BPS BusBoard Prototype Systems

KIT #1

Junior Genius KITS

Blinky Lights

Instruction & Knowledge Guide

Junior Genius KITS

Blinky Lights

Build electronic circuits to learn how LEDs and transistors work.

Includes 24 parts plus a power box, wires, batteries and a BB400 BreadBoard!

Table of Contents

Introduction

Electronics is a fantastic hobby. A basic understanding of electricity is helpful for anybody, and it opens the door to thousands of fun projects. This kit has several circuits to get you started with the basic building blocks of electronics.

A breadboard is a great way to experiment with electronic circuits. Parts are simply plugged in to connect them together to make circuits. The parts can be easily unplugged to make changes allowing quick fixes and experimentation. You can take the circuit apart and rebuild it into something completely new; it's the Lego® of electronics.

This kit will show you how to use a breadboard by building a few simple circuits that show how the breadboard connections work. It will also introduce you some basic electronic parts and how they work.

This kit is designed for students in grades 5 and higher, however younger kids can often complete the circuits (sometimes with parental help, and sometimes they help the parents!).

Helpful Instruction
Each activity has clear and detailed steps with colorful diagrams to help.

What's Happening?
A behind-the-scenes look into each activity explaining what is happening, complete with electronic schematics.

Things To Try
Take the activity further with extra experimentation ideas and questions to solidify what you have learned.

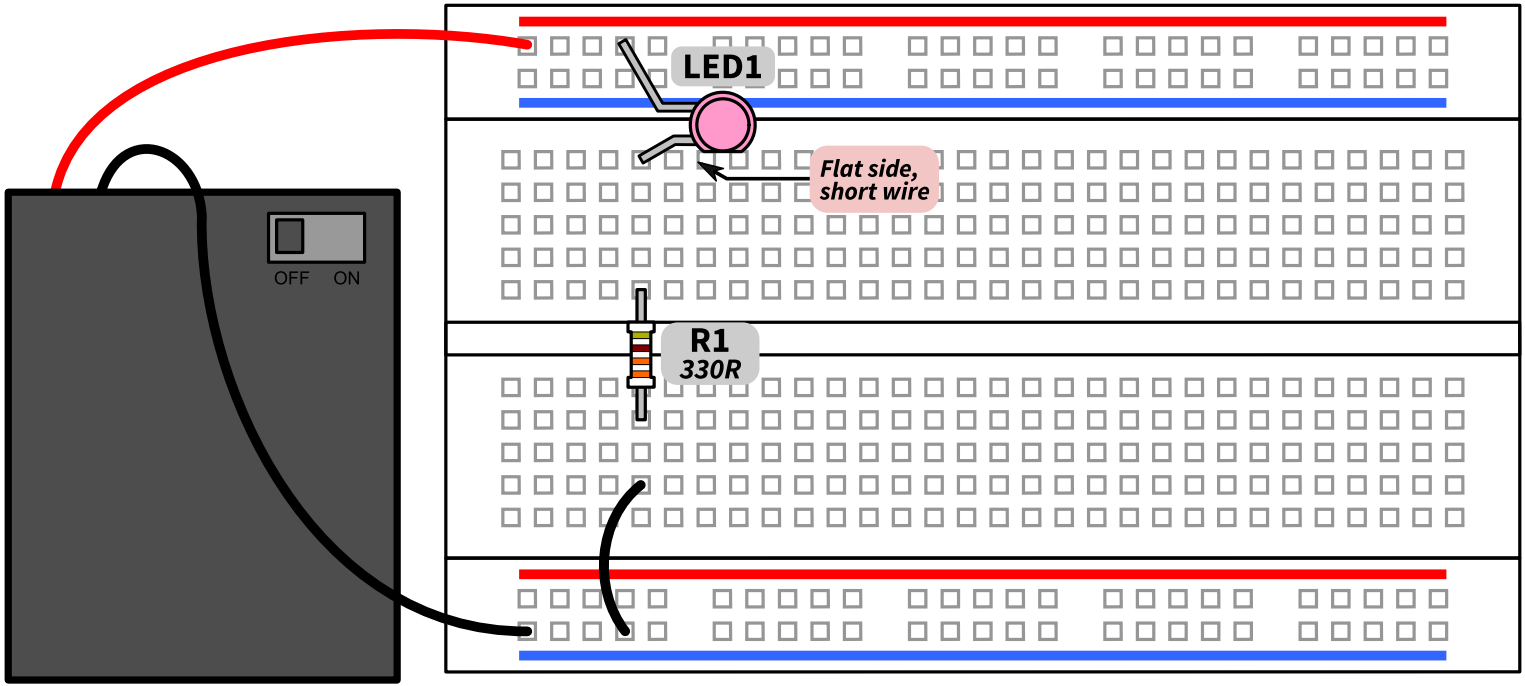
Did You Know?
Additional interesting and little-known information related to electronics and electricity.

Troubleshooting Tips
Helpful suggestions to get your circuits working if you run into a problem.

Online Resources
More explanations, diagrams and experiments to further your knowledge and discovery of electronics.

Activity # 1 - Single LED Circuit

Build your first circuit with one LED, a resistor and a wire.



Instructions

1) Place the breadboard so that the red positive (+) power rail is at the top

2) Connect the Battery Box *(Power switch OFF)*
The red wire on the battery box is positive power. The black wire is negative power *(also called the ground wire)*.

Place the battery box to the left of the breadboard. Plug the red wire into the positive (+) power rail at the top. Plug the black wire into the negative (-) ground rail at the bottom.

Color Coding in Electronics

In electronics, color coding is used to help avoid wiring errors. Usually red colored wire is used for the positive power, and black wire for negative (ground) connections.

3) Install the LED 
Plug in the LED with the round side *(long wire)* in the positive (+) power rail at the top and the flat side *(short wire)* into a hole in the circuit area below.

NOTE: Place the LED close to the left side of the breadboard to keep room for later activities.

4) Install the 330 ohm resistor 
Find the resistor with orange-orange-brown-gold stripes. Plug one resistor wire into the same column as the LED flat side *(short wire)*. Plug the other resistor wire into the lower circuit area.

5) Install the black jumper wire
Plug one end into the same column as the resistor in the lower circuit area. Plug the other end of the wire into the negative (-) rail.

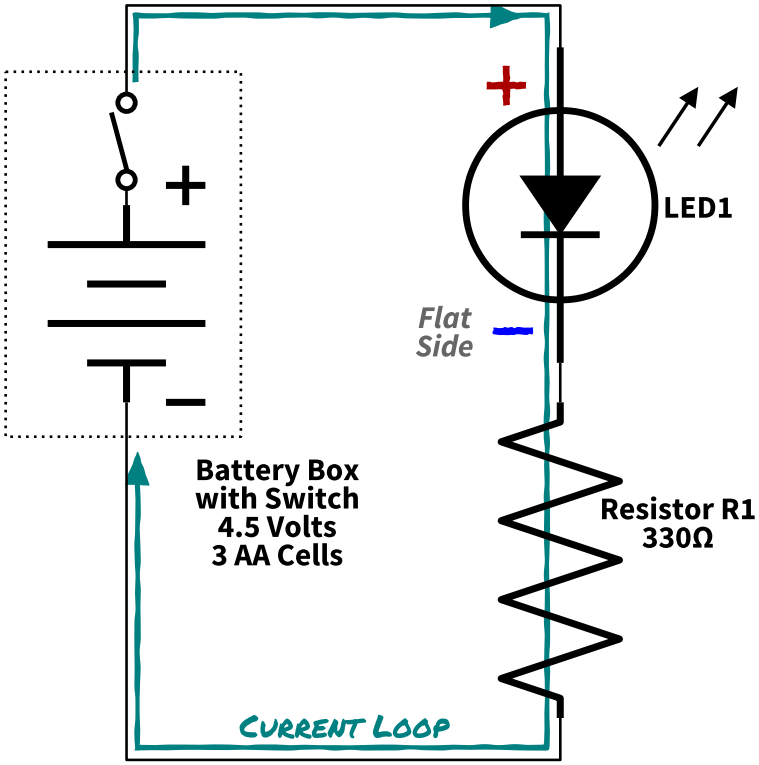
6) Turn on the battery box
Move the battery box switch to the "ON" position. The LED will turn on.

Troubleshooting

If the LED does not turn on, please check the following:

- Check all your connections. Check that two parts that are supposed to be connected are plugged into the same column or into the same power rail.
- Check that the correct resistor value was used.
- Check that the LED isn't backwards.
- Check that the battery red wire and the LED round side (long wire) are both connected to the same positive (+) power rail.
- Check that the black wire and the battery box black wire are both connected to the same negative (-) power rail.
- Check that the batteries are inserted into the battery box correctly and that they have a charge and are not dead.

What's Happening?



Electric current always flows in loops. You have created a loop from the battery box, to the LED, to the resistor, and back to the battery box.

Electric current flows through the LED causing it to light up when the switch is on.

The schematic diagram to the left shows the symbols for the batteries, switch, LED and resistor. You can see on the schematic that the electric current flows in a closed loop.

Why do we need a resistor?

The LED circuit needs a resistor. An LED will burn out if there is too much current going through it. The job of the resistor is to slow down the flow of electric current to control the brightness and to protect the LED.

Additional Online Resources

Scan the QR code or enter the URL into your web browser to access additional content related to this activity.

www.jrgkit.com/101

Things To Try!

1) Move the power switch on the battery box back and forth to make the LED flash.

2) With the LED already on, unplug one end of the black wire. The LED will turn off because the loop is broken. You have made the wire act like a switch. Tap the wire pin in the hole to make the LED flash.

3) Move the bottom end of the black jumper wire to different places in the negative (-) power rail, the other rails, and the circuit area. Which places cause the LED to light and which places don't?

4) Move the top end of the black jumper wire to different places in the circuit area. Which are the four holes that are connected to the resistor wire hole?

5) Tap the red power wire in the positive (+) power rail hole to make the LED flash.

Why the letter R?

Often the character R is used instead of the Ω symbol when writing resistor values. A 100Ω resistor value can be written as 100R. Sometimes the R is used instead of a decimal place for small resistances, so 1.5Ω is written as 1R5. Replacing the tiny decimal point with an R helps ensure the wrong value isn't accidentally read on diagrams

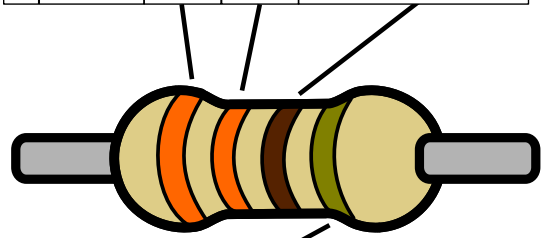
Things To Try Explanations & Answers

2) The LED will turn off because the electrical current loop is broken. You have made the wire act like a switch.

3) This shows you which holes are connected to the negative (-) power rail. The LED will only light up when the black jumper wire is inserted into the negative (-) power rail.

4) Only the holes in the same column as the resistor wire are connected. Holes to the left and right are on their own connection strips.

Color	Digit 1	Digit 2	Multiplier (# of Zeroes)
Black	0	0	0 (x 1 ohm)
Brown	1	1	1 (x 10 ohms)
Red	2	2	2 (x 100 ohms)
Orange	3	3	3 (x 1,000 ohms)
Yellow	4	4	4 (x 10,000 ohms)
Green	5	5	5 (x 100,000 ohms)
Blue	6	6	6 (x 1,000,000 ohms)
Violet	7	7	*not common*
Grey	8	8	*not common*
White	9	9	*not common*



Color	Tolerance	Notes
Gold	5%	Usual for 1/4 Watt resistors
Brown	1%	Has 3 value stripes, 5 total
Red	2%	Has 3 value stripes, 5 total
Silver	10%	*not common*
None	20%	*not common*

Resistor Wattage

Through hole resistors come in different sizes according to how much power they can dissipate: 1/8 Watt, ¼ Watt, ½ Watt, 1 Watt and larger sizes are available.

You can use the power formulas in the math section to determine how much heat a resistor will generate, and then use one with more than double the wattage. It is best to have a 2x safety factor (or more). We avoid operating parts close to their rated wattage, voltage, or current in order to have more reliable circuits. Parts fail more often when they are stressed close to their limits.

Appendix #2 - Units

Unit Multipliers

Some very big and very small units are used in electronics. To make the numbers easier to use, prefixes are used to indicate a multiple or fraction of a unit.

Prefixes to make units bigger

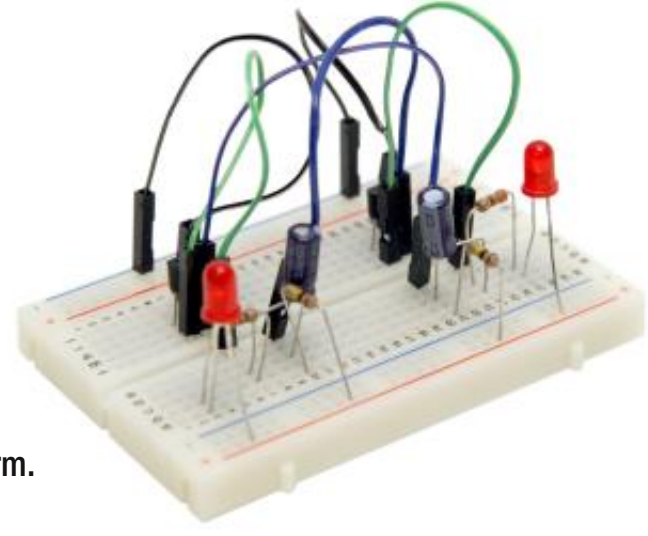
Prefix	*Abbreviation*	*Multiplier*
Tera	T	10^{12} (x 1,000,000,000,000)
Giga	G	10^{9} (x 1,000,000,000)
Mega	M	10^{6} (x 1,000,000)
kilo	k	10^{3} (x 1,000)

Thank you for using our Blinky Lights kit!

Send us your feedback and suggestions!

What parts did you enjoy? What things did you find difficult? What would you change to improve the kit? Have ideas for our future kits and expansions? We want to hear it all!

Tell us what you thought of our first electronics kit.
Visit our website and fill out our Blinky Lights feedback form.



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