Build a Light-Tracking Bristlebot

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p012/robotics/build-a-light-tracking-bristlebot (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p012/robotics/build-a-light-tracking-bristlebot)

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Experimental Procedure

Assembling Your Robot's Body

Follow the steps in this slideshow to build your robot's body. Make sure you read the captions below each image for important notes about each step. You can also watch a video (https://youtu.be/avESoUJhREA) that shows how to assemble the robot.

Slideshow Images

1. Cut the heads off two toothbrushes with *slanted* bristles.

2. Do *not* use toothbrushes with straight bristles for this project, or your robot will not work.

3. Peel the paper backing off the bottom of the breadboard to expose the sticky tape.
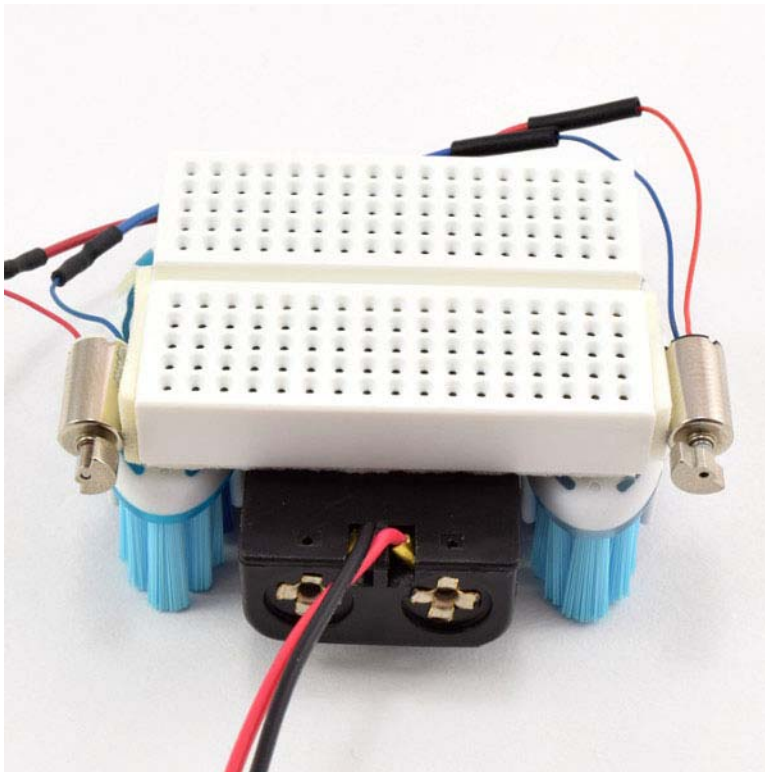
4. Mount the battery holder to the sticky tape, as shown. Make sure it is centered on the breadboard.

5. Insert the AAA batteries into the battery holder. Press the flat ends of the batteries up against the metal springs.

6. Attach the two toothbrush heads on either side of the battery holder. Make sure to mount them symmetrically.

7. Attach the two vibration motors to the sides of the breadboard using double-sided foam tape. Make sure the small weights on the motors can spin freely and not get stuck.

End of Slideshow Images

Assembling Your Robot's Circuit

If you have never used a breadboard before, you should refer to the Science Buddies resource How to Use a Breadboard (http://www.sciencebuddies.org/science-fair-projects /references/how-to-use-a-breadboard) before you continue.

Build the circuit on your robot's breadboard by following along with the slideshow. Make sure you read the captions below each image for important notes about each step. You can also skip to this part of the video (https://youtu.be/avESoUJhREA?t=6m55s) to see the circuit assembly steps.
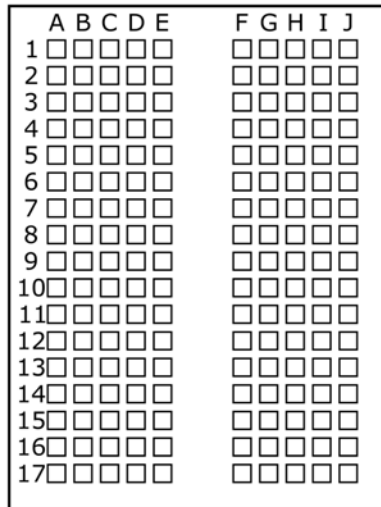
Slideshow Images
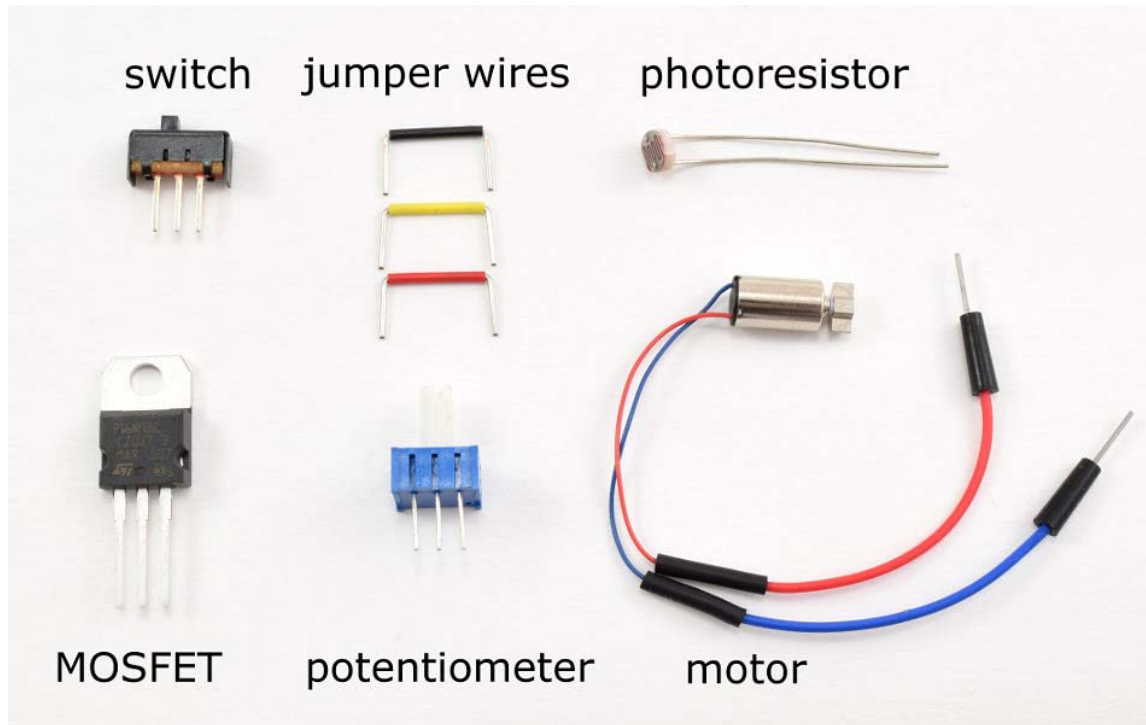
1. Identify these parts in your bristlebot kit.
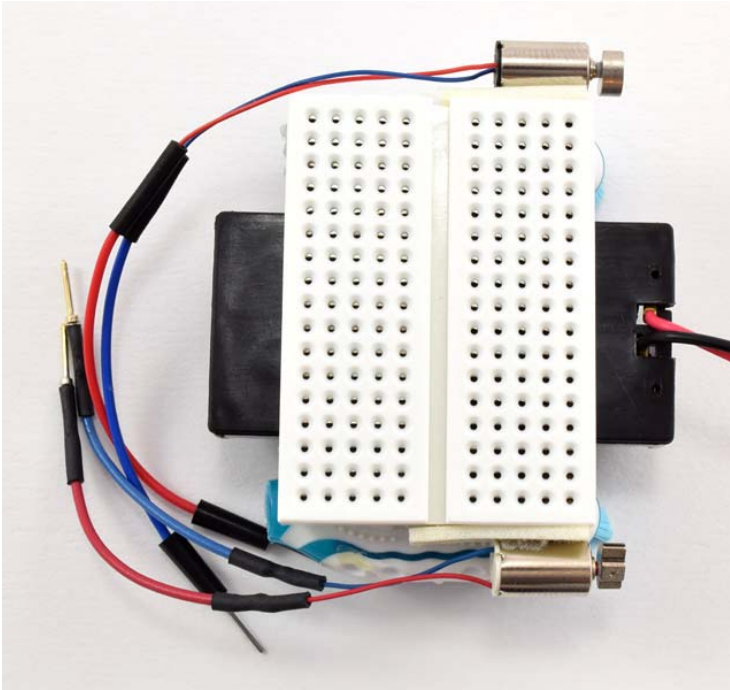
2. Orient your robot's body so the battery pack wires are facing to your right.
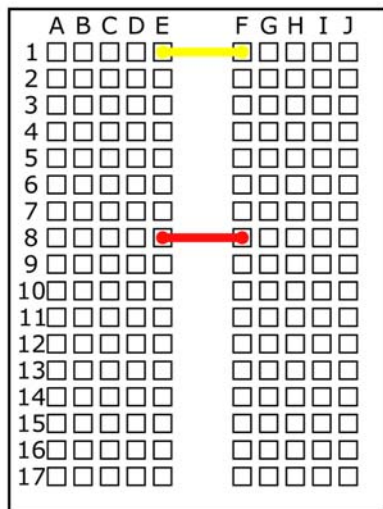

3. Some of the jumper wires in your kit might be longer than necessary. Bend them into U-shapes, as needed, to fit them into the breadboard.
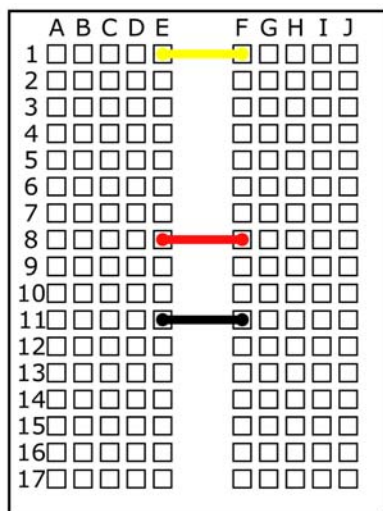
4. Your breadboard does not have row and column labels printed on it. The diagram has labels for reference, but you will need to count the holes on your breadboard.
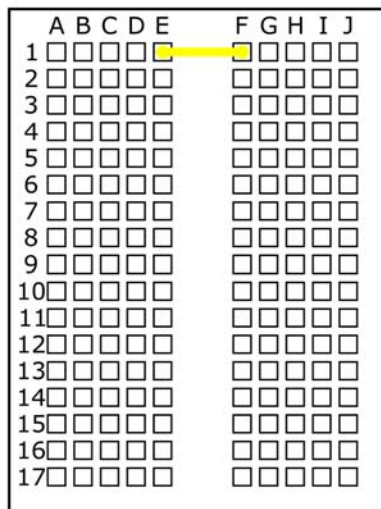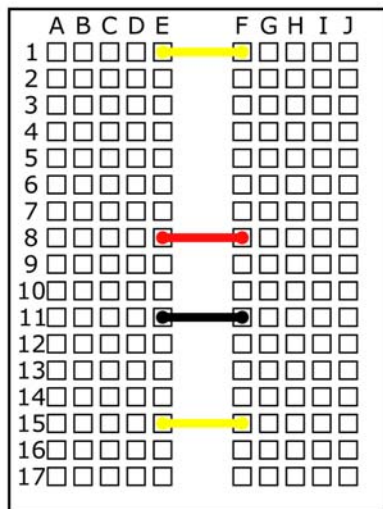

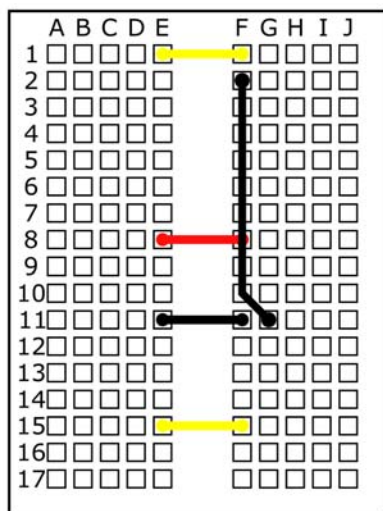5. Connect the short yellow jumper wire from E1 to F1.

6. Connect the short red jumper wire from E8 to F8.

7. Connect the short black jumper wire from E11 to F11.

8. Connect the short yellow jumper wire from E15 to F15.

9. Connect the long black jumper wire from F2 to G11. Bend this wire slightly to the right to make room for the power switch later.
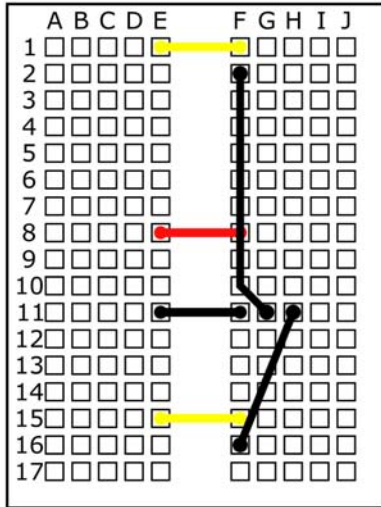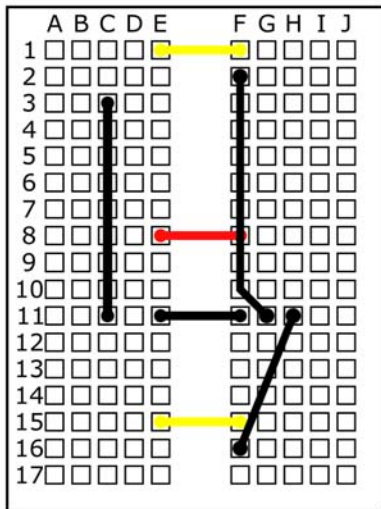
10. Connect the medium black jumper wire from H11 to F16.

11. Connect the long black jumper wire from C3 to C11.
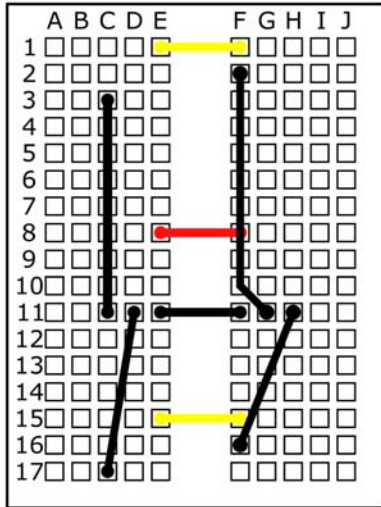
12. Connect the medium black jumper wire from D11 to C17.
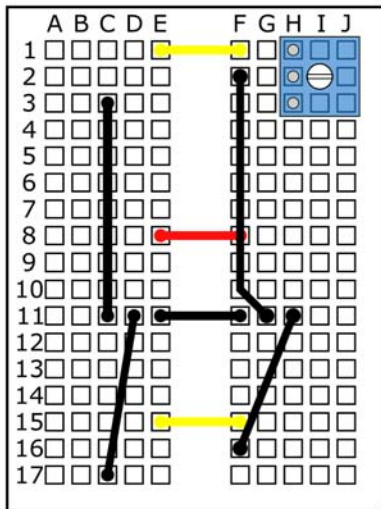
13. Insert a potentiometer's pins into H1, H2, and H3.
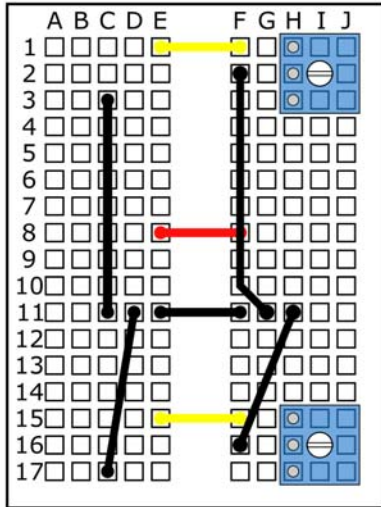
14. Insert a potentiometer's pins into H15, H16, and H17.
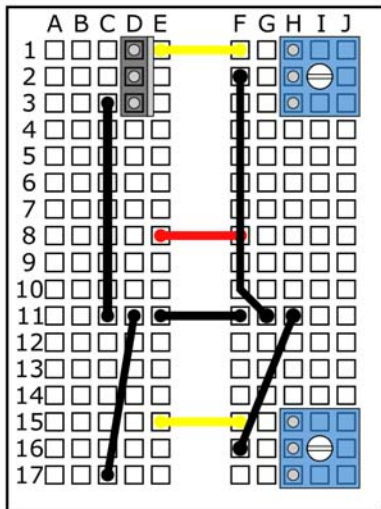
15. Insert the MOSFET's pins into D1, D2, and D3. The text on the MOSFET must face to your left; the large metal tab must face to your right.

16. Insert the MOSFET's pins into D15, D16, and D17. The text on the MOSFET must face to your left; the large metal tab must face to your right.

17. Insert the photoresistor's leads into A1 and A8. Direction does not matter.
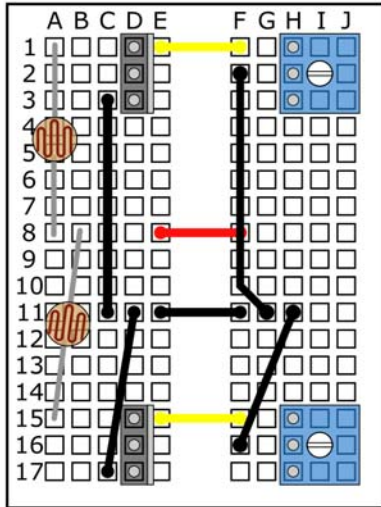
18. Insert the photoresistor's leads into B8 and A15. Direction does not matter.
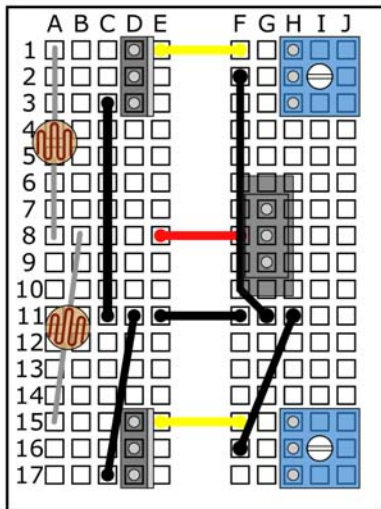
19. Insert the power switch's pins into G7, G8, and G9. Direction of switch does not matter. Slide the switch down toward row 17 of the breadboard (this is the 'off' position).
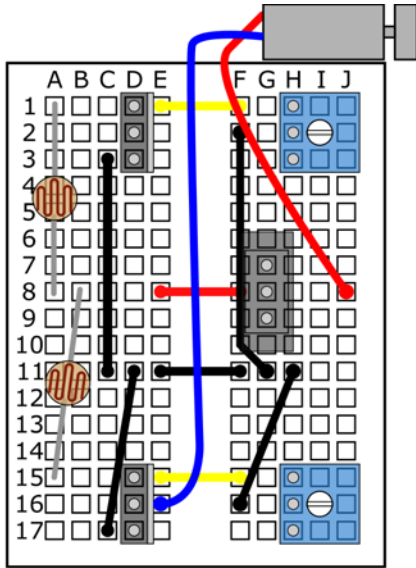
20. Connect the top motor's red lead to J8 and the blue lead to E16.

21. Connect the bottom motor's red lead to I8 and the blue lead to E2.

22. Connect the battery pack's red lead to J7 and the black lead to J11.

End of Slideshow Images

Testing Your Robot

To learn how to use your robot, you can watch this video (https://youtu.be/zd5auiUpoMk), or follow the steps below. If you run into trouble and your robot does not work as described, the video also includes troubleshooting information, and you can check out the FAQ (#help) section of this project.
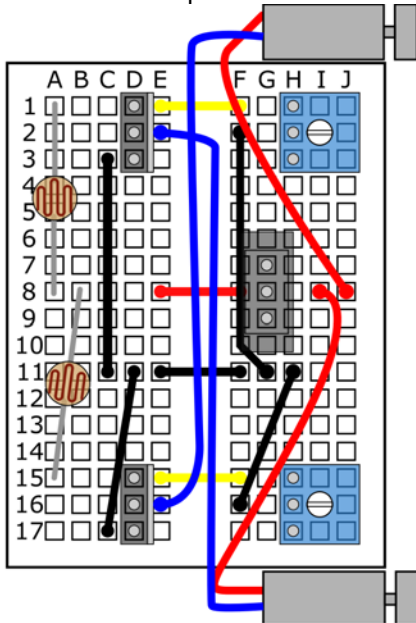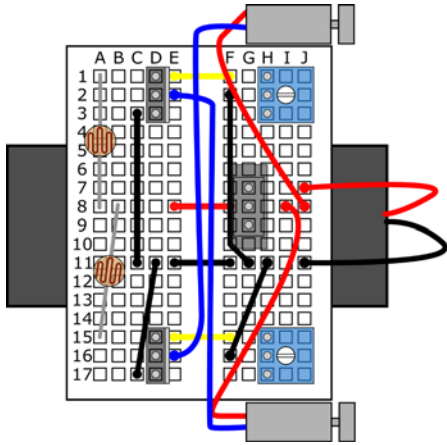
1. Make sure you slide your robot's power switch down toward row 17 when holding the robot, as shown in the circuit assembly slideshow. This is the "off" position.
2. Bend the photoresistors' leads so they face up, outward, and slightly away from each other. The photoresistors sense light and help your robot steer left and right. If they are directly next to each other, they will have trouble sensing different amounts of light.
3. Turn the white knobs on both of your potentiometers all the way counter-clockwise.
4. Turn the robot on by sliding the power switch up.
5. *Slowly* start turning one of the potentiometers clockwise. You should eventually see one of the motors start to spin, and feel and hear the robot vibrate. Make sure your hands are not blocking light to the photoresistors when you do this.
6. Turn the potentiometer back down until the robot *just* stops vibrating.
7. Repeat steps 5–6 with the other potentiometer.
8. You have just set the robot's sensitivity to light slightly below the ambient light levels in the room (for more details on how this works, see this question in the FAQ (#question8)). That means that the motors will only spin if they are exposed to *brighter* light. You can test this by holding the robot directly up to a lamp.
9. Now, if you aim a flashlight directly at the robot's photoresistors (not at the ground in front of the robot), it should move, and you should be able to steer it left and right by aiming at only one photoresistor at a time.
10. Practice steering your robot around with a flashlight. It might not work perfectly at first, and may require some tinkering on your part. If your robot has trouble steering:
    a. Try adjusting the aim of the photoresistors. Make sure they are not too close together or it will be difficult to make the robot steer left and right; or too far apart or it will be difficult to make the robot go straight.
    b. Try adjusting the potentiometers to change the robot's sensitivity to light.
    c. If your robot has severe steering problems (for example, it will only turn sharply to one side), make sure the toothbrushes are mounted symmetrically.

d. If your robot does not work at all (does not respond to changes in light, or moves all the time regardless of light), there is probably something wrong with your circuit. See the FAQ (#help) section for help.
11. Slide the power switch back to the "off" position to save battery power when you are not using your robot.

Using Your Robot in a Science Fair Project

If you want to enter your robot in a science fair, just building it might not be enough. How could you use your robot to do an experiment? Here are a few ideas:

- Build a maze or obstacle course for your robot and challenge people to guide the robot through it using a flashlight. Is there a learning curve to operating the robot? Do people complete the maze faster on subsequent runs?
- Measure how fast the robot moves when exposed to different intensities of light.
- Measure how fast the robot moves on different surfaces.
- Measure how fast the robot moves or how easy it is to steer with different types of toothbrushes for feet. Be very careful when peeling toothbrush heads off the bottom of the breadboard, as this can ruin the sticky tape if you do it too quickly.
- If you have access to a multimeter, use it to measure the resistance of the potentiometers. How do they affect the robot's speed when exposed to a constant source of light? How does the threshold at which the motors start spinning change?

Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at https://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p012/robotics/build-a-light-tracking-bristlebot#help (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Robotics_p012/robotics/build-a-light-tracking-bristlebot#help).

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