



THE MAGIC OF SCIENCE!



EXPERIMENTS FROM THE HARRY POTTER ALLIANCE

While Hogwarts defies imagination, science brings magic to life in the real world! Try these *Harry Potter*-themed experiments to add a little magic to your explorations in science, technology, engineering, art, and math. All aboard the STEAM train to Hogwarts!

This kit was created by the Harry Potter Alliance, a 501(c)(3) nonprofit that turns fans into heroes. We have chapters in countries around the world and have engaged millions of fans of every age in our work for equality, human rights, and literacy. Become a member of Dumbledore's Army for the real world: visit thehpalliance.org for resources, trainings, curriculums, and ways to take action or send us an owl at info@thehpalliance.org.

ENGINEER A ROBOTIC HOPPING POT

Adapted from researchparent.com/homemade-wigglebot

In *Harry Potter and the Deathly Hallows*, we read about *The Tales of Beedle the Bard*, a collection of wizarding children's stories. One of the stories is about a selfish wizard whose cauldron comes to life and hops around, making a noisy mess until the wizard learns to be kind to others. We can't magic your cauldron to life, but we can do the next best thing: build a tiny robot!



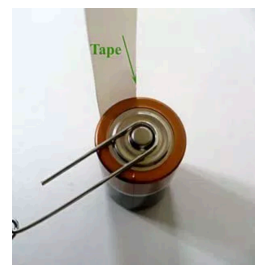
Time Required: ~30 minutes

Materials:

- ✦ Disposable cup
- ✦ Electrical tape
- ✦ 3 markers
- ✦ 1 AA battery
- ✦ 2 metal paper clips
- ✦ Clothespin
- ✦ Popsicle stick
- ✦ Googly eyes (optional)
- ✦ Scissors
- ✦ Hot glue gun or glue (optional)
- ✦ 1.5-3 V DC motor with wire leads

ROBOTIC HOPPING POT INSTRUCTIONS

1. Tape the markers into the inside of the cup with the points facing down. Keep the caps on to avoid mess as you're building! Set aside
2. Now, make a "battery pack." Using your electrical tape, tape the paper clips to the ends of your AA battery. Place one "loop" of one paperclip at one end of the battery and fold the tape over, making sure that the metal of the paper clip is touching the metal of the battery. Repeat on other side of battery.
3. Attach the battery pack to the motor by wrapping the wire leads around the paper clips (one lead per paper clip). The axel of the motor should spin. If the axel does not spin, check to make sure your paperclips are completing the circuit by touching metal on both the battery and the lead wire and are securely attached. To turn the motor off, unwrap one of the lead wires from the paperclip.



ROBOTIC HOPPING POT INSTRUCTIONS

4. Tape the battery pack onto the top of the disposable cup, slightly off-center. In the space, tape the motor onto the cup. The axle can face up or off to the side of the cup – this will affect how your Hopping Pot hops, so it is great to experiment with!
5. Attach the clothespin to the motor. When the motor spins with the paper clip attached, it will tilt with the uneven weight distribution, causing the pot to hop. You can make this effect more dramatic by attaching a popsicle stick to the clothes pin.
6. Add a face to your Hopping Pot by gluing on googly eyes and drawing a mouth!
7. Remove the marker caps, place the Hopping Pot on a piece of paper and watch it go!



TALK IT OUT

1. What would happen if one of the legs on your Hopping Pot was shorter than the others? What if you used more than one battery?
2. Electricity works by having a complete circuit: electrons can move from the power source through a conductor to the mechanical parts of the robot and back again in an endless circle. What is the path of the circuit you created for your Hopping Pot?

✎ **Answer:** Positive end of battery → paper clip → lead wire → motor → lead wire → paper clip → negative end of battery

TAKE ACTION!

While Muggles don't have Hopping Pots, we do have lots of robots! Robots help with lots of jobs, including assembling things in factories, helping clean the ocean after oil spills, helping doctors perform surgery, providing one-on-one support in schools and nursing homes, making coffee, and much more!

Take a walk or drive around your community. Where do you see places that may use robots to help people?

DESIGN YOUR OWN MARAUDER'S MAP

Adapted from sciencekids.co.nz/experiments/invisibleink.html

In *Harry Potter and the Prisoner of Azkaban*, we find the Marauder's Map, an enchanted map that shows every path and person in Hogwarts castle – but only if you know how to reveal the map's secret messages!

Time Required: 10 minutes (excluding drying time)

Materials:

- | | | | |
|-------------|------------------------|----------------------------|-------------------|
| ✎ One lemon | ✎ Bowl | ✎ White paper | ✎ Wand (optional) |
| ✎ Water | ✎ Paint brush or Q-tip | ✎ Lamp or other light bulb | |
| ✎ Spoon | | | |

MARAUDER'S MAP INSTRUCTIONS

1. Squeeze some lemon juice into the bowl and add a few drops of water – you can experiment with different amounts of water to see how it changes the end result (your secret message or map).
2. Mix the water and lemon juice with the spoon.
3. Dip the paint brush or Q-tip into the mixture. Draw a map or write a secret message on the paper. If drawing with the mixture proves difficult, it may help to draw your map or message first with markers on a different piece of paper, cover the drawing with plastic wrap, then trace the map or message with the mixture.
4. Wait for the juice to dry so it becomes completely invisible.
5. *Lumos!* To read your secret message or show it to someone else, tap your wand to the paper and say, "I solemnly swear I am up to no good," while holding the paper close to a light bulb.



TALK IT OUT

1. The Marauder's Map in *Harry Potter* works by enchantment, but your map isn't magic – it's science! Why do you think the message appears when you hold it near a light bulb?

✦ Answer: Lemon juice is an organic substance that oxidizes and turns brown when heated. Diluting the lemon juice in water makes it very hard to notice when you apply it the paper; no one will be aware of its presence until it is heated and the secret message is revealed.
2. If you made a map, what was challenging about it? If you wanted to make your map more accurate, what would you do differently next time?

TAKE ACTION!

When we make maps, we are showing other people what is important in our school, community, city, and world. Look up a map of where you live. Does this map include the things that are important to you, or are there landmarks (like your school, doctor's office, or favorite ice cream shop) missing from the map? Print out the map and draw the landmarks that you would add!

Once you know where your landmarks belong, get them added to the world's largest map!

1. On a computer, open Google Maps.
2. Search for the address of your landmarks.
3. Click "Add a missing place" and add as much information as possible. Google will review your submission and hopefully add your important landmarks to our collective map!

Bonus: Instead of (or in addition to) Google Maps, you can also add your landmarks to openstreetmap.org. OpenStreetMap's data supports many independent map apps, so that's one more way to make sure your favorite landmarks are shared around the world!

BUILD A GOLDEN SNITCH CATAPULT

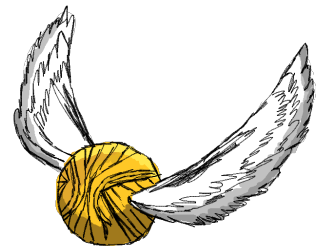
Adapted from science-sparks.com/golden-snitch-catapults

You can't have a trip to Hogwarts without taking in some Quidditch! Practice your Seeker skills by engineering and launching your own Golden Snitch!

Time Required: 20 – 30 minutes

Materials:

- | | | | |
|-------------------|-----------------------|---------------------|----------|
| ✓ Popsicle sticks | ✓ Feathers | ✓ Markers | ✓ Paper |
| ✓ Rubber bands | ✓ Double-sided tape | ✓ Gold glitter glue | ✓ Pencil |
| ✓ Ping pong ball | ✓ Spoon or bottle top | ✓ Tape measure | |



GOLDEN SNITCH CATAPULT INSTRUCTIONS

1. Stack 5 popsicle sticks together and twist a rubber band at each end of the stack until tight. Set aside.
2. Take another two popsicle sticks and secure these at just one end with another rubber band.
3. Wedge the 5-stick stack between these two sticks.
4. Secure the whole lot with another rubber band by looping the rubber band over one side of the stack, twisting it, and then looping over the other side of the stack, and repeating until tight enough. You should end up with an “x” on top.
5. Attach a place for your projectile to sit, such as a spoon or bottle top, to your catapult arm using a rubber band or tape.
6. To make the Golden Snitch, color the ping-pong ball with a marker; then, coat the ball in glitter glue. Once dry, glue two feathers to the sides for wings.



FLIGHT INSTRUCTIONS

1. Once your catapult and snitch are assembled, set your catapult at the “starting line.”
2. Place your snitch on the spoon or bottle top and press down so the arm bends slightly.
3. Release the snitch!
4. Measure the distance between your catapult and where the snitch landed (assuming no one caught the snitch for a game-ending 150 points). Write down the results.
5. Repeat steps 1 – 4 at least two more times (for a total of three times). Write down the results and calculate the average distance traveled by your snitch.
6. Try pressing down with more or less pressure and measuring the distance each time you release the snitch. You can also try changing your catapult design to see if you can make the snitch fly further! Whatever you do, remember to measure and record your findings!

TALK IT OUT

1. What techniques (how much pressure you applied, where you pressed down on the catapult, etc) or design elements (parts of the catapult or the Golden Snitch) helped your snitch fly the furthest?
2. How does a Golden Snitch catapult work?
 - ✎ Answer: Magic, mostly! But also, when you push down on the spoon, the catapult arm bends, giving it potential energy. When the arm is released, the potential energy becomes kinetic energy and is transferred to the Golden Snitch, which flies through the air. The further down the arm is pushed, the more force is used, which gives the arm more energy to transfer to the Golden Snitch - meaning it should travel further and faster.

TAKE ACTION!

Science is one of the most important tools we have for understanding the world and solving some of its biggest problems. Unfortunately, not everyone has access to the tools they need to do great science. Talk to your science teacher – does your classroom have all the supplies it needs? If not, work with your friends and a trusted adult to host a science supply drive, where members of the community can donate whatever supplies are needed to your school!

Making sure everyone has access to great science tools is super important because of one of the biggest issues we face: climate change. We will need a strong community of scientists and supporters to adapt to new weather patterns, bigger storms, and long droughts. What is your community doing to adapt to and prevent climate change? Research what your town or city is doing to reduce its carbon footprint and prepare for weather changes. Want more magical ways that you can help? Visit climatekids.nasa.gov/how-to-help for ideas!

HOGWARTS RESCUE: CALL FOR CODE

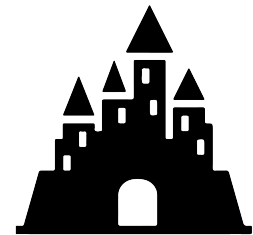
Adapted from littlebinsforlittlehands.com/superhero-computer-coding-game-without-a-computer

Harry is lost on the Hogwarts grounds and he needs your help! Practice the basic concepts of computer coding and explore the Quidditch Pitch, the Great Lake, the Forbidden Forest, and more as you work to find Harry and bring him back to Hogwarts Castle. Muggle technology doesn't work at Hogwarts, so this activity requires no computer.

Time Required: 20 – 60 minutes

Materials:

- ✎ Hogwarts grounds grid (one per person)
- ✎ Character cutouts
- ✎ Command cutouts or Post-It Notes (3 colors)
- ✎ Toy bricks or other obstacles



HOGWARTS RESCUE INSTRUCTIONS

1. Set up your obstacles, start, and goal (Harry) on the Hogwarts grounds grid.
2. Cut out your *commands* and your *characters* (note: you may need multiple copies of the commands to complete the task).

HOGWARTS RESCUE INSTRUCTIONS

3. Set the Hogwarts grounds grid in the middle of a table.
4. Start the game! Write the *code* using the commands (*Forward*, *Turn Right*, and *Turn Left*) by laying each command on the table in front of you one at a time. Your character should navigate (one square at a time) from the starting point to Harry, and lead him safely back to the entrance of Hogwarts while avoiding all obstacles. Move your character one command at a time as you write the code. (You cannot turn and move forward in one command. They are two separate commands.)
5. When you return Harry safely to Hogwarts, you win! Celebrate your victory!
6. Once you've mastered navigating the Hogwarts grounds one command at a time, challenge yourself by writing a longer piece of code. Do not move your character as you go. Plan the commands out in your head and place them all out on the table. Then, move your character through the series of commands and see if you got it right!

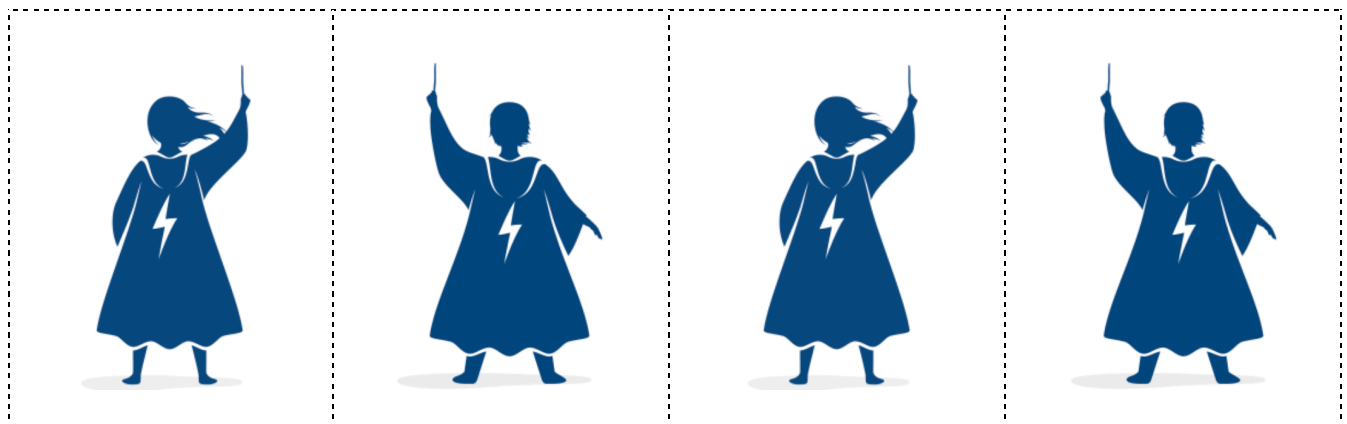
TALK IT OUT

1. What did you enjoy about writing your Hogwarts Rescue code? What was challenging?
2. Why could your character only move one command and one square at a time?
✎ Answer: The code you have written with the commands is an *algorithm*. An algorithm is a detailed, step-by-step instruction set or formula for solving a problem or completing a task. In computing, programmers write algorithms that instruct the computer how to perform a task. Even though the computer works very quickly, it still only reads and executes one command at a time – just like your character can only follow one command at a time.

TAKE ACTION!

Learning to code can open up lots of possibilities for future projects and careers! Does your school have a coding class or club? If not, talk to a teacher about what steps you can take get your school to start one! You can also check out [codecademy.com](https://www.codecademy.com) and [codewars.com](https://www.codewars.com) to get started on your own!

Beyond your school, there are other important steps you can take! Like all things, technology is better when we have a diverse team of people working on it! Check out organizations like Girls Who Code (girlswhocode.com) and Black Girls Code (blackgirlscode.com) and find out how you can become a participant or a supporter.



HOGWARTS RESCUE

START	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD
FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD
FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD	FORWARD
FORWARD	FORWARD	FORWARD	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒
TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒	TURN RIGHT ⇒
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