



Little Leonardo's™ MakerLab: Robots includes a collection of simple hands-on activities for young readers related to robots, robotics, coding, and artificial intelligence. Activities included range from building very simple robots using common household items, to how to create code to make robots learn and perform basic tasks. Also includes a glossary of key terms.

With original Renaissance man *Leonardo da Vinci* as inspiration, the Little Leonardo's™ MakerLab series of books include fun hands-on activities designed to engage children's hands and minds, which helps them better understand and retain the knowledge gained from the activities.



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LITTLE LEONARDO'S™ MakerLab ROBOTS

King ★ Paprocki

GIBBS SMITH

LITTLE LEONARDO'S™ MakerLab ROBOTS

MORE THAN
★ 20 ★
HANDS-ON
ACTIVITIES!



Written by
BART KING

Illustrated by
GREG PAPROCKI

LITTLE LEONARDO'S™

MakerLab ROBOTS



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GIBBS SMITH
TO ENRICH AND INSPIRE HUMANKIND

Leonardo da Vinci (1452-1519) was born in Italy, the son of a gentleman of Florence. He made significant contributions to many different disciplines, including anatomy, botany, geology, astronomy, architecture, paleontology, and cartography.

He is one of the greatest and most influential painters of all time, creating masterpieces such as the *Mona Lisa* and *The Last Supper*. And his imagination led him to create designs for things such as an armored car, scuba gear, a parachute, a revolving bridge, and flying machines. Many of these ideas were so far ahead of their time that they weren't built until centuries later.

He is the original "Renaissance Man" whose genius extended to all five areas of today's STEAM curriculum: Science, Technology, Engineering, the Arts, and Mathematics.

You can find more information on Leonardo da Vinci in *Who Was Leonardo da Vinci?* by Roberta Edwards (Grosset & Dunlap, 2005), *Magic Tree House Fact Tracker: Leonardo da Vinci* by Mary Pope Osborne and Natalie Pope Bryce (Random House, 2009), and *Leonardo da Vinci for Kids: His Life and Ideas* by Janis Herbert (Chicago Review Press, 1998).



MAKE A ROBOT HEAD

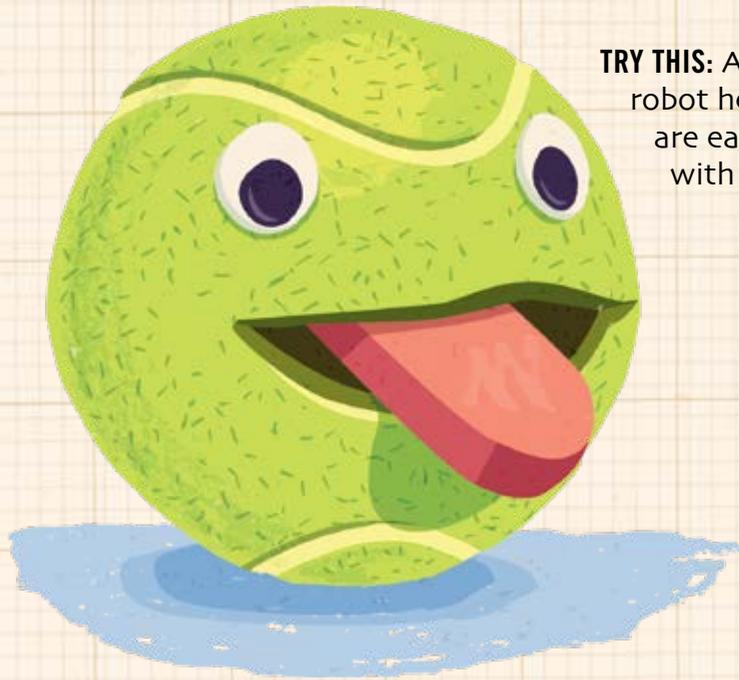
What You Need:

- ✧ An old tennis ball
- ✧ A marker
- ✧ An adult to help
- ✧ An X-Acto knife
- ✧ Gloves
- ✧ A pair of googly eyes (or art supplies to make your own)
- ✧ Other things for decoration

What You Do:

1. Draw a line on the ball with a marker where a mouth will be cut.
2. Ask the adult to put on gloves. Then have them carefully cut through the ball where the line is. (Make sure they cut away from themselves.)
3. Pinch in the sides of your robot head on either side of the mouth and it will open. Stick something in the mouth for fun, like an eraser or a dog toy.
4. Attach the googly eyes. You can also add hair, ears, antennae, or other touches.
5. Save this head for some of the robot projects coming up. You can attach the head to a robot body with things like a suction cup, glue, wire, or tape.

TRY THIS: Another fun idea to use for a robot head is a toilet paper roll. These are easy to decorate and to top off with hair.



MAKE A SCAVENGER ROBOT

If you **scavenge**, you are using things that no one else wants. For this activity go through junk and even trash to find cool robot parts (see Where to Find Things to Tinker With on page 7).

What You Need:

NOTE: This list only includes *some* of the materials you could use. Use your imagination to find other things.

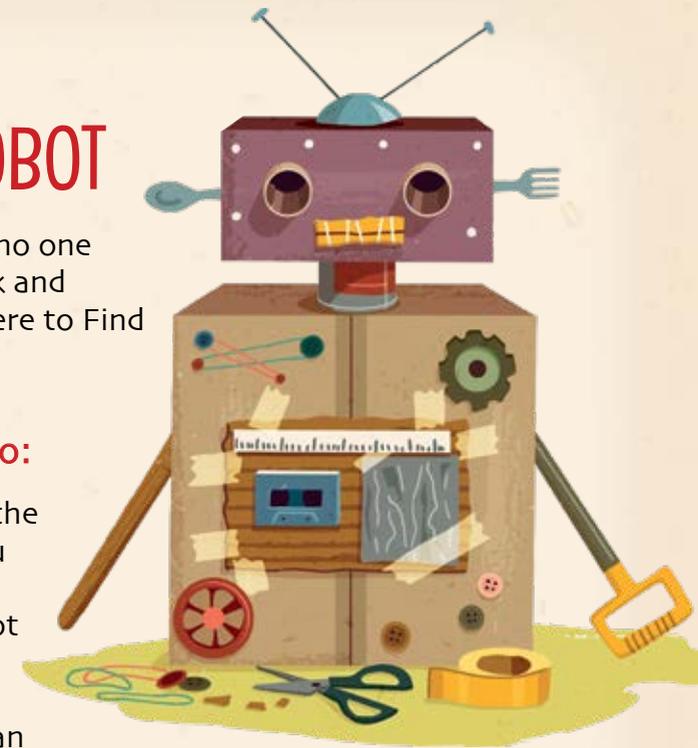
- ✧ Cardboard and other building materials
- ✧ Foil wrap
- ✧ Buttons
- ✧ Clear tape
- ✧ Double-sided mounting tape
- ✧ Scissors
- ✧ Ruler or tape measure
- ✧ White glue
- ✧ Pencil
- ✧ Screwdriver
- ✧ Hole punch
- ✧ Rubber bands
- ✧ String
- ✧ Brass fasteners

What You Do:

1. Remember the drawing you made in the Dream Robot activity on page 4? See if you can make it. Or design a different robot and build that. Don't worry. This robot doesn't have to work. Just try to make a robot that looks like it *could* work.
2. If you're not sure where to begin, start with the head you made from a tennis ball in the Make a Robot Head activity on page 8.
3. Cardboard is a great material for robot parts. Have an adult help you cut out cardboard pieces that match your design.
4. Wrap robot parts in foil to give your robot a metal look.
5. Pizza box cardboard and buttons make a great robot console.

What You Need to Know:

It's hard work making a robot. For example, it took almost 30 years to make the walking robot called ASIMO. So take your time and be patient.



GRAVITY-BOT

This robot also uses the power of gravity . . . but in a different way than the Boat-Bot on page 13.

What You Need:

- ✧ Two 3 x 5 inch index cards
- ✧ A small cardboard box about the same size as the index cards
- ✧ Tape
- ✧ String
- ✧ Foil
- ✧ Hole punch
- ✧ Tape measure
- ✧ Decorations to use for the robot's head, arms, feet, antenna (straws, ribbon, etc.)

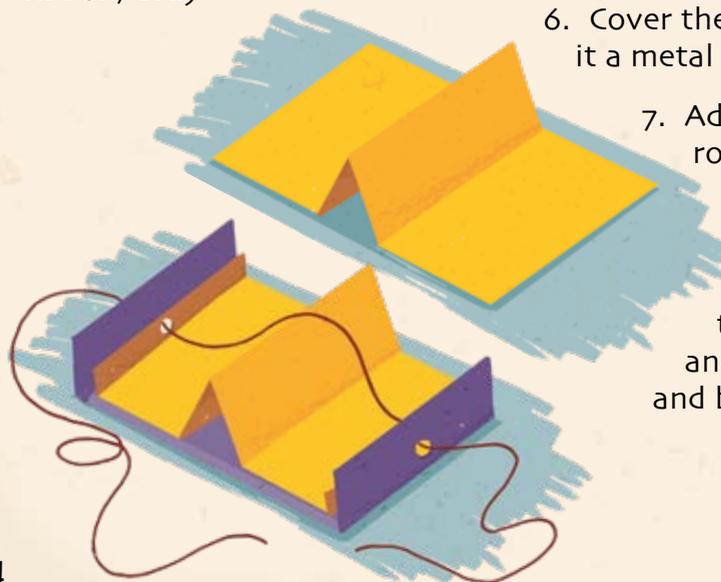
What You Do:

1. Fold one index card so that there's a tent shape in the middle, like in the top picture below.
2. Place the folded card on top of the other index card and tape it there.
3. Fold the ends of the two cards, like in the bottom picture below, so that about ½ inch of the bottom card and a small bit of the top card are folded up.
4. Punch a hole through the taped index cards in the center of each of the two ends you folded up. Make sure the holes go through both the top and bottom cards.
5. Thread about 3 feet of string through both of those holes and *over* the tent shape in the top card, as shown in the bottom picture below. Set these index cards aside.

6. Cover the cardboard box with foil to give it a metal look. This is your robot's body.

7. Add decorations to the box for the robot's head, arms, legs, and any other cool stuff you'd like.

8. Tape the index cards to the back of your robot's body so that the tent shape faces out and the two holes are at the top and bottom.



9. With your completed Gravity-Bot laying flat on a surface, grab the string just above the robot's head with one hand. Hold the other end of the string in your other hand, about a foot below the bottom of the robot.

10. **IMPORTANT:** Stretch the string as tightly as you can by moving your top and bottom hands apart. You'll notice that the string will push hard against the tent part of the index card when you do this.

11. Lift the robot up, holding onto the string with both hands so that the robot's head is on top and its legs are on the bottom. Keep the string tight while you do this.

12. As you hold up the robot, move your two hands a little closer together. That will loosen the tension on the string. The robot should start sliding down the string. Now pull your hands farther apart again, making the string tight. The robot should stop!

13. To start over, move the robot back to the top of the string, pull the string tight, and hold it up again.

14. Turn on some music and see if you can move your robot in time to the music.

What You Need to Know:

When one thing rubs against another, that's **friction**. For example, bicycle brakes usually use the power of friction. If you squeeze a bike's brake handles, the brakes rub against the wheels, slowing them down. When you pull the Gravity-Bot's string tight, friction slows it down. But loosen your hold on the string, and gravity takes over and moves the robot down.



ROBOT DANCER

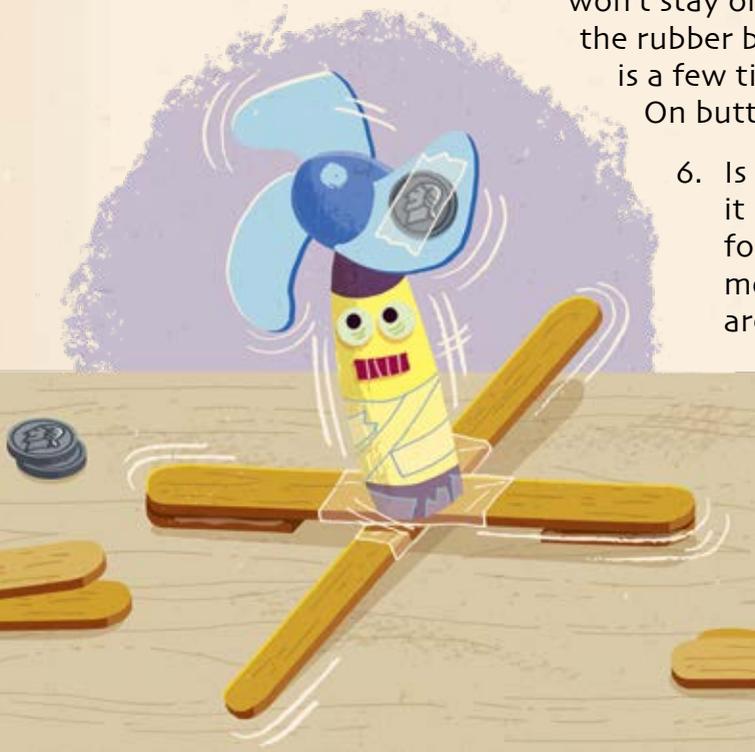
What You Need:

- ✧ 1 cheap battery-operated hand fan (you can find these at dollar stores)
- ✧ 3 Popsicle sticks or craft sticks
- ✧ Strong tape (like duct tape or electrical tape)
- ✧ Some coins (pennies, nickels, or quarters)
- ✧ A rubber band

What You Do:

1. Tape one of the Popsicle sticks across the bottom of the hand fan. Then tape another one across the first stick to form an X, like in the picture below.
2. Break the third Popsicle stick in half, then break one of those halves in half again, creating 2 short pieces of stick. Tape those 2 short pieces onto the bottom of the first stick at each end.
3. You should now be able to set your fan on a table. The X will help it stand up.
4. Tape one of the coins to one of the fan's blades.
5. Now turn on the fan. If the fan's On/Off button won't stay on without you holding it down, wrap the rubber band around the fan where the button is a few times until it's tight enough to hold the On button down when you let go.
6. Is your fan dancing? In other words is it shimmying and wobbling back and forth? If yes, enjoy! If not, try taping more coins to the blade. Or if the blades are made of rubber, try bending one of the blades in half and taping it in place that way.

TRY THIS: If your fan falls over when you turn it on, try taping a smaller coin or something that weighs even less than a coin to one of the blades.



ART-BOT

What You Need:

- ✧ 3 markers (they should be different colors)
 - ✧ Scotch tape
 - ✧ A Styrofoam or light plastic cup
 - ✧ An electric toothbrush
 - ✧ Paper
 - ✧ A table or flat surface
 - ✧ A box lid or cookie sheet
4. Tape a piece of paper to a table, or to the inside of a large box lid or the bottom of a cookie sheet to keep your Art-Bot from falling off the edge of the table.
 5. Take the caps off the markers.
 6. Place the Art-Bot on the paper with the marker tips down.

What You Do:

1. Make sure the caps are on your markers. With the cup right side up, tape the markers to the outside of the cup an equal distance from each other with the caps at the top. The top end of the caps should extend just past the top lip of the cup.
2. Turn the cup over and set it on a flat surface. The cup should be resting evenly on the tops of the 3 marker caps.
3. Now place the electric toothbrush across the bottom of the cup so that the On/Off button is on top. Move the toothbrush back and forth until it seems balanced on top of the cup. Then tape it in place.
7. Turn on the toothbrush. The cup should start to move around on the paper, drawing an amazing work of art.
8. If your Art-Bot isn't working, try moving where the markers are taped to the cup. Or try unscrewing the brush part of the toothbrush and removing it. That will make it easier to balance the toothbrush on top of the cup.



CODING: SPEAKING THE ROBOT'S LANGUAGE

Imagine a special pencil. You can only use this pencil to *copy* things. The pencil won't work if you try to write your own words with it. You can only copy someone else's words. And you can't draw a picture with it unless you're *tracing* another picture. What a lousy pencil!

That's how many people use computers and robots. They use apps and programs written by someone else. That can be fun. But it's not creative.

So what if *you* could tell a robot what to do? A real robot has a computer inside of it. The computer is the robot's brain. And inside of that computer are many instructions. These instructions are called the computer's code. **Code** is language for computers.

When you write code, you're a **coder**. You are telling the computer what to do. Computers are very good at following instructions. But you have to write *good* instructions. Think about what makes good instructions and the better at coding you will become. For example, if you wanted a robot to feed your dog, you wouldn't just tell it to:



1. Pick up the dog's bowl.
2. Put dog food in the bowl.
3. Set the bowl on the ground.

With these instructions the robot might walk through a wall to get to the bowl. Then it could put just *one* kernel of food in the bowl. And the robot might put the bowl in someone else's front yard. So for this chore the robot's instructions would need many more steps.

Computer code is like a recipe. If you want a robot to make a cake, you have to list all the things you need to make the cake. Then you list all the steps needed to prepare it. Like this:

What You Need:

- ✧ 1 cup sugar
- ✧ ½ cup butter
- ✧ 2 eggs
- ✧ 1½ cups flour
- ✧ 2 teaspoons baking powder
- ✧ ½ cup milk

What You Do:

1. Preheat the oven to 350°F.
2. Mix the sugar and butter together in a bowl.
3. When that mixture is creamy, mix in the eggs.
4. Add the flour and baking powder. Mix well.
5. Stir in the milk until the mixture is smooth.
6. Pour the mixture into a pan.
7. Bake for 35 minutes in the oven.



HUMAN ROBOT: DRAWING

What You Need:

- ✧ One other person as your partner
- ✧ A table or desk
- ✧ Paper and a pencil

What You Do:

1. Sit down at a table or desk with some paper and a pencil. You will be a *robot* and your partner will be a *coder*, who will give you instructions.
2. The coder should think of an object or animal for the robot to draw, but don't tell the robot what it is.
3. Now tell the robot *how* to draw it using clear instructions. For example, "Draw a straight line from left to right" is okay to say. "Draw the roof of a house" isn't.
4. *No cheating.* If the coder wants the robot to draw a dog, for instance, they can't just say, "Draw a nice wolf."
5. The robot can't ask questions. It can only follow the coder's instructions. If the robot makes a mistake, it can only erase something if the coder tells it to.
6. When you finish the picture, see if you can guess the object or animal the coder was thinking of.

HUMAN ROBOT: MOVING

What You Need:

- ✧ One other person as your partner
- ✧ A room with a door and a chair or something else to sit on

What You Do:

1. You'll be the robot first. Sit down and don't move until the coder instructs you.
2. The coder's job is to give the robot clear instructions using only 5 commands:
 - *Stand*
 - *Turn left*
 - *Stop*
 - *Go*
 - *Turn right*

3. The coder gives the robot a series of clear instructions to get up and leave the room. The robot will follow each of these instructions so long as they include at least one of the 5 commands listed above. If the coder says something like *Go a little bit* or *Turn left some more*, remember that all the robot can understand are *Go* and *Turn left*.

4. The robot will need to decide exactly what the instructions mean. For example, does *Go* mean to just take one step? Or does it mean to keep going until you run into something?
5. Once the robot has successfully left the room, switch roles with your partner. Try doing this again in your new roles.

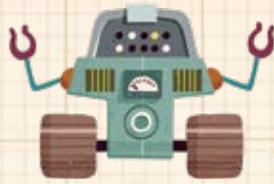
GENIUS VERSION: Add a new action for the coder to instruct the robot to do. For example, what if the door to the room is closed? For the robot to open the door *and* leave the room you'll need a lot more commands:

- *Stand*
- *Move right hand up*
- *Move right hand to the left*
- *Rotate right hand counter-clockwise*
- *Stop*
- *Move right hand down*
- *Open right hand*
- *Move right hand backward*
- *Turn right*
- *Turn left*
- *Close right hand*
- *Rotate right hand clockwise*
- *Go*
- *Move right hand to the right*
- *Push*
- *Move right hand forward*
- *Pull*

DOUBLE-GENIUS VERSION: For this version, the robot is blindfolded. So in addition to a robot and coder, you'll also need an adult to act as a safety monitor. The adult should make sure there are no dangerous objects or hazards that could hurt someone walking around blindfolded. If the coder sees that the robot is about to run into something, say *Stop*.



GLOSSARY



ANDROID (ANN-droyd): A robot that looks and acts like a human. Also called a DROID.

CAPACITOR (cup-PASS-uh-tur): A device used to store electricity.

CODE: A language that provides instructions to a computer.

CODER (CO-dur): Someone who writes computer code using a programming language.

DECISION FLOWCHART (dis-IJ-unn FLOW-chart): A diagram that provides a step-by-step guide for making a decision.

DRONE: A small remote-controlled aircraft that flies without a pilot.

FRICION (FRICK-shun): The force created by two objects touching or rubbing against each other when one or both of them is moving.

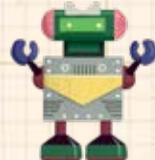
GRAVITY (GRAV-uh-tee): A force that causes objects anywhere in the universe to naturally move toward one other, like making things appear to "fall" toward the surface of Earth.

HTML (aitch-tee-em-ell): A computer code used for designing websites.

INDEPENDENT ROBOT (in-duh-PEN-dunt ROW-bot): A robot that can move and think on its own.

JAVA (JAW-vuh): A computer code used to design Android apps.

LEVER (LEV-urr): A strong bar or other support that helps to lift and move something heavy.



MAGNETISM (MAG-nuh-tis-um): A force that can pull closer or push away objects that have a magnetic material like iron inside them.

MECHANICAL POWER (muh-CAN-ick-ull POW-ur): The rate of work done by a mechanical device, such as the amount of HORSEPOWER generated by an engine.

MOBILE ROBOT (MOW-bull ROW-bot): A robot that can move around.

POWER: Energy used to operate machines, lights, and other devices. The energy can come from various sources, such as water, wind, the sun, or electricity.

PROGRAMMED ROBOT (PRO-grammed ROW-bot): A robot that does the same job over and over.

PULLEY (PULL-lee): A wheel or set of wheels used with a rope or chain to help lift heavy objects.

PYTHON (PIE-thawn): A computer code used in ROBOTICS.

REMOTE-CONTROLLED ROBOT (re-MOAT cun-TROLLED ROW-bot): A robot that's controlled from a distance by a human.

ROBOTICS (row-BOT-icks): The study of how to design, build, and operate robots.

ROBOTICS CLUB: A club where kids work together on fun robot projects.

SCAVENGE (SKAA-vunj): To look for something useful anywhere you can find it.

SCRATCH: A computer code designed for beginners.

SWIFT: A computer code used to design apps for the iPad and iPhone.

TINKER (TING-ker): Someone who likes to build things and figure out how they're put together.

ALSO AVAILABLE

LITTLE LEONARDO'S MAKERLAB: SPACE

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Perfectly timed to capitalize on the makerspaces trend, *Little Leonardo's MakerLab: Space* activities range from building a simple model to illustrate the vast scope of our solar system to a demonstration of the speed of light. The activities are designed to engage both the readers' hands and minds, which helps them better understand and retain the knowledge gained from the activities. Inspiring ideas for young readers interested in astronauts, outer space, rockets, space exploration, and astronomy.

BART KING taught middle school for many years. He's written 28 books, including *The Big Book of Girl Stuff*, *The Big Book of Boy Stuff*, *The Big Book of Superheroes*, *The Big Book of Gross Stuff*, and *Bart's King-Sized Book of Fun*. Bart's Gibbs Smith titles have sold more than 830,000 copies combined. He lives in Portland, Oregon.

2019 is the 50th anniversary of the Apollo 11 moon landing

