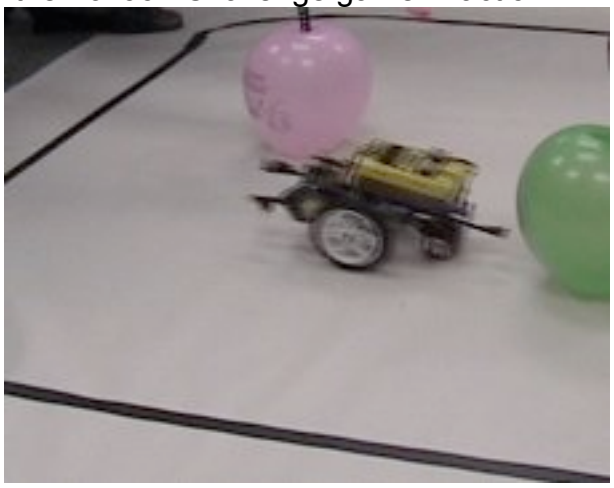
Lego Robot Tutorials
Light Sensors

Light Sensors for Robot Games

In this activity, you will use a light sensor to play a balloon popping game. Go to the Web site to see the Balloon Challenge game in action!



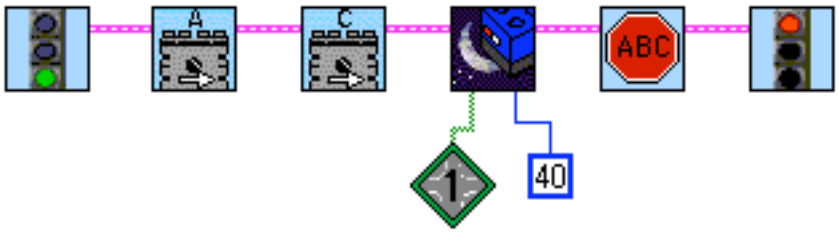
Before starting this activity, you should Build a Robot and know how to Program Your Robot to Move.

The Light Sensor

You use the light sensor to tell light from dark. The light sensor measures the brightness of a single spot as a number between 1 and 100. "1" is the darkest, and "100" is the brightest. Light sensors connect to one of the three input ports numbered 1, 2, and 3 on the RCX.

Wait for Dark

Suppose you want your robot to go forward until it reaches a black line on the surface, then stop. You can use a light sensor and the **Wait for Dark**  function to do this:

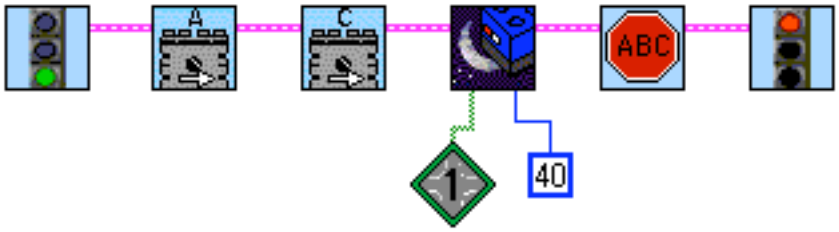


The part in the box means: wait until the light sensor on input  reads a value less than  . Then the program goes to the next step, **Stop All Motors.**

It's the program that waits, not the robot. To find **Wait for Dark**  , click **Wait For**  on the Functions palette.

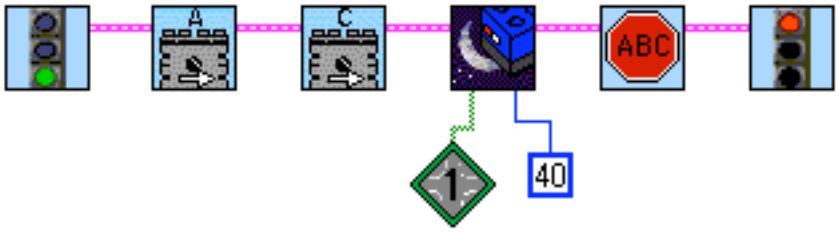
Wait for Dark

Try reading the whole program step by step and telling what it does:



Go to the Web site for a possible answer.

Set the Input Port



Our program has two *modifiers* below Wait for Dark  . Modifiers change the action of a function. The Input 1  modifier says read the light sensor connected to input 1 on the RCX. You could also tell it to read from input 2 or 3.

To find the modifiers, click **Modifiers**  on the Function palette.

Set the Cutoff Brightness

The **Numeric Constant**  tells **Wait for Dark**  to wait until the light sensor reads less than 40. This is called the cutoff brightness. Numeric Constants are also on the Modifiers  palette.

To change the number, use Window => Show Tools Palette to bring up the Tools Palette, then select the Edit Text tool. Or you can click the Tab key until the cursor turns into a vertical bar. Click in the box and type the number.

Measure the Light Levels

How do you know that  is the right number for the cutoff brightness? Actually, you don't know, you have to measure it. For best results, the cutoff brightness should be set to half way between the brightness of the lighter background and the black line.

1. Download your light sensor program and run it. This tells the RCX that a light sensor is connected port 1, or whatever port you choose.

2. With the program not running but the RCX on, press the View button until the caret ^ is under port 1. The RCX now displays the brightness value being read on port 1.

Measure the Light Levels

3. Place the robot so the light sensor is over the light background. Write down the value shown on the RCX display. In the picture, it reads 53.

4. Place the light sensor over the black tape and write down the brightness value. Let's say it is 35.

5. Add the light and dark values together, then divide by 2. In this case, 53 + 35= 88, 88 / 2 = 44. You can use the calculator program on your computer.

6. Enter the result (in this example 44) into the box for the cutoff brightness.

Light Sensor Tips

Notice the small light source built into the light. This provides light when pointed down at a surface.

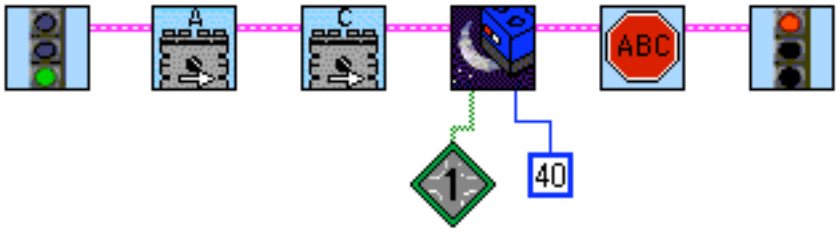
TV camera lights, camera flashes, sunlight, and overhead lights can affect the light sensor in competitions. To reduce these effects, place the light sensor 1/8" - 1/4" from the surface. In this range the built in light is brighter than other lights, so other lights have less effect.

Always check measure the light levels with the View button before a competition, and set the cutoff brightness. The room lights may be quite different at a competition than at your club.

For further protection, place your light sensor under the middle of the robot.

Challenge 1: Stop on the Black Line

Enter our sample program into RoboLab:



Download the program to your robot. Make sure the light sensor is plugged into input 1.

Place your robot in the middle of the Test Pad that comes with the Lego Robotic Invention System. It has a black oval on a white background. Run your robot. Does it stop on the black line?

TIP: Measure the light levels and set the cutoff brightness to the best value.

Challenge 2: Back and Forth

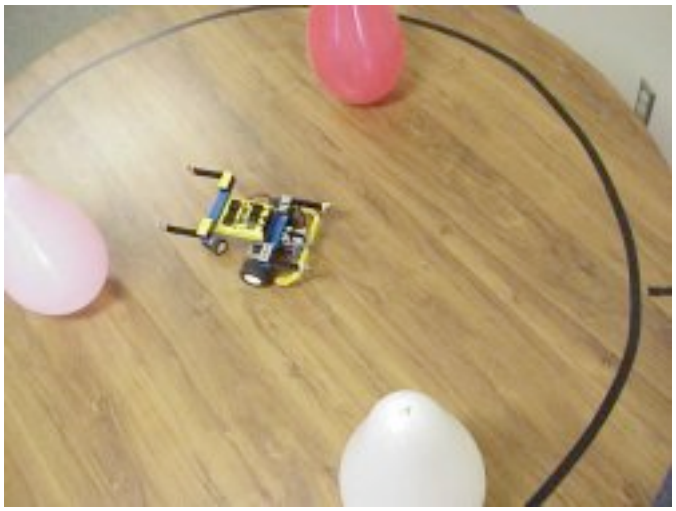
Write a program that makes your robot go back and forth between two black lines in an endless loop. Test your robot on the test pad that comes with the robot kit. Does it stay inside the black oval?

Tip: Use loops for repeated action.

Tip: Check out the Flip Direction function  . It's on the main page of the Functions Palette. *Context Help* will tell you how to use it.

Challenge 3: Balloon Challenge

Now you are ready for a real robot game! Your objective is to pop all the balloons inside the boundary in the shortest time. At least part of your robot must stay inside the boundary.



Picture by ChanJin Chung and Joe Engalan

The Balloon Challenge movie and complete rules for Balloon Challenge are on the Web site.

TIP: Use the light sensor to detect the black tape that marks the boundary, then turn your robot so it stays inside the boundary. Don't try to detect the balloons with the light sensor.