Build an Obstacle-Avoiding Robot (BlueBot Project #4)

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p028/robotics/obstacle-avoiding-robot (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p028/robotics/obstacle-avoiding-robot)

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Experimental Procedure

Note: This engineering project is best described by the **engineering design process,** as opposed to the **scientific method.** You might want to ask your teacher whether it's acceptable to follow the engineering design process for your project before you begin. You can learn more about the engineering design process in the Science Buddies Engineering Design Process Guide (http://www.sciencebuddies.org/engineering-design-process/engineering-design-process-steps.shtml).

Assembling Your BlueBot Chassis

1. Follow the instructions in the video to assemble your robot chassis.
    a. Your kit comes with printed directions for assembling the chassis, but we recommend watching the video so you fully understand how all the parts fit together.
    b. The blue plastic parts come with a thin layer of protective plastic coating. Peel this coating off before assembling your chassis.
    c. We also recommend using double-sided foam tape to attach the battery holder to the top of the chassis, as shown in Figure 4. The printed directions recommend putting the battery holder in-between the two chassis plates, but this makes it harder to change the batteries.
    d. You will have some extra parts when you are done, including screws, nuts, and blue plastic gears. Put these parts aside for now; you will not need them for this project.

https://www.youtube.com/watch?v=SBeGl_IgWwY (https://www.youtube.com/watch?v=SBeGl_IgWwY)

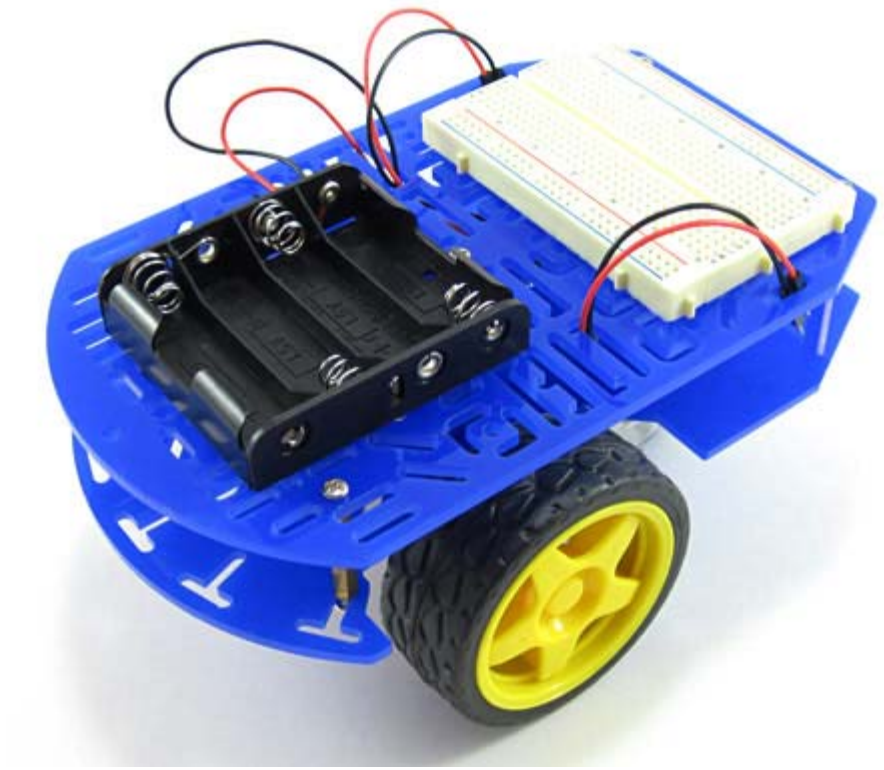


Figure 4. A completed BlueBot chassis with breadboard and battery pack on top.

Assembling Your Circuit

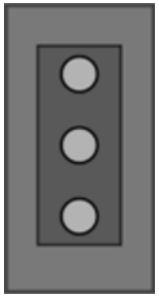
1. To build your circuit, you will need to know how to use a breadboard. Watch the video and see the Science Buddies reference How to Use a Breadboard (http://www.sciencebuddies.org/science-fair-projects/references/how-to-use-a-breadboard).

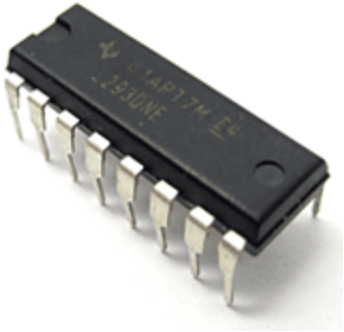
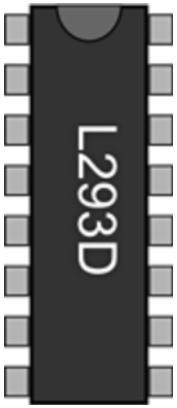
   https://www.youtube.com/watch?v=6WReFkfrUIk (https://www.youtube.com/watch?v=6WReFkfrUIk)

2. Now that you know how to use a breadboard, you are ready to assemble your BlueBot circuit. Table 2 shows a list of all the components in the circuit and where they go on the breadboard. You can download and print a PDF (http://www.sciencebuddies.org/science-fair-projects/test-checklist-Robotics_p028.pdf) of this table—complete with checkboxes to track each step—to use while you are building your robot. You can also view a slideshow (#breadboard-slideshow) that shows breadboard diagrams of the circuit. Follow along in the table and/or slideshow to build your circuit one component at a time. Your finished circuit should look like the one in Figure 5 (#figure5). Pay attention to these notes:
   a. Remember to push all components *firmly* into the breadboard.
   b. All references to orientation (up, down, left, and right) assume you have the breadboard "right-side up," so the writing is facing you.
   c. Your jumper wire kit comes with an assortment of colors, and the colors may vary. It does not matter what color jumper wires you use. Your colors do *not* need to match the colors in the diagrams. In general, you should use the shortest wires possible, to help keep your circuit neat.
   d. Your lever switches act as bump sensors, so they need to be mounted on the *front* of your robot, not on the breadboard. You also need to attach popsicle

sticks to the levers to extend the robot's "whiskers." See Figures 6 and 7 for instructions on how to mount the lever switches to your robot's chassis.

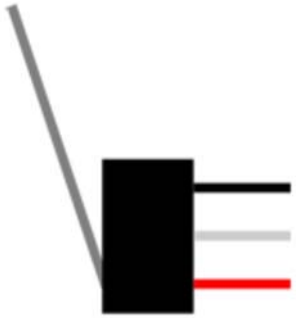
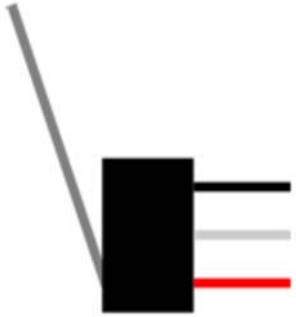
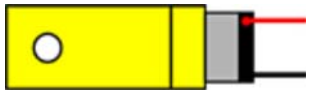
e. Insert the batteries *last*. If you see or smell smoke when you insert the batteries, you have a short circuit somewhere. Immediately remove the batteries and re-check your wiring.

Component	Picture	Symbol	Breadboard holes	Note
Power switch			F1, F2, F3	The direction in which it is facing does not matter, but make sure to slide the switch down (toward row 30, away from row 1), this is the "off" position.
Jumper wire			J2 to (+) bus	Color does not matter.
Jumper wire			Left side (+) bus to right side (+) bus	Color does not matter.
Jumper wire			Left side (-) bus to right side (-) bus	Color does not matter.

Component	Picture	Symbol	Breadboard holes	Note
H-bridge motor driver			Left side: holes E15 to E22 Right side: holes F15 to F22	The semi-circular "notch" in one end of the chip must face up (towards row 15). You may need to bend the pins together slightly to get them to fit into the breadboard. Note: the writing on your H-bridge might not match the picture exactly. This is OK.
10 kΩ resistor			J16 to (-) bus	Brown, black, orange, gold stripes. Direction does not matter.
10 kΩ resistor			J21 to (-) bus	Brown, black, orange, gold stripes. Direction does not matter.
10 kΩ resistor			A16 to (-) bus	Brown, black, orange, gold stripes. Direction does not matter.

Component	Picture	Symbol	Breadboard holes	Note
10 kΩ resistor			A21 to (-) bus	Brown, black, orange, gold stripes. Direction does not matter.
Jumper wire			J15 to (+) bus	Color does not matter.
Jumper wire			J18 to (-) bus	Color does not matter.
Jumper wire			J19 to (-) bus	Color does not matter.

Component	Picture	Symbol	Breadboard holes	Note
Jumper wire			J22 to (+) bus	Color does not matter.
Jumper wire			A15 to (+) bus	Color does not matter.
Jumper wire			A18 to (-) bus	Color does not matter.
Jumper wire			A19 to (-) bus	Color does not matter.

Component	Picture	Symbol	Breadboard holes	Note
Jumper wire			A22 to (+) bus	Color does not matter.
Top lever switch			Red wire to (+) bus Black wire to B21 White wire to B16	See Figures 6 and 7 for mounting instructions.
Bottom lever switch			Red wire to (+) bus Black wire to I21 White wire to I16	See Figures 6 and 7 for mounting instructions.
Top motor			Red lead to C17 Black lead to C20	When the robot is driving forward, this is the "right" motor.

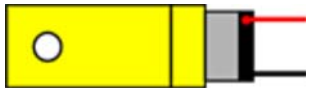
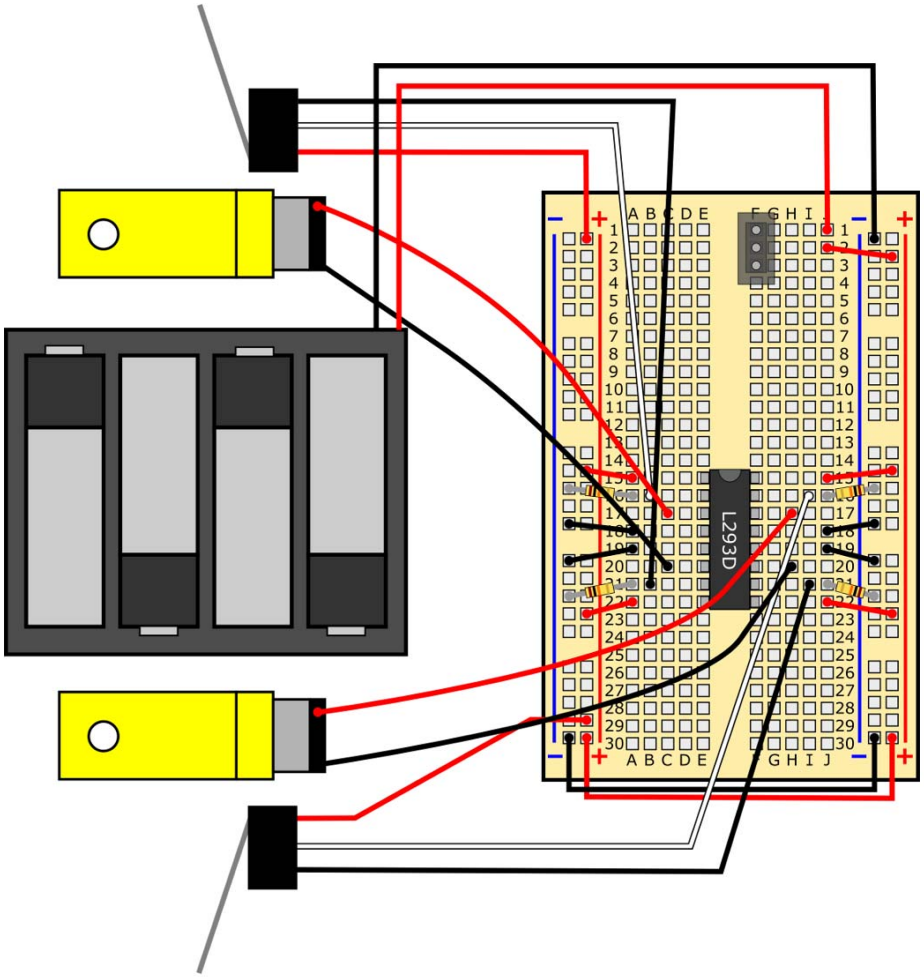
Component	Picture	Symbol	Breadboard holes	Note
Bottom motor			Red lead to H17 Black lead to H20	When the robot is driving forward, this is the "left" motor.
Battery holder			Red lead to J1 Black lead to (-) bus	Do not insert batteries until circuit is complete.
AA battery			N/A	Insert into battery holder. Make sure (+) signs on batteries line up with (+) signs in battery holder.

Table 2. List of circuit components and locations. A printable PDF version (http://www.sciencebuddies.org/science-fair-projects/test-checklist-Robotics_p028.pdf) is available.



Slideshow with step-by-step instructions viewable online.

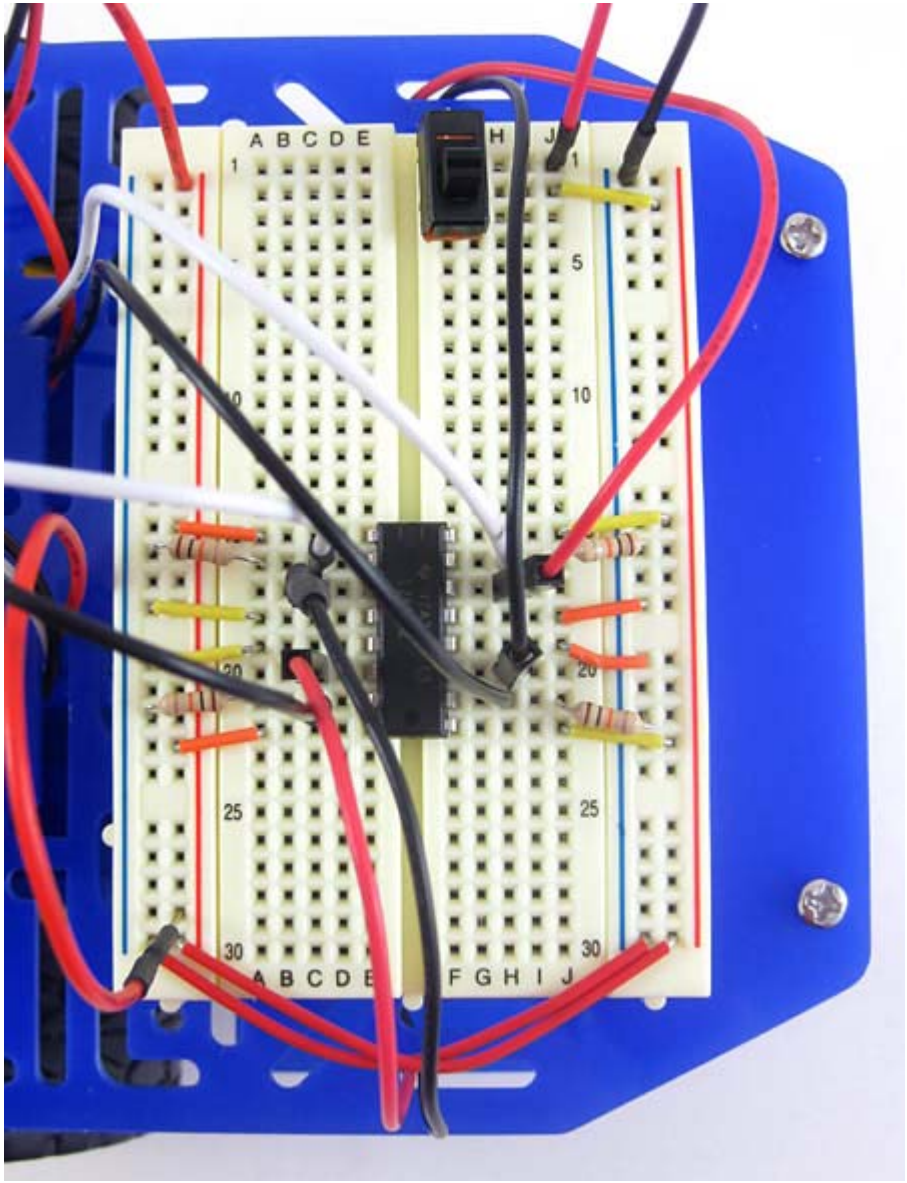


Figure 5. Your completed circuit should look like this.

3. Use double-sided foam tape to attach the lever switches to the front of your robot, and to attach popsicle sticks to the lever switches, as shown in Figures 6 and 7.

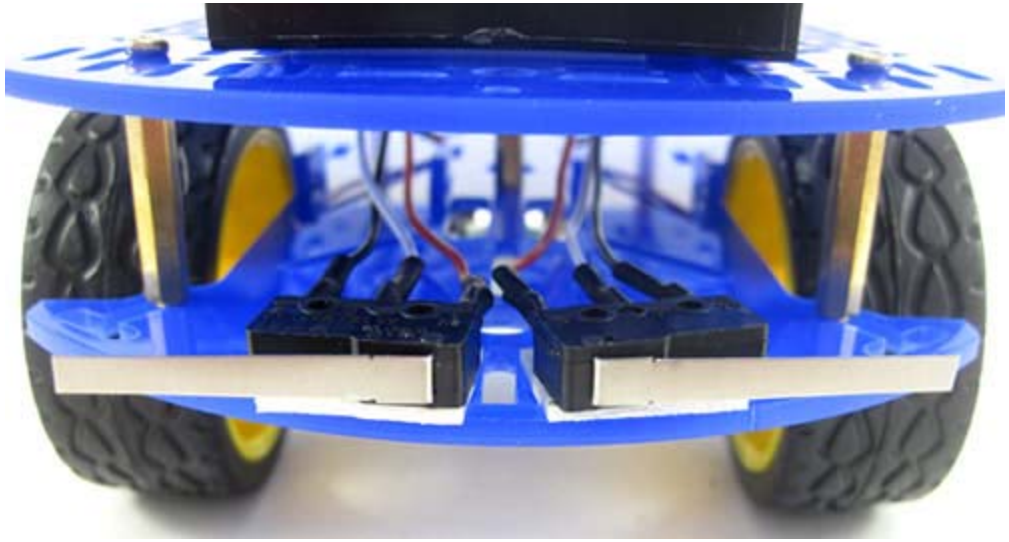


Figure 6. Use double-sided foam tape to mount the lever switches to the front of your robot. You can decide exactly where you want to put the switches; for example, whether you attach them to the top or bottom plate of the chassis. Note that you might end up adjusting them later.

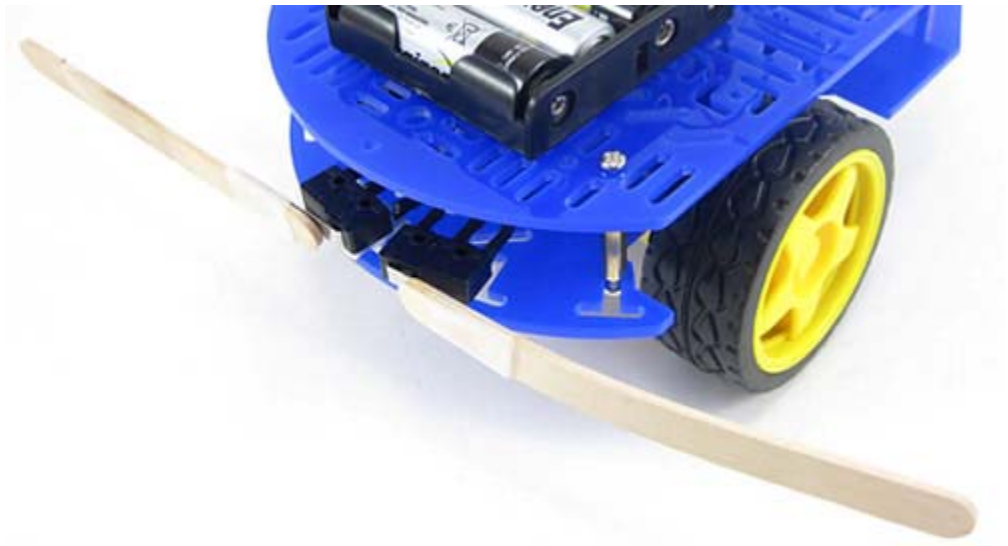


Figure 7. Use tape to attach popsicle sticks to the metal arms of the lever switches to act as "whiskers."

Testing Your Robot

You are finally ready to start testing your robot! Remember that now you will need to follow the The Engineering Design Process (http://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps) to get your robot working. Follow these steps to learn how to use your robot.

1. Double-check your circuit against the breadboard diagrams in the previous section. Remember that just *one* misplaced wire can prevent the circuit from working properly.
2. Hold the robot's chassis in one hand, so the wheels are off the ground.
    a. Turn the robot's power switch "on" by sliding it up, toward row 1 on the breadboard.
    b. Your robot's wheels should start spinning forward. If you press down on the popsicle stick attached to either lever switch, that should cause the wheel on the opposite side of the robot to spin backward. Check Table 3 to see what you should do next.

Observation	What to do
I see or smell smoke.	Immediately turn your robot off. You have a short circuit somewhere. Recheck your wiring against the breadboard diagrams in the previous section.
Each wheel spins forward when I turn the robot on, and each wheel goes in reverse when I press the lever switch on the opposite side of the robot.	Your robot works! Move on to the next step.
One or both wheels spin backwards when I turn the robot on.	If a wheel is spinning backwards, reverse the red and black wires of that motor. See the Help (#help) section for more details.
The wheels spin when I turn the robot on, but do not change direction when I press the lever switches.	You have an error in your circuit somewhere. Re-check your circuit against the breadboard diagrams in the previous section. Remember that just one misplaced wire can prevent your circuit from working.
Pressing a lever switch causes the wheel on the *same* side of the robot to switch direction.	You have your two motors *or* your two lever switches' wires reversed. Swap *one* set of connections, but not both (for example, take the motor wires that are plugged in to the right side of your breadboard and switch them with the motor wires on the left side of your breadboard).
The wheels do not spin at all when I turn the robot on.	See the Help (#help) section for troubleshooting information.

Table 3. Troubleshooting procedure for the first time you turn on your robot.

3. Once you have your robot's circuit working, try putting it down on the floor and aiming it toward a wall at about a 45 degree angle. The robot should drive toward the wall, touch the wall with one of its "whiskers," then turn away and keep driving. You can also try putting your hand or foot in front of the robot's whiskers as it drives around, forcing it to turn.
4. Your robot might not work perfectly; sometimes it might get stuck or fail to turn. This is where the engineering design process really comes into play. Think about what you can do to improve your robot. Here are some suggestions to get you started:
    a. Do the popsicle sticks come loose or fall off? Is the connection between the popsicle sticks and the lever switches sturdy enough?
    b. What happens if you change the position or angle of the lever switches? Is it better for the "whiskers" to be pointing straight out to the side, or angled slightly forward or backward?
    c. What happens if your robot drives *straight* into an obstacle, without hitting either whisker? Can you think of a way to fix this?
5. Once you have your robot working, see if you can get it to navigate a more complicated "obstacle course" or maze. Can it automatically bounce off several

obstacles and keep driving without getting stuck? Can you let it drive around a room in your house or school and just bounce off the existing furniture and walls? How long can it drive before it gets stuck? What other improvements could you make to help prevent the robot from getting stuck?

Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at https://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p028/robotics/obstacle-avoiding-robot#help (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p028/robotics/obstacle-avoiding-robot#help).