lead around the zinc electrode of the second potato.

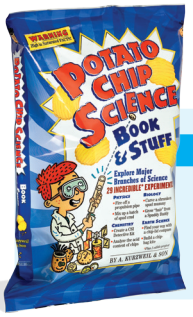
3. Complete the electrical circuit by twisting the exposed ends of the wire connector around the two unconnected electrodes.

4. Set the time using the two clock controls.



CHIP CHALLENGE

Try powering a clock off a couple of lemons. Can you find other fruits that will keep your clock ticking?



EXCERPTED FROM
Potato Chip Science
ISBN: 978-0-7611-4825-8
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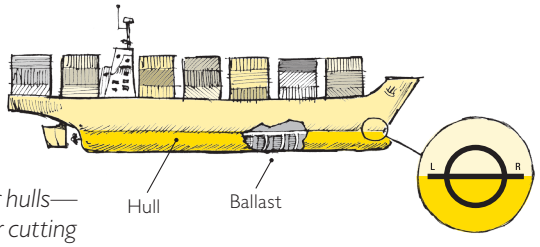
FIELD: HYDRODYNAMICS
CONCEPT: BUOYANCY

Chip-Ship Challenge

How Many Pennies Can You Float Inside a Chip Bag?



All oceangoing cargo ships display a "load line" on their hulls—a circle with a horizontal bar cutting through it. If the bar drops beneath the water, the crew knows the ship is overloaded.

METHOD

1. Load a cargo of 50 pennies inside your empty chip bag "boat." Make sure they're evenly distributed.

2. Fill the bucket with at least 5 inches of water. Gently lower the bag of pennies into the water. What happened to the bag? (It sank, didn't it?)

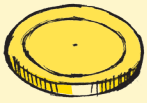
3. Remove the bag and empty it. Repeat step 1, only this time place the chip lid flat on top of the pennies so it holds the bag open. Gently lower the bag into the water. This time, watch it float.

4. Leaving the bag in the water, add more pennies on top of the lid. See how much cargo you can load into your chip ship before it sinks.

MATERIALS

100 pennies (plus a few extras)

Small (1-ounce) chip bag



Chip lid (included in kit)

Bucket of water

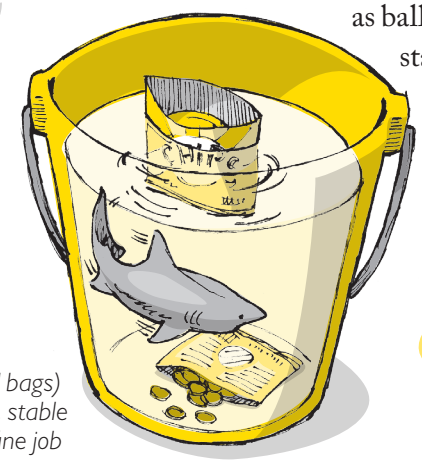
This trick really floats my boat.

Meaning

The chip ship, like all cargo vessels, is designed to carry as much weight as possible. What keeps a boat from sinking? Buoyancy—the upward force that liquids and gases exert on objects.

The more water the hull of the ship displaces (pushes aside), the more buoyant the vessel. The more buoyant the vessel, the more cargo it can carry.

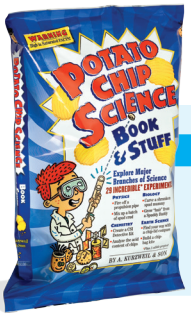
Positioning a lid on top of the pennies broadens the hull of your chip ship, which increases the volume inside the vessel and the amount of water displaced outside. The pennies at the bottom of the chip ship also serve as ballast—weight that improves stability. If properly designed, your chip ship can carry cargo more than 100 times its own weight.



Boats (and bags) with broad, stable hulls do a fine job of carrying cargo.

CHIP CHALLENGE

Can you make a chip ship that holds more than 100 pennies? (Hint: Try keeping the bag open with cotton swabs or toothpicks.)



EXCERPTED FROM
Potato Chip Science
ISBN: 978-0-7611-4825-8
WORKMAN • workman.com

Time Factor: *2–5 minutes*

FRANKENSTEIN'S HAND

HERE'S A "HANDS-ON" DEMONSTRATION of a scientific principle that has cropped up elsewhere in this book: the chemical reaction between a comon acid and an equally familiar base. You can give this experiment something of a Halloween flavor by marking the glove with bones, veins, and screws. You can also add a little ketchup at the bottom of the glove—just to raise the gore factor. Your audience will love the special effects as the hand grows and grows.

You Will Need

- 3 TABLESPOONS VINEGAR
- DRINKING GLASS
- 2 TEASPOONS BAKING SODA
- RUBBER GLOVE

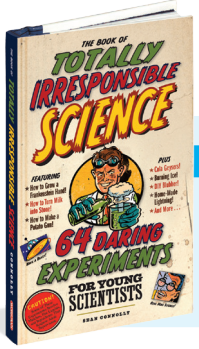
TAKE CARE! **this is a safe experiment with very little risk. make sure that the glove fits tightly on the glass before you do the experiment; if it's loose, try a wider-mouthed glass. you might want to take care that the glove doesn't inflate too much, which could cause it to fly off the glass. and in case you're thinking about having a little fun at your little brother or sister's expense—say, by telling them you found this hand on the sidewalk—don't come running to us if you get in trouble with the parental units!**

METHOD

1. Pour the vinegar into the glass.
2. Add the baking soda to the inside of the glove. Hold the glove by its wrist and shake the powder into the fingers.
3. Carefully attach the glove to the top of the glass as shown so there's no gap.
4. Pull the glove upright by its fingertips and shake gently, allowing the baking soda to drop into the glass.
5. Stand back and watch as Frankenstein's hand begins to come alive.

The Scientific Excuse

Baking soda is a chemical base, which reacts strongly with the acetic acid of the vinegar. One of the by-products of this reaction is carbon dioxide, which increases the pressure inside the glove-glass arrangement. As more gas is produced, the pressure increases further and pushes out the weaker surface (the rubber glove), inflating it gently.



EXCERPTED FROM
The Book of Totally Irresponsible Science
ISBN: 978-0-7611-5020-6
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Time Factor: *less than 2 minutes*

STRAW THROUGH A POTATO?

WE'VE ALL HEARD ABOUT THE SAVAGE FORCE OF A TORNADO. Its 300 mile-per-hour winds are strong enough to drive a piece of straw clear through a telephone pole. So you can imagine that if you left a drinking straw near a potato as a tornado approached, you might return to find the potato skewered by the straw. But can you imagine getting the same result by hand? Read on, and see how you can do it.

You Will Need

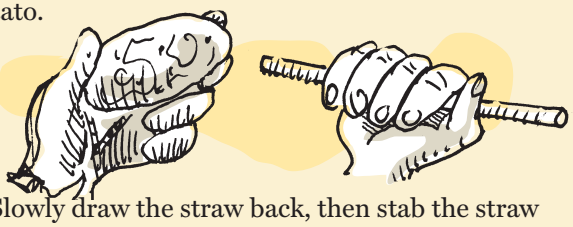
- GARDENING GLOVE (LEFT GLOVE IF YOU'RE RIGHT-HANDED OR VICE VERSA)
- UNCOOKED POTATO
- RIGID (NON-BENDY) DRINKING STRAW

METHOD

1. Put the glove on one hand.

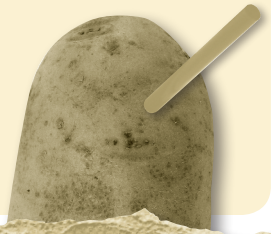
2. Hold the potato (lengthwise vertically) with the gloved hand, pinching it between your thumb and index finger.

3. Holding the potato steady, pick up the straw (holding it in the middle), and line it up with the potato.



4. Slowly draw the straw back, then stab the straw quickly into the potato.

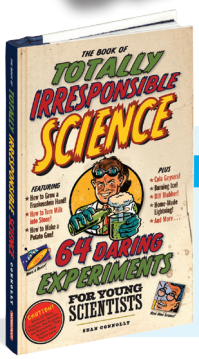
5. If you're quick enough—and the straw is strong enough—you'll stab it right through the potato.



The Scientific Excuse

The cylindrical shape of the straw gives it surprising strength along its length, although it remains weak and flexible crossways. That strength, coupled with the narrowness and sharpness of its edge, gives the straw a good chance of making it through the potato with ease. Some people might see your thumb over one end of the straw as you push and decide that it's all due to air pressure. That's a nice try, but not the reason—and you can prove it by doing the experiment again with your thumb well away from the open end of the straw.

TAKE CARE! **This is a relatively low-risk experiment, although the same combination of strength and sharpness of the straw could lead to a hand injury if your aim isn't up to scratch. (That's why you should use the gardening glove.)**



EXCERPTED FROM
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ISBN: 978-0-7611-5020-6
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Time Factor: *less than 2 minutes*

DANCING MOTHBALLS

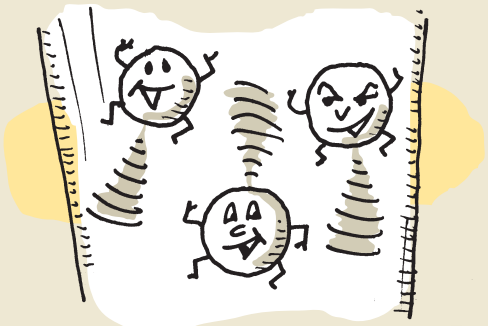
IF THERE'S SUCH A THING AS JUMPING BEANS, WHY CAN'T there also be dancing mothballs? In just a few easy steps, you'll see how easy it is to make them. How in the world is all of this irresponsible? Well, just look at those ingredients and imagine how your kitchen will smell after you mix them. How popular will you be then?

You Will Need

- WIDEMOUTH GLASS JAR OR DRINKING GLASS
- WATER
- 4 TABLESPOONS VINEGAR
- 2 TEASPOONS BAKING SODA
- SEVERAL MOTHBALLS

METHOD

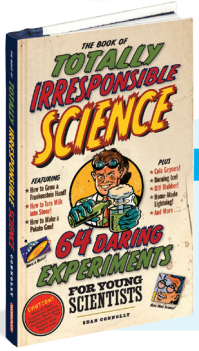
1. Fill the jar or glass with water, leaving an inch at the top.
2. Add the vinegar and baking soda and stir gently to combine.
3. Add 2 or 3 mothballs.
4. Watch as the mothballs slowly "dance"—sinking first, then slowly rising, then sinking again.



The Scientific Excuse

The vinegar, baking soda, and water react to release carbon dioxide. The mothballs seem smooth, but in fact they have very rough and uneven surfaces. Carbon dioxide bubbles can lodge on these surfaces. When enough bubbles are attached, the mothballs become less dense than the liquid and rise to the top. At the surface, much of the carbon dioxide is released into the surrounding air, making the mothballs denser once more and allowing them to sink . . . and repeat the process.

TAKE CARE! **This is a fairly low-risk experiment. Make sure you discard the liquid and its contents afterward so the next person in the kitchen isn't tempted to drink it!**



EXCERPTED FROM
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ISBN: 978-0-7611-5020-6
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Time Factor: *less than 2 minutes*

Overcoming GRAVITY

YOU CAN CHOOSE THE LEVEL OF IRRESPONSIBILITY FOR THIS experiment, depending on your nerve. You can try it over a table or a sink—or over the head of a very courageous volunteer. No matter which approach you use, it's always fun to see people's shocked expressions if they've never tried this classic experiment demonstrating air pressure.

You Will Need

- DRINKING GLASS
- WATER
- PLAYING CARD OR POSTCARD
- TOWEL OR TUB (IN CASE OF TROUBLE)

TAKE CARE! **The best objects to cover the rim of the glass are light but firm—so the playing card and postcard are ideal. Anything heavier scores well with firmness but might be a little too heavy for the air pressure to do its trick. Another word of warning to remember: Don't keep the glass and card overturned for too long. If the card becomes soggy, it deforms. That makes it harder for the air pressure to work, so gravity might suddenly win!**

METHOD

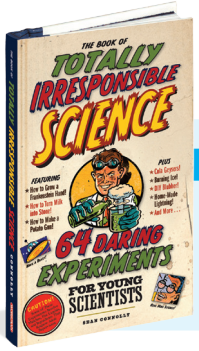
1. Fill the glass three-quarters full with water.

2. Place the card squarely over the mouth of the glass, making sure that there's no gap.
3. Pressing the card to the rim, turn the glass over—over your volunteer's head, if you feel brave!
4. When the glass is upside down, remove your hand from the card.

5. The card should remain attached to the glass and no water should leak out.

The Scientific Excuse

The simple explanation to this experiment is that it all depends on air pressure. The water inside the glass certainly presses down on the card, but what's surprising is the strength of the air pressure working in the opposite direction—greater than the force of gravity, in this case.



EXCERPTED FROM
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Newton's Science Friction EXPERIMENT

This experiment is a demonstration of one of the outside forces that acts on moving objects, causing them to slow down and stop: friction. We see it at work whenever we compare, for example, a hockey puck sliding across a skating rink with the same puck sliding across a carpeted floor. But this experiment shows how friction is at work between the pages of a book, and how that force can build up astoundingly. Each overlap is a source of friction, but multiplying that force by 50, 60, or however many overlaps you managed to produce, will increase the force a great deal.

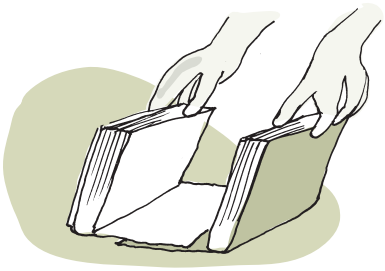
MATERIALS

- 2 PAPERBACK BOOKS OF ABOUT THE SAME SIZE AND NUMBER OF PAGES

TAKE CARE!
NO REAL PROBLEMS HERE—JUST DON'T USE SOMEONE'S PRICELESS FIRST EDITION (EVEN IF IT *IS A* PAPERBACK).

1. You're aiming to "lock" the books together by having their pages overlap one another.

2. Put the books on a table, facing each other so that they just touch.

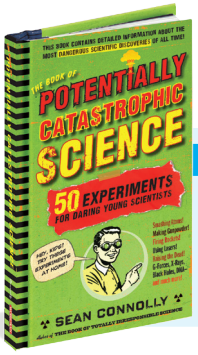


3. Lift each book up by the open-pages side so that the spines stay on the table but edge closer to each other by about 1½ inches.

4. Rifle through the pages with your thumbs (from the back of the book to the front).

5. If you've managed to do this right, the pages of the books will overlap each other by the same 1½ inches.

6. Try to pull the books apart. It seems as though they're locked together.



EXCERPTED FROM
The Book of Potentially Catastrophic Science
ISBN: 978-0-7611-6005-2
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Gagarin's Balloon Thrust EXPERIMENT

The key to getting a rocket to leave the atmosphere and go into orbit is thrust, the power needed to give it that essential speed. And in order to achieve that sort of power, you need to have a reliable fuel supply—and enough of it.

This experiment uses balloons to help you make the connection between fuel, thrust, length of flight, and the distance covered. Basically, you're the one supplying the fuel (with your breaths), which in turn determines the amount of thrust that your balloon rockets will have. Then you can see the direct relationship between thrust and the length of the flight.

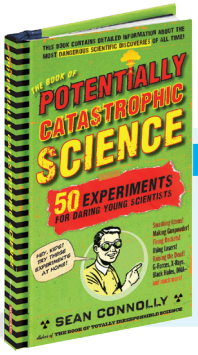
MATERIALS

- BALLOONS OF DIFFERENT SIZES (LIKE THE "PARTY BAG" OF BALLOONS)
- PENCIL
- PAPER
- AT LEAST ONE FRIEND TO HELP
- STOPWATCH OR WATCH WITH A SECOND HAND
- RULER OR TAPE MEASURE
- GRAPH PAPER (OPTIONAL)

TAKE CARE!
THIS EXPERIMENT WORKS BEST IF YOU HAVE A LOT OF ROOM—YOU REALLY DO WANT THE BALLOONS TO COVER A LOT OF DISTANCE. BUT BE CAREFUL IF IT IS TOO WINDY, BECAUSE A SUDDEN GUST COULD THROW YOUR CALCULATIONS OFF.

1. Choose about 4 or 5 balloons of different sizes and record them as "1" to "4" (or "5") on your paper. Leave a good bit of space between each balloon entry, because you'll be adding more information.
2. For each balloon entry, mark "Size," "Length of Flight," and "Distance."
3. Blow up a balloon using a series of same-size breaths: Have your friend count those breaths and mark them under "Size."
4. Pinch the balloon shut and take it to the launch site.
5. Have your friend get ready to time the flight from the moment you let go.
6. Keeping the pinched end pointing at you, hold the balloon out and let go.

7. Ask your friend to mark the time under "Length of Flight," and then you can both measure the distance it flew and enter that under "Distance."
8. Repeat steps 3 to 7 for each balloon.
9. See whether you can draw any conclusions between the size of the balloon's fuel supply (the number of breaths) and the time and distance.
10. If you want, you can make charts of these relationships using "Number of Breaths" as the Y axis (the upward-pointing one) and "Length of Flight" and then "Distance" for the horizontal X axis.



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ISBN: 978-0-7611-6005-2
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MAGNETIC ATTRACTION—OR NOT

THESE SIMPLE EXPERIMENTS SHOW MAGNETISM IN ACTION BY REVEALING HOW IT AFFECTS THE WORLD AROUND US.

WHAT YOU WILL NEED

- 2 simple bar magnets
- Piece of thin cardboard
- Small jar of iron filings (see Resources)
- Bowl of sand

DO THE DEED

The saying goes that "opposites attract." Regardless of whether this is true for different personalities, it's definitely true for the opposite poles of magnets. But when you try to push the similar poles of a magnet together, they repel.

1 Lay one of the two bar magnets flat on a level table or other smooth surface, with the ends of the magnet facing to your right and left.

2 Hold the other magnet flat against the table but a few feet from the first magnet.

3 Very slowly, bring one end of the second magnet up toward the first magnet. When the second magnet comes close enough to the first magnet (the distance will depend on the strength of the magnets), it will start to react. If similar poles are facing each other at the point of contact, the first magnet will spin around and away from the end of the second magnet. If opposite poles are facing each other, the first magnet will quickly slide over and stick to the magnet in your hand.

4 Now take the piece of cardboard in hand and hold it level.

5 Place one magnet on top and in the center of the cardboard.

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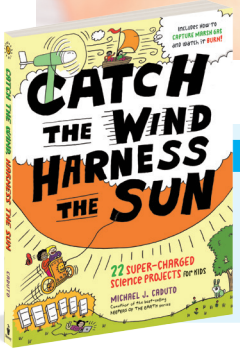

EXCERPTED FROM
ISBN: 978-1-60342-794-4
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MAGNETIC ATTRACTION—OR NOT CONTINUED

6 While holding the cardboard with the magnet balanced on top in one hand, take the second magnet and move it around under the cardboard. Watch how the magnet on top reacts.

7 Now place one magnet on a table.

8 Sprinkle a teaspoon of iron filings onto the cardboard and tap the cardboard to spread it out evenly.

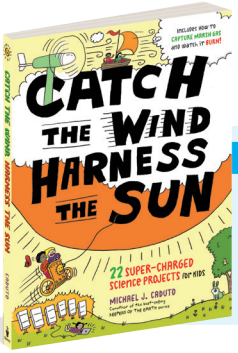
9 Carefully place the cardboard on top of the magnet, with the magnet centered beneath the iron filings.

10 Gently tap the edge of the cardboard, then watch how the iron filings arrange themselves along the magnetic lines.

11 Pick up the cardboard and move the magnet around under the iron filings. How do the iron filings react? Do they react differently at the different poles of the magnet? Why or why not?

12 Hold the magnet and swish one end around in the bowl of sand for a minute or two. When you lift up the end of the magnet, it will have some dark flecks stuck to it. Do these look familiar?

Once you've tried Magnetic Attraction—or Not, think of a way you can harness the power.



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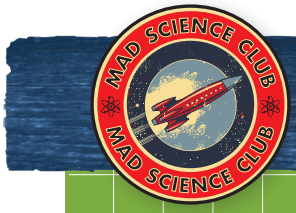


WORKMAN Activity

UN-TRUE NORTH

YOU WILL EXPERIENCE A FORCE OF NATURE YOU CANNOT SEE WHEN TRYING UN-TRUE NORTH.

WHAT YOU WILL NEED:

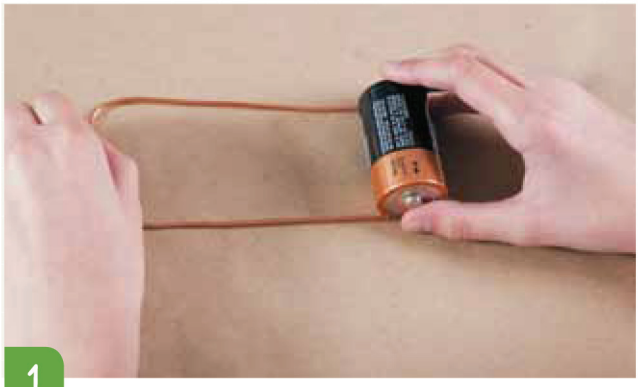
* Piece of thin, bare copper wire about 12 inches (30 cm) long
* 1 size-C battery
* Electrical tape
* Compass
* Small bar magnet

! SAFETY FIRST !

If you are using a new battery, the copper wire and the battery can become very warm. Don't hold the wire in direct contact with your skin for too long, and don't keep both ends of the wire connected to the battery for more than a few minutes.

DO THE DEED

Here is a simple way to detect the magnetic field created by an electrical current.

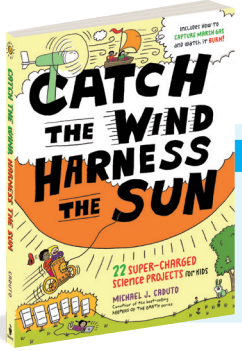


1

Take the piece of wire and bend it into a U-shape, with the mouth of the U matching the length of the C battery.

2

Use a 2-inch (5 cm) piece of electrical tape to fasten one end of the copper wire firmly against the flat side (negative terminal) of the battery. Now tape the other end of the wire onto the small nub sticking out of the other side of the battery (positive terminal).



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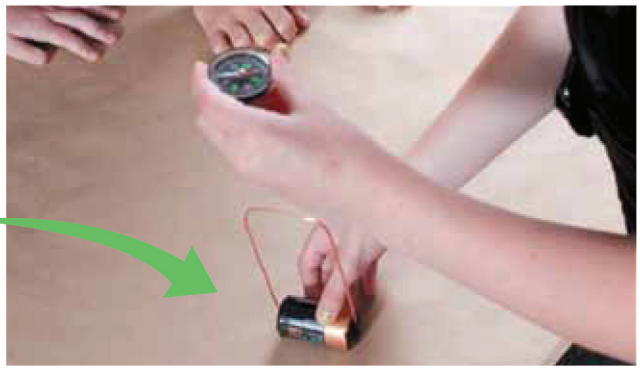
UN-TRUE NORTH CONTINUED

3 Hold the compass and notice the position of the needle as it points north.

4 Hold the compass about 12 inches (30cm) above the wire, and then move the battery so the wire is parallel to the compass needle.



5 Gradually bring the compass close to the wire until it is almost touching. Watch the compass needle turn as it reacts to the magnetic field that surrounds the electrical current running through the wire.

6 Raise the compass again. Now turn the battery 180 degrees so that the ends are switched around. This will reverse the direction the current is flowing around the wire loop.

7 Lower the compass toward the wire through which the current is now flowing in the opposite direction from the first time you did this. When the compass needle turns this time, how is it turning differently from the way it turned in Step 5?

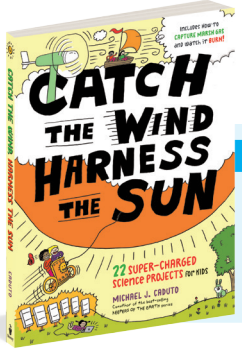
8 Untape the connection on one end of the battery and watch to see if the compass needle changes direction and points back toward the North Pole.

9 Take the small bar magnet in one hand and bring the compass down over it until they are almost touching. How does the compass needle react? Remember which way the North arrow is pointing.

10 Take the magnet away from the compass needle and turn the magnet 180 degrees so that the poles are switched around.

11 Bring the compass toward the magnet again and see which way the North arrow points this time.

A compass needle moves so, that it lines up with Earth's magnetic field. If brought close to a magnetic field that is stronger in that location, the compass needle will turn and align with that magnetism.



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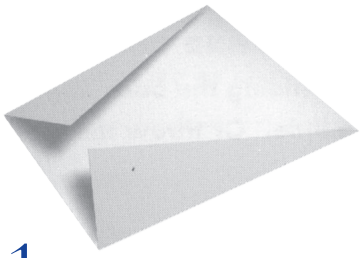
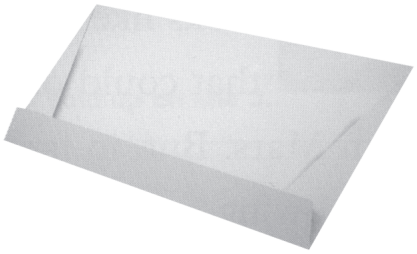
Making the World Record Paper Airplane

Don't forget: Fold in on the dashed blue lines (so you can't see them anymore) and fold away on the dotted red lines (you'll still be able to see them along the outside of the creases). **Folding tip:** This model can get a little bulky in the nose, so make your creases as sharp as possible. You may also find that the paper from folds 1 and 2 bunches up as you make the folds 3 through 10. Make a crease and flatten it down as you go.

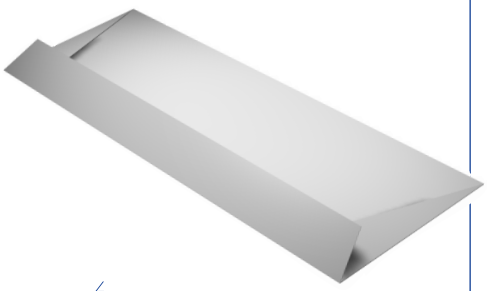


1. Fold in along lines 1 and 2.

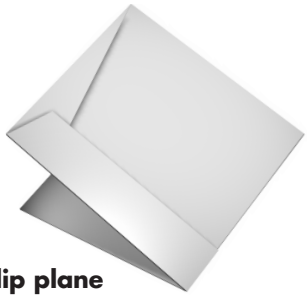
2. Fold up along line 3 to line 4.



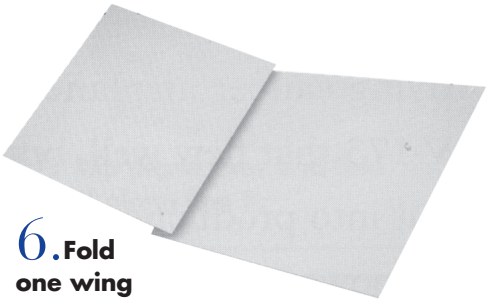
3. Continue folding up along lines 4 through 9.



4. Fold along line 10.

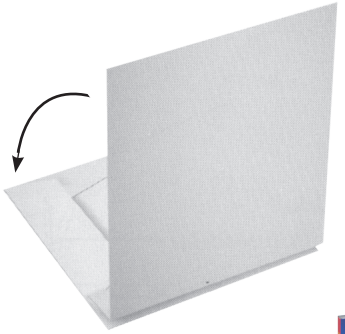


5. Flip plane over and fold in half along line 11.

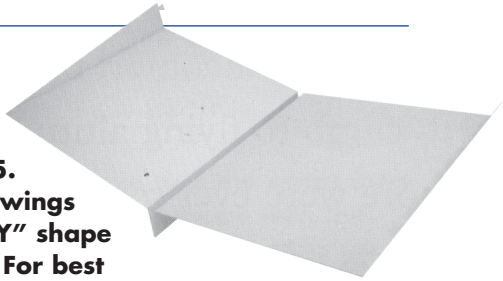


6. Fold one wing down along line 12.

7. Flip the plane over and fold the other wing down along line 13.



8. Fold wing tips up along lines 14 and 15. Make sure the wings form a slight "Y" shape with the body. For best flight, add a little up elevator.



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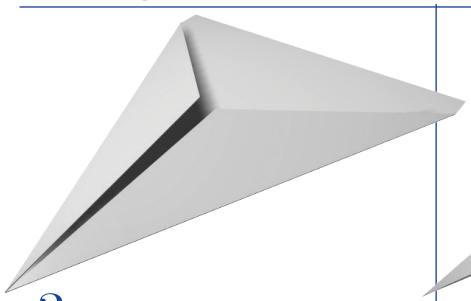
Making the Slice

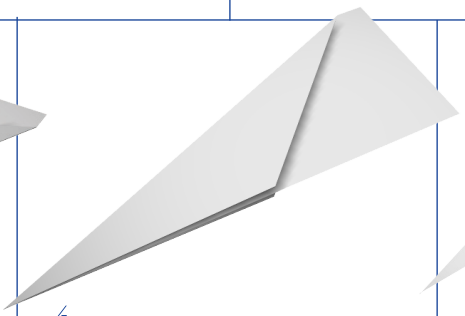
Don't forget: Fold in on the dashed blue lines (so you can't see them anymore) and fold away on the dotted yellow lines (you'll still be able to see them along the outside of the creases).

1. **Fold plane in half along center, line 5, and reopen.**

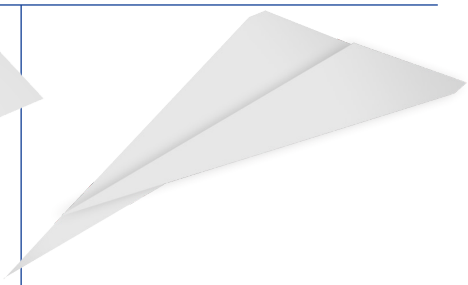
2. **Fold in along lines 1 and 2.**



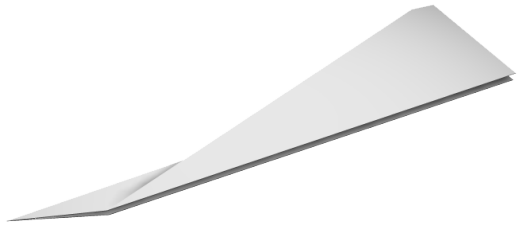
3. **Fold in along lines 3 and 4.**



4. **Fold plane in half along center, line 5.**

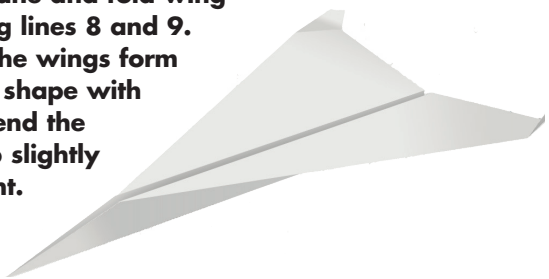


5. **Fold one wing down along line 6.**



6. **Flip plane over and fold the other wing up along line 7.**

7. **Open plane and fold wing tips up along lines 8 and 9. Make sure the wings form a slight "Y" shape with the body. Bend the elevators up slightly for best flight.**



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