girl scouts
river valleys

Home Scientist Badge Day

Science is all around you. Come to Home Scientist Badge Day and find out where it has been hiding in your own home. Learn about the chemistry in your kitchen, why you might get shocked walking across carpet, and unfold the mystery of why something sinks or floats. Become a scientist for the day as you conduct fun hands-on experiments.

Program Grade Level: Girl Scout Brownie

School Grade(s): 2–3

Program Essentials Focus Area: STEM (Science, Technology, Engineering, and Math)

Program Duration: 2 hours

Optimal Setting: Room with table and chairs

Optimal Group Size: 40–100 girls

Learning Objectives:
Girls will:

- See the science in their everyday lives.
- Try out simple experiments.
- Make predictions and test results.

Program Portfolio Links: Brownie Home Scientist Badge

Badge Requirements Met: All badge requirements met.

Outcome Indicators:

☐ Girls develop strong sense of self
☒ Girls seek challenges in world
☒ Girls promote cooperation and team building
☐ Girls identify community needs
☒ Girls gain practical life skills
☐ Girls develop healthy relationships
☒ Girls can resolve conflicts
☒ Girls are empowered to make a difference

Program Overview

Time Allotment for Activity	Activity	Materials Needed
	Drop in Activity: Water tricks • Girls can try some simple demonstrations with water to get their investigative minds going. (Alternative: other suitable brainteasers, puzzles, etc.)	• Plastic cups • Trays • Eyedroppers • Cotton thread • Index cards • Ziploc bags • Pennies • Dish soap • Plastic forks • Paper clips
10 minutes	Welcome and Introductions	• Name tags • Writing utensils
20 minutes	Activity Station #1: Elephant Toothpaste • Girls learn about some common kitchen chemicals and how they can be combined to make a nifty reaction.	• Empty 16-24 ounce pop bottles (1 per 3 girls) • Hydrogen peroxide • Dish soap • Pie pans, cake pans, or trays (1 per bottle) • Yeast • Warm water • Thermometer
20 minutes	Activity Station #2: Cauldron Bubbles • Girls find out about density and why things float or sink. They use what they've learned to create a bubbling effect.	• Empty pop bottles or tall clear cups or vases • Water • Vegetable oil • Food coloring • Salt • Pepper • Alka-Seltzer tablets
20 minutes	Activity Station #3: Striped Fruit Juice • Girls practice separating liquids of different densities.	• Clear plastic glasses, 9 ounces or less • Small 3 ounce cups • Sparkling water • Different kinds of juice: white grape, apple, orange, cranberry, pomegranate • Eyedroppers or turkey basters
20 minutes	Activity Station #4: Static Electricity • Girls explore static electricity and make a device to store electricity.	• Styrofoam plates • Aluminum foil • Paper or plastic cups • Masking tape • Nails • Film canisters
20 minutes	Activity #5: Science Toy – climbing doll	• Climbing doll pattern

	• Girls make a simple physics toy based on similar traditional toys.	on cardstock • Straws • Scissors, glue, drawing utensils • Yarn • Pennies • Tongue depressor/craft stick
10 Minutes	Clean up/evaluations	• Adult/Girl Evaluations • Writing utensils

Possible Adaptations (special needs, materials, etc.):

- Check out ways to stay safe using Safety-Wise at Volunteers.GirlScoutsRV.org/Safety-Wise.
- Ensure that your activities are accessible to everyone. Ask in advance if any special accommodations need to be made. If you have questions regarding specific adaptations, please contact River Valleys at 800-845-0787.
- This is meant to be a curriculum guide to structure Home Scientist Badge Day around. The program can be altered and expanded based on availability of materials and time as long as it meets the award requirements. Portions of the materials may also be made into a take-home activity for girls.
- This program can be adapted to fit the needs of a collaborator. Possible changes that can be made are below. This is not a comprehensive list.
    - Replace intro activity: Mind warm-up with an introduction to the collaborator and puzzles they to solve.
    - Replace climbing doll activity: for a toy—make an optics toy such as a periscope or kaleidoscope, or a polymer like silly putty, cornstarch goo, or other variation.
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Notes to the Facilitator:

- A take home sheet for leaders is attached to this document. This can be customized based on what activities are chosen and what needs to be completed at home.
- A note on format – the climbing doll activity can take different girls more or less time depending on how much decorating they want to do. One possible format would be to do the previous four activities in rotations, with groups of 10-20, and then return to the large group. Introduce the activity, and let girls work at their own paces. Have some filler activities for those who finish early, such as helicopters and ring gliders.
- Several activities can get messy so be sure to have plenty of paper towels to clean up when necessary.

Activity #1: Water Tricks (Drop In Activity)

Time Allotment: 10 Minutes
Prep Needed:

- Copy instruction signs for each station.
- Collect materials and sort into stations.
- If desired, make example water mazes.
- This is a good activity to have Program Aides, YEAs or even girls who arrive early learn how to show to others.

Materials Needed:

- 9 ounce clear plastic cups (18)
- Eyedroppers (12)
- Plastic trays (6)
- Ice cream buckets or other containers for water (4)
- Ziploc bags
- Plain 4x6 index cards
- Pens
- 2–3 foot lengths of cotton kitchen twine (or provide scissors)

Steps:

1. Water Mazes
    - Draw a maze on index card.
    - Place card in Ziploc bag.
    - Use eyedropper to place drop of water on “start” of maze, and tilt card so drop runs through maze.
2. Penny Balance
    - At one station, have pennies on trays to catch water, and cups with eyedroppers.
    - Make predictions of how many drops of water you can place on a penny before the water spills.
    - At a separate station, have same set up plus a small plate or index card with small amount of dish soap, and cotton swab.
    - Touch swab to penny before balancing water; do more drops fit, or fewer?
    - Keep soap station separate and keep soap out of water containers.
3. Water Walks a Tightrope
    - Take two plastic cups, 2–3 feet of cotton kitchen string, and water in one cup.
    - Get string wet.
    - Then, hold string with one end in each cup, and stretch out arms so string is taut.
    - Stand over tray or sink to catch spills.
    - Slowly tilt the cup with water so water starts to dribble out.
    - At the right angle and speed, you can get the water to stick to the string while travelling down into the second cup.
4. Paper Clip Balance
    - Hold fork so tines are flat.
    - Place paper clip at edge of tines.
    - Lower fork into the water and when paper clip seems to be floating, tip the fork down and away to leave the floating clip in the water.
    - If it doesn’t work the first time, take the clip out, make sure it’s flat, and start with it relatively dry.

Activity #1: Elephant Toothpaste
Time Allotment: 20 minutes

Prep Needed:

- Just before program, make yeast water early. It will be effective for several hours and you won't have to mess with getting the temperature right during the program. Follow water temperature guidelines on the yeast package.

Materials Needed:

- Yeast – one package makes enough for 2 cups for 16 teams
- Hydrogen peroxide – enough for at least 1/3 cup per team, or 6 cups for 16 teams
- Dish soap – each group only needs a few drops (dividing into multiple squeeze bottles helps the process go faster)
- Empty, rinsed pop/water bottles, 16-24 ounce size – 1 per team
- Plastic tray, disposable cake or pie tin, or similar pan to catch overflow – 1 per team
- Optional: food coloring
- Filler activity: whole milk, shallow bowls, food coloring, dish soap

Steps:

1. Divide girls into groups of 2-3. Give each team a bottle and a pan.
2. Use the following talking points throughout the activity: *Water is a very important part of our world, and it's a really big part of chemistry too. Water often helps mix different things together. Lots of times when there is a chemical reaction using liquids, there will be water used to start it, or water left over at the end. It's so important that it's sometimes called "the universal solvent" because it mixes with so many different things.*
3. *There are different ways to describe water, as well as other chemicals. Sometimes we name water by using two letters and a number; who can tell me what that is?* (If a lot of people raise their hands, have everyone tell you at once.) *Yes, it's also called H2O!*
4. *In this name, the H stands for hydrogen and the O stands for oxygen. The number 2 after the hydrogen means that there are two little bits of hydrogen for every one bit of oxygen. Okay, remember that while I talk about this other chemical.*
5. *This chemical comes in a bottle like this – any guesses what it might be? It's called hydrogen peroxide. Do you know what it might be used for?* (Let them answer, or help out if they don't know – disinfectant, kind of bleach, etc.) *We can use letters and numbers as another name for hydrogen peroxide, too. It's H2O2. Remind you of anything? Exactly – it's just water with "extra" oxygen tacked on! It's not really extra, of course, because you can't use hydrogen peroxide as a substitute for water – for example, you can't drink it – and just pretend the other oxygen isn't there.*
6. *But that extra oxygen isn't packed in there as securely as the rest, and it's possible to kick it out of the peroxide molecule so you're left with water and the leftover oxygen. You have to have extra energy to do that. Where can energy come from?* (Accept all answers.)
7. *Take a look at the bottle. A peroxide bottle is pretty much always dark brown; it's never clear. Any idea why? Well, it's about keeping the extra energy out. Sunlight, or most any light, can give peroxide enough energy that it will start to break down, so the bottles are dark to keep the light out. It's not a lot of energy, so it doesn't change to water all it once – it does it slowly.*
8. *But we want to do it faster – to give it enough of a push that the oxygen leaving is noticeable. Except that normally we can't see oxygen. So, we're going to make it noticeable by using it to blow bubbles for us.*
9. Each team needs a bottle and a tray to put it in. They are going to put about an inch of hydrogen peroxide in the bottom of the pop bottle. Remind them of the chemical formula, and what you're going to push out of the peroxide.
10. Ask them if you can blow bubbles in plain water. Eventually we should get the idea that we can, but they don't stick around very long. *What makes bubbles that last? – Soap, so that's what*

we're going to add. Each team needs one squeeze of soap in their bottle. At this point you can have them add a drop or two of one food coloring in the mixture too, just so it looks interesting, but it shouldn't be very much. If it gets too dark, the bubbles can stain their hands if the girls touch the bubbles.

11. *"What do we need to get the oxygen out? Energy. We're going to do that with some yeast, which is a little bitty organism related to mushrooms. We 'woke up' some yeast already with some warm water."* Everyone should put a few spoonfuls of yeast water in their bottles (mix the yeast water in big cups, then distribute to smaller ones so multiple people can add to their bottles at once)
12. This part takes a little waiting. They should see some changes right away, so ask them about what they see. Some people will get slightly different effects and some will take longer, but they should get some foam developing in the bottles. The bubbles are usually tiny and dense. When they first come out the top of the bottle, sometimes instead of immediately spilling over, the bubbles keep rising in a column straight out of the bottle until they finally get heavy enough to fall over.
13. If girls grab onto the bottle, it should feel a little warm. This isn't just the warm yeast water, though. The reaction itself is exothermic meaning it gives off heat. The foam is safe to touch, too, though of course they shouldn't get it in their mouth or eyes (it's not nasty, just tastes gross and can lightly sting).
14. Instruct girls to wash up well afterwards.
15. If you have time left, try the color swirls activity (see activity resources at end).

Activity #2: Cauldron Bubbles, Doubled
Time Allotment: 20 minutes
Prep Needed:

- Gather materials and supplies.
- Optional: Pour water and oil into the glasses ahead of time.

Materials Needed:

- Clear glasses
- Pitcher
- Water
- Oil
- Salt
- Pepper
- Sugar
- Optional: Sand
- Alka-Seltzer tablets

Steps:

1. Divide girls into small groups. Give each group a cup and a small amount of salt, pepper, sand and sugar.
2. Have girls fill a glass no more than half full with water. Then add about ½ inch of oil. The oil should float on top of the water because it is less dense. This means that if you had a gallon of each, the oil would weigh less than the water.
3. Ask the girls to pour in some salt and share with the group what they see happen. The salt is less dense than the oil so it will sink down to the water layer, but it will bring an oil bubble with it. The oil and salt together are denser than water, so they sink together in the water. Then, the salt dissolves and the oil bubble is again less dense than the water and floats back up to the top.
4. Have the girls take turns trying the other materials. Is the result the same or different?
5. Give each group a second cup, and have them repeat step 2.

6. Tell them that this time they will create other bubbles to stir up the mixture. Give each group an Alka-Seltzer tablet and have them break it into small pieces. Tell them not to put the entire tablet in at once, or there might be more than the usual spills to clean up.
7. Have the girls take turns putting one small piece of tablet in and watching what happens. What seems the same as the other experiment? What seems different?

Activity #3: Striped Fruit Juice
Background Information: Fruit juices are all mostly water can be similar in density, however, the differences are enough that if you pour carefully and don't mix them, you can get the juices to stay in separate layers.

When in doubt, sweeter juices will generally have more sugar and be denser. A chart of recently tested juices ranked in this way, from least dense to most:

Sparkling mineral water
Water
Coconut water (plain, not coconut milk)
Apple (filtered, store brand)
Pineapple (canned, Dole)
Orange (no pulp, Tropicana)
Grape, 100%, either regular or white (Welch bottled)

Please note: Apple and pineapple were very close and hard to keep separate. Pineapple and orange looked very similar due to the color and were hard to detect. It is recommended to choose either pineapple OR orange juice to experiment with instead of both.

Time Allotment: 20 minutes
Prep Needed:

- You may wish to practice this at home first.

Materials Needed:

- Clear cups no bigger than 9 ounces (1 per girl plus a few extra)
- Different flavors of fruit juice (about 1 cup total per girl)
- Spoons (1 per girl—can reuse spoons during each rotation)
- Club soda or sparkling mineral water (½ cup per girl)
- Large eyedroppers or basters
- Small 3 ounce cups (3 per person)
- If desired, food coloring: many of the juices are similar colors, so adding a small amount of color to some of the less colorful juices will make the layers more visible as well as more fun

Steps:

1. Demonstrate the format to begin: pour mineral water and two different juices each into separate small cups. Choose two juices that are as far apart in density as possible, such as grape juice and coconut water. Set out a clear glass and spoon so the group can see what you are doing
2. Ask if the group has heard of density and its definition. Point out that if you place a penny and a Ping-Pong ball in a glass of water, different things happen to the two objects – the penny sinks and the ball floats. Anything that is less dense in water will float in water, and if it is denser then it will sink.
3. Tell the girls that they are going to do the same thing with liquids. It will be tricky, because all the liquids are very close to water, but you'll show them how it will work.
4. Ask girls: *If denser things sink and less dense things sink, what will be on the bottom? We will start with the densest item.* Also, ask if they can guess what could be different in the fruit juices to make them more or less dense.

    - The amount of sugar content is the most obvious difference, but many variables are possible, including pigment (either added or naturally occurring color.) The mineral water is lightest of all – it has no sugar at all to weigh it down, plus it has carbon dioxide bubbles, which are less dense (that's why the bubbles rise to the surface.)
5. Point out that you chose two juices and poured them into separate small container as well as a third glass with mineral water. Explain that you brought the glasses to the main glass back to prevent mixing the layers. They will need to try to keep the main glass still when adding their liquids into the main glass.
6. Pour the densest juice (grape in our example) in the clear glass.
7. Place the spoon in the cup so the tip of the spoon is on the bottom of the cup but not touching the sides and the back of the spoon bowl is the side facing up. Another option is to slightly tip the main glass, then slowly pour the juice down the inside of the glass.
8. Take the second juice cup and very slowly pour it over the back of the spoon into the glass. If the liquid level gets high enough to cover the spoon bowl, you will need to lift it up so you are continuing to pour over the back of the spoon. Essentially, you are "breaking the fall" of the second liquid so it can't dive down into the first one and churn itself into a blend.
9. Let each layer settle a little then repeat then process with the mineral water. The colors may have mixed a little, but you should be able to see "stripes."
10. If you put the less dense liquid first, you can still add the next one in this way: use a large eyedropper or baster to pick up as much of the juice as possible, and carry it to the main glass with the small cup underneath (to catch drips). Slowly tilt the baster into the cup so it rests along the side of the glass. Gently squeeze the bulb so that the heavy liquid runs down the side and slips down underneath the lighter layer.

Activity #4: Static Electricity
Time Allotment: 20 Minutes
Materials Needed:

- Styrofoam plates, 1 per girl
- Styrofoam cups, 1 per girl
- Cardboard squares
- Aluminum Foil
- Masking tape
- Film canisters, 1 per girl
- Steel, non-galvanized nail, size, 1 per girl
- Lightweight items to move: Pringles can, empty pop/water bottle, small bits of paper
- pieces of Styrofoam, or balloons

Steps:

1. Warm up: Make static to make things move – rub a piece of Styrofoam or a balloon on your hair, and see what kinds of things you can get to move, such as making a bottle or Pringles can roll, or getting small bits of paper or Rice Krispies to jump.
2. Explain at this station they will be learning how everyday items can be energy conductors to make static electricity.
3. Begin activities (see activity resources for instructions).

Alternative or addition to Activity #4: Electro-active Slime
Time Allotment: 20 Minutes
Prep needed:

- You can make the slime in advance and bring it for girls to experiment with or make it as the main activity. Note that it works best when allowed to chill for a while.

Materials needed (1 batch is enough for 4 girls to take home):

- 3/4 cup cornstarch
- 2 cups vegetable oil
- Glass or tumbler
- Refrigerator
- 1x6x6 inch Styrofoam

Steps:

1. Mix the cornstarch and vegetable oil together in the glass.
2. Refrigerate the slime mixture until it is chilled.
3. Remove from the refrigerator and stir (separation is normal). Allow the mixture to warm enough so that it can flow.
4. Take a block of Styrofoam and charge it by rubbing it on hair, or a wool sweater.
5. Tip the container of slime (which should flow slowly).
6. Place the charged Styrofoam about an inch (2 cm) from the flowing slime. It should stop flowing and seem to gel.
7. If you wiggle the charged Styrofoam the slime may follow or pieces of it may even break off. When the Styrofoam is removed the slime will continue to flow. After use, refrigerate slime in a sealed container – divide mixture into 4 Ziplocs for girls to take home.

Activity #5: Doll Climber Toy
Time Allotment: 20 minutes
Prep Needed:

- If you need to conserve on time, pre-trace and rough cut the figures.
- Make copies of instructions/diagrams from activity resources.

Materials Needed (per girl):

- Piece of poster board at least 5" by 5" or 13cm by 13cm (similar in stiffness as a cereal box)
- String (5 feet or 1.5 meters)
- Plastic drinking straws
- Scissors
- Tape
- 1-2 coins or item similar in weight (pennies work well)
- Optional: tongue depressor
- Optional: Coloring utensils to decorate dolls

Steps:

1. Cut out the body - It says 2" line to line or 5 cm line to line. Make sure it's accurate. Rough cut (bubble cut) it out. Stick "tape doughnuts" (pieces of tape stuck end to end--sticky side out) to the back of the pattern at the hands and feet. Now fine-cut the poster board on the outside pattern lines. The two lines on each arm just show where the straw will be taped later.
2. Prepare and tape the straws - Peel the pattern off the cardboard, but first notice where the lines on the arms are, and how they go across the arms. Cut straws as long as the arms are wide (about 3/4"). Tape them on. Press the tape on hard, because the straws take a lot of stress.
3. Reinforce the straws - Wrap another piece of tape around the arm perpendicular to the first, as indicated by the red arrow. Think of this as taping the tape that holds the straw. Straws that aren't fastened securely can pull loose if girls pull on the strings hard during the experiment.

4. Tape a coin around the midsection of the doll. The coin provides weight so the climber slides back down when you let go. Sometimes you have add a second coin if the climber gets stuck, but try it with one.
5. Add string and test its climbing capability. Cut about a 5 foot piece of string. Thread the ends through from the top (see diagram in activity resources). Wrapping a little tape might help keep the string from unraveling and make it easier to thread through. Once it is through, a bigger piece of tape will keep the string from pulling back out.
6. Hang the loop of string on top of the doll on a doorknob. Making the figure climb is very easy to show someone, and harder to describe in words. With both hands, pull down very gently on both strings. Pull one string down while allowing the other string to rise. The doll will tilt one way and go up. Pull the string that was going up down instead while letting the other string go up. The doll tilts and rises again! And so on.
7. Making a pivot is optional, but it frees you from having to use a doorknob. Before you start, see if you can figure out how the climbing doll works. Adding the pivot limits how far you can pull the string down each time, making it a bit more of a challenge to figure out.
8. Wrap about a 1' piece of string a couple of times around the middle of a tongue depressor, Popsicle stick or piece of dowel about as long (6"). Tie it tightly. If it slides around, tape it so it stays in the middle.
9. Determine the middle of the loop of string on top of the doll. Tape it securely to both ends of the tongue depressor. Use several wraps for strength. Kids can pull hard.
10. You can tie the pivot string around a pipe or tie a loop in it to hang it from a hook. Sometimes when doing this project with groups where there is nothing to hang from, you may tape the pivot string to the wall.

Activity Resources

The following pages contain supplemental resources:

- Badge completion take home information sheet
- Water tricks table instructions
- Static electricity instructions
- Doll climber pattern, pictures
- Ring glider plan
- Color swirls

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Badge Event: Home Scientist Badge Day
Planning Guides Requirement(s) Met: Science, Technology, Engineering, and Math

	Steps	Activity Choices
Badge Requirements	**Step 1.** Be a kitchen chemist **Step 2**. Create static electricity **Step 3**. Dive into density **Step 4**. Make something bubble up **Step 5.** Play with science	The full requirements can be found in the Junior Girls Guide to Girl Scouting.
Badge Steps Completed Today	**Step 1.** Be a kitchen chemist **Step 2**. Create static electricity **Step 3**. Dive into density **Step 4**. Make something bubble up **Step 5.** Play with science	• Striped juice snack • Make an electrophorus, play with static • Cauldron bubbles, snack • Elephant toothpaste • Climber toy, aeronautics toys, water tricks •
Badge Steps to Finish	N/A	N/A

Resources:

- Brownie *Girls Guide to Girl Scouting* – Home Scientist Badge
- Websites: ZOOM - www.pbskids.org/zoom; Science Bob - www.sciencebob.com; Science Toymaker - www.sciencetoymaker.org

More to Explore:

- Visit a museum with exhibits on physics, electricity, or weather.
- Invite someone to your meeting who makes up their own recipes or craft patterns, or remembers or has made their own mechanical toys.
- Talk to someone with a background in electricity, chemistry, or food science

Challenge #1: Water Walks a Tightrope

tools: two cups (one with water), cotton string

If you wanted to pour the water from one cup into the other, you'd put the one with the water above the one without and tip the cup so the water poured out of it into the second cup. You've done it lots of times. What would happen if the second cup wasn't directly underneath, but you started to pour out the water anyway? (Don't do it yet – we haven't mentioned the trick, and you'll have a big puddle to mop up!)

There's one more item here, remember? That's right, the string! Being a tightrope walker takes a lot of patience and concentration, and that's what you'll need here. Use the string to patiently…carefully…walk the water from one cup to the other.

The trick is to keep the tightrope – well, tight! Get the string wet, and let the ends of the string fall into each cup. Stretch out your arms so the string is pulled tight between the two cups, one end is in the water in the first cup, and the other is well inside the second and ready to help the water get into the second cup.

Practice this over a tub – less clean up!

Challenge #2: But how can THAT float?

tools: paper clips or pins, forks, cup of water

So things that are less dense than water can float. But paper clips and pins and needles are solid metal, often steel. How can you make them float?

The paper clips and pins are also very small. In general, if you just drop them in, they will sink. With a little trickiness and a steady hand, you can take advantage of something else water has: surface tension.

Think of the surface of the water as having sort of a skin. The molecules of water are electrically attracted to each other, and tend to 'stick together' with other water molecules all around them. At the surface, there aren't as many molecules to hang onto, so these molecules bond to each other with extra-strength. If something is small enough, it can rest on top of this skin of tightly bound water molecules. As soon as it breaks through, however, its density will make it sink.

Can you make one of the paper clips or pins float on top of the water? Remember, you don't want it to break the surface. (Hint: Hey, what do you suppose these forks are for?)

Challenge #3: Balancing act, or surface tension, part 2

tools: pennies, water, eyedroppers

If you were to get together with a bunch of your friends, join hands, and then squeeze together in as small a space as possible, what shape would you be in? Maybe it will be a bit blobby, but mostly it would be a circle, the most efficient shape for enclosing space.

Surface tension will also tend to hold the water in as round a shape as it can manage, as long as there isn't very much of it. (Think of when it starts to rain – the first small raindrops on a window or car will be like little clear beads on the surface, until there's more rain and it all runs of the surface.)

Your challenge is to drop single drops of water from the eyedropper onto a penny, counting as you go. How many drops fit on your penny?

Challenge #4: Balancing act, or surface tension, part 3

tools: pennies, water, eyedroppers, soap

Follow-up to the first penny balancing act: soap decreases the surface tension of water (that's part of how it carries grease off your dishes, but that's another story.)

Shake off the penny and put a *tiny* smear of soap on the top. Now try again. How many drops fit this time?

(Be sure to rinse off your hands afterwards, and don't get any of this soap on the other pennies!)

Challenge #6: Water Mazes (just for fun)

tools: mazes in Ziploc bags, eyedroppers

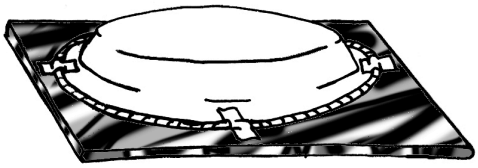
Now let's really play with that surface tension. Pick one of the mazes, keeping it in the plastic bag.

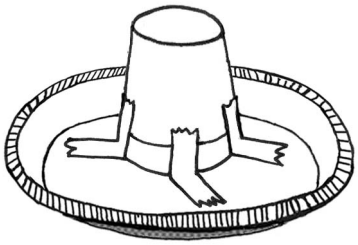
Find the place where it says START, and place a single drop of water from the eyedropper on it. Your challenge is to tilt the maze enough to move the water drop along the path, staying in the lines as much as possible, and definitely keeping the water on the maze!

Which mazes are the trickiest? Race your friends! Try making a maze of your own!

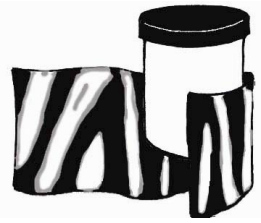
Electrophorus (refer to diagram below)

- Fold aluminum foil around cardboard to cover one side of cardboard. Tape foil in place on bottom of the cardboard square with four small pieces of tape.
- Put the Styrofoam plate upside down on the side of the cardboard that is completely covered with foil. Use four small pieces of tape to hold it in place. - Rub the plate with your hair or fuzzy/wool clothing to generate an electrical charge. You can tell you have done it right if you feel or see your arm hair stand up when you hold the plate above your arm.
- Tape the Styrofoam cup upside down in the middle of the aluminum pie pan. The cup will be the handle for your transfer plate.





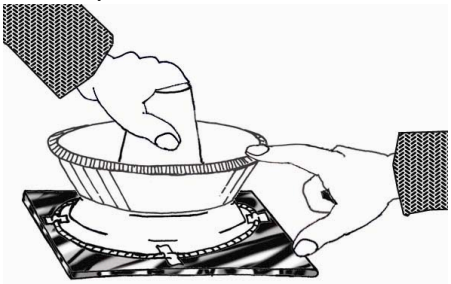
Leyden Jar (refer to diagrams at right)



- Wrap an aluminum foil strip around the film canister.
- Make sure the top edge of the aluminum foil is only halfway up the film canister. Use one small piece of tape to hold to foil in place.
- Fold over and crimp the extra foil to cover the bottom (bottom must be completely covered with aluminum foil).
- Poke the nail into the top of the film canister and push it most, but not all, of the way down.
- Fill the inside with water a little higher than the aluminum foil.

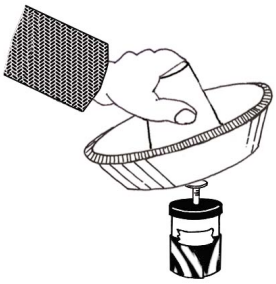
Charge Your Leyden Jar (refer to diagrams below)

- Rub your plate with your hair again (remember, to generate a large charge, use your hair or fuzzy/wool clothing).
- Using the cup as a handle put the pie pan on the plate.
- Touch your finger to the pie pan and your thumb to the foil base.
- Take your fingers off the pie pan and foil base.
- Using the cup as a handle, touch the pie pan to the nail in your Leyden Jar.
- Repeat steps B-E about 10 times.



Use Your Leyden Jar (refer to diagram at right)

- Hold the foil covered part of the jar in one hand.
- Touch the nail with your other hand.



Try the following experiments.

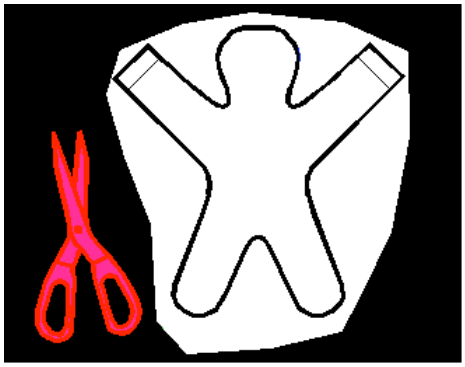
- Shock yourself with the Leyden Jar.
- Compare it to a shock made by rubbing your feet on the floor.
- Charge your Leyden Jar. Hold one hand of a partner.
- Hold your Leyden Jar in your other hand.
- Have your partner touch the top of the Leyden Jar.
- Did the shock move fast or slow?

Climbing Man Diagrams

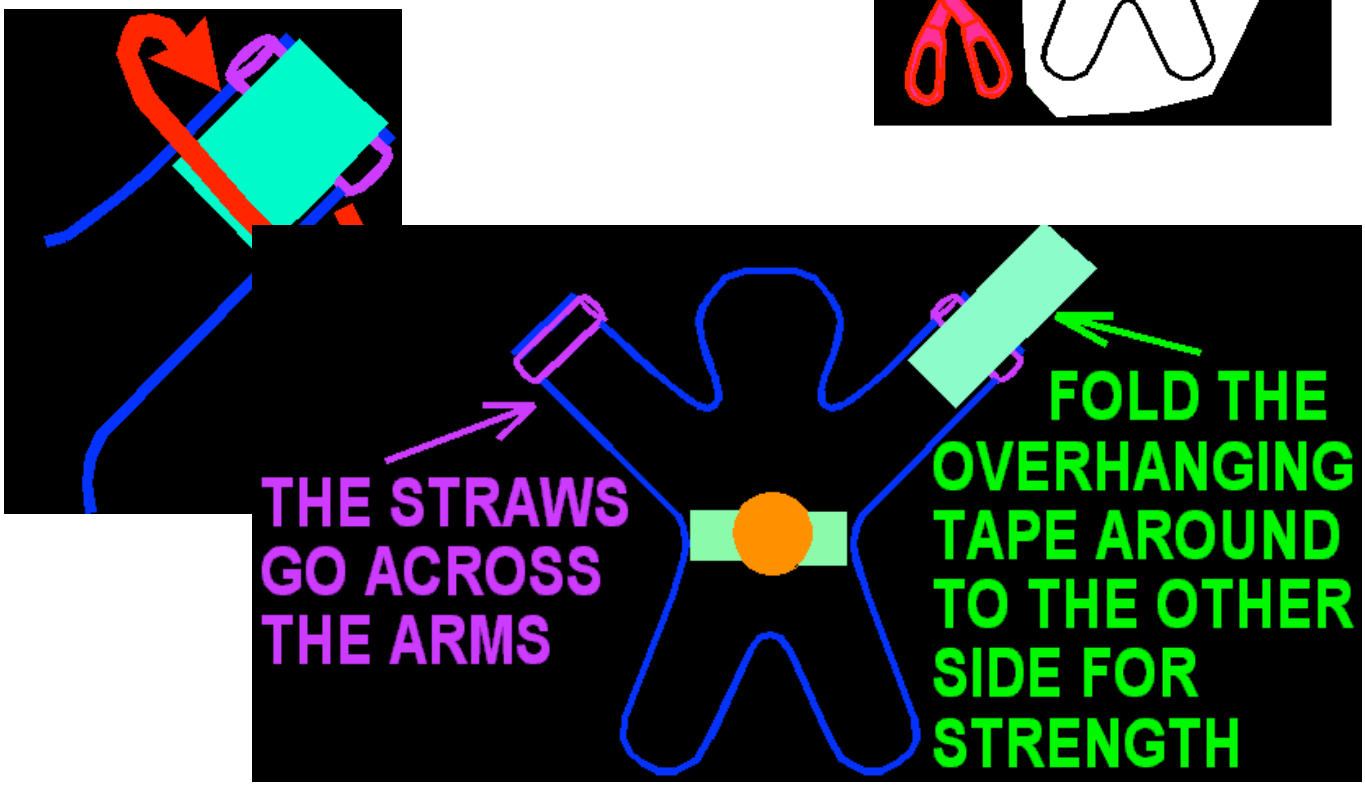
What you need:

- **a piece of poster board at least 5" by 5" or 13cm by 13cm (it should be as stiff as cereal-box cardboard).**
- **string (5 feet or 1.5 meters)**
- **plastic drinking straw**
- **scissors, tape**
- **one or two coins**
- **(optional) tongue depressor**

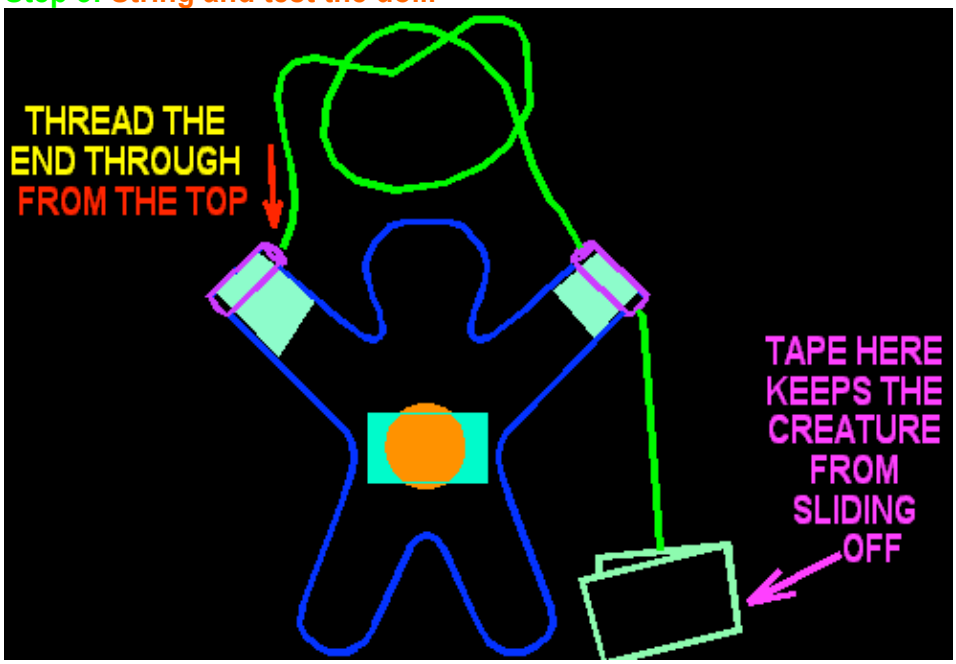
Step 1 Cut out the body.



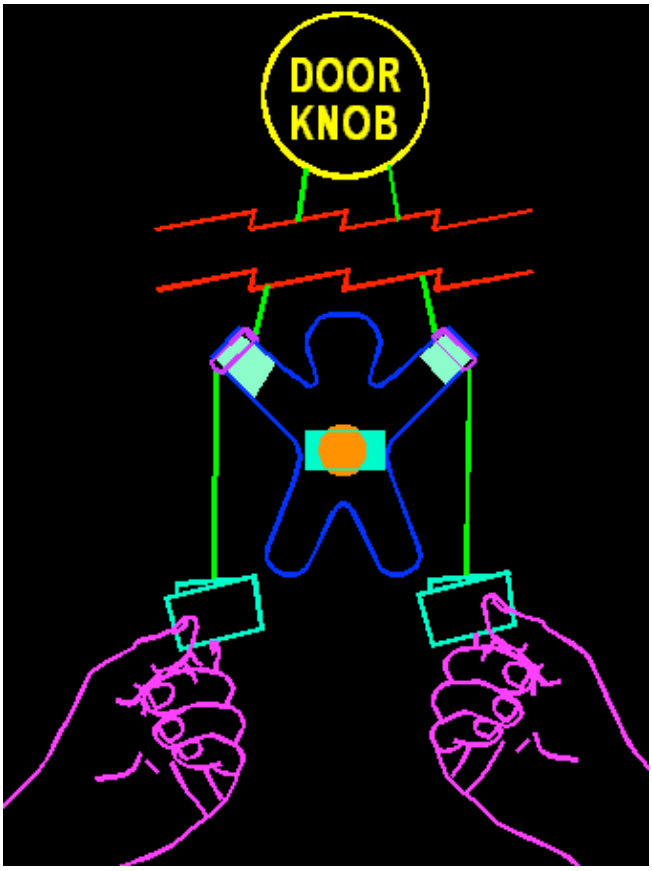
Step 2 Tape on the straws, coin.



Step 3: String and test the doll.



Step 4: Make a pivot

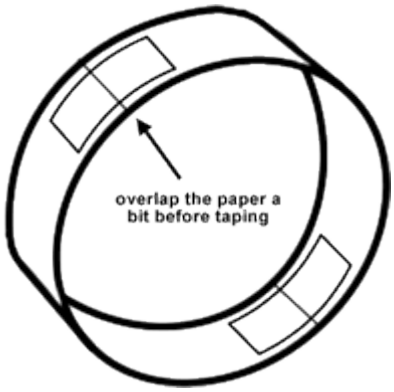


5 cm line to line
2" line to line

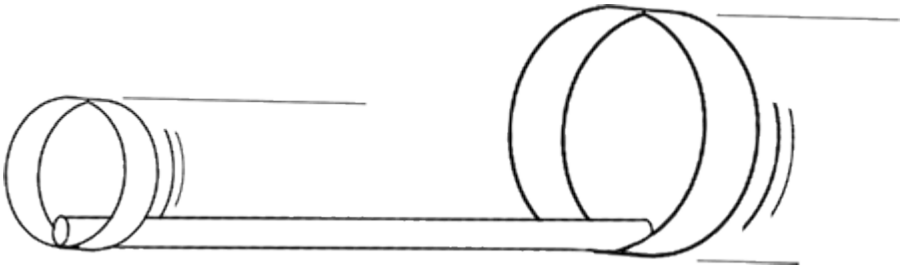
5 cm line to line
2" line to line

Ring Glider Instructions

A regular plastic drinking straw
3 X 5 inch index card or stiff paper
Tape
Scissors



1. Cut the index card or stiff paper into 3 separate pieces that measure 1 inch (2.5 cm) by 5 inches (13 cm.)
2. Take 2 of the pieces of paper and tape them together into a hoop as shown. Be sure to overlap the pieces about half an inch (1 cm) so that they keep a nice round shape once taped.
3. Use the last strip of paper to make a smaller hoop, overlapping the edges a bit like before.
4. Tape the paper loops to the ends of the straw as shown below. (notice that the straw is lined up on the inside of the loops)



5. That's it! Now hold the straw in the middle with the hoops on top and throw it in the air similar to how you might throw a dart angled slightly up. With some practice you can get it to go farther than many paper airplanes.

Can we really call that a plane? It may look weird, but you will discover it flies surprisingly well. The two sizes of hoops help to keep the straw balanced as it flies. The big hoop creates "drag" (or air resistance) which helps keep the straw level while the smaller hoop in at the front keeps your super hooper from turning off course. Some have asked why the plane does not turn over since the hoops are heavier than the straw. Since objects of different weight generally fall at the same speed, the hoop will keep its "upright" position.

To make it a true experiment, you can try to answer these questions:

1. Does the placement of the hoops on the straw affect its flight distance?
2. Does the length of straw affect the flight? (You can cut the straws or attach straws together to test this)
3. Do more hoops help the hoop glider to fly better?
4. Do the hoops have to be lined up in order for the plane to fly well?

Color Swirls

Materials Needed:

- Shallow bowl for each group
- Dish soap (in a small container)
- Cotton swabs for dipping
- Food coloring
- Milk – whole or 2%

Each group should get some milk in a shallow dish, about ¾ to 1 inch deep.

Limit the amount of food coloring each group can use, and remind them not to wiggle or stir the milk. For example, I'd say 4 or 5 drops is plenty, but they can divide that up however they want – it can be 2 drops of red and 1 each of the other three, or 3 blue and 1 each green and yellow, or two red and two blue, or whatever. Put the drops near the middle.

Now dip the end of the cotton swab in soap and put that end into the milk (not in the colors but near it) and pull it out. The soap decreases the surface tension of the milk, which means that the molecules don't stick together very well and they separate from each other, taking the colors along with them for a ride. Soon the colors are churning and swirling around, and it looks very cool. That's it, that's all there is – just looks cool.