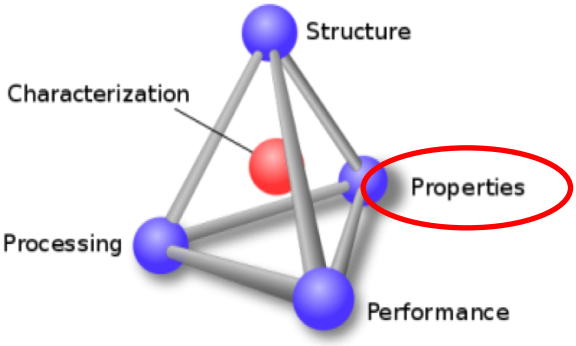
Conductivity

You Will Be Able To:

Create simple and complex circuits using conductive ink.

Pre-lab Questions:

1) Electrical conductivity fits in the properties category of the tetrahedron. Please explain why it fits in the properties category.



2) What type of bonding does each material have? What do the materials with high electrical conductivity (higher than $2x10^6$ S/m) have in common? Why do you think that type of bonding is related to high electrical conductivity?

5.96×10^7 S/m
Copper

3.87×10^7 S/m
Aluminum

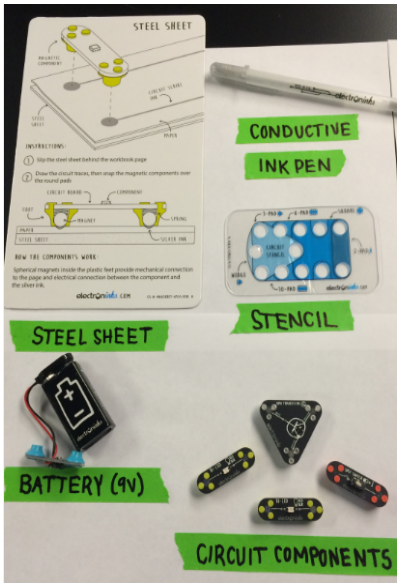
2.4×10^6 S/m
Titanium Alloy

$\sim10^{-11}$ S/m
Silica

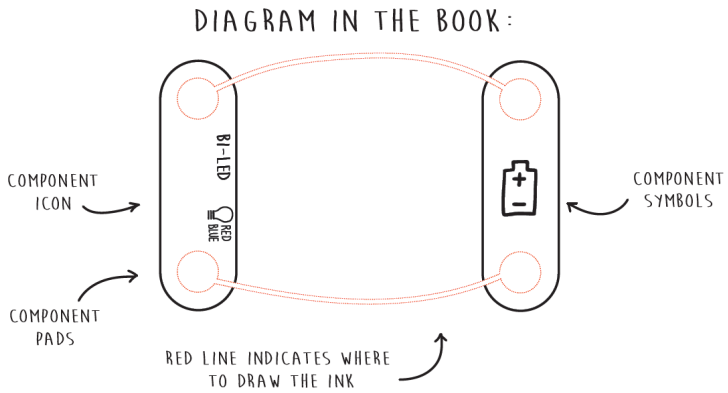
10^{-14} S/m
Polystyrene

Conductivity

What you need:



Practice drawing a circuit:

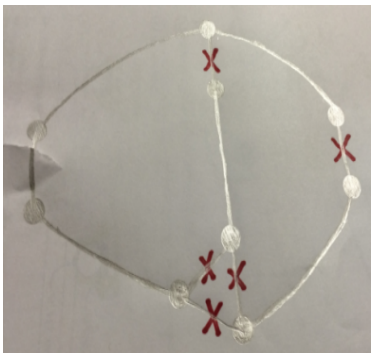


Use the conductive ink pen to draw thick lines between the circuit elements and completely fill in the circles. This allows the electrons to flow freely and make the circuit work.

*****Ask a TA to check your work before going onto the activities. See section below for dealing with problems.*****

My circuit does not work. What do I do?

1) Too many lines:



Electrons **prefer** the path with the smallest resistance

If you draw a line between two circles, the current will flow through the silver ink rather than the circuit, creating what's called a **short circuit**.

2) Not enough ink:

Electrons will not flow through a circuit unless there is a **continuous path**.

If you don't make the lines thick enough, the electrons cannot move forward and no current will flow.

Make sure your lines connecting circuit elements are thick and have lots of ink on them. Double check the circles contacting your elements also have enough ink. Not enough ink causes an **open circuit**.

3) Didn't use stencil:

Using the stencil to draw the circles in the correct locations will make your circuit work better. Use the stencil to draw the circles for the BI-LED and NPN Transistor.

Basic Activity 1: Conductivity Detector

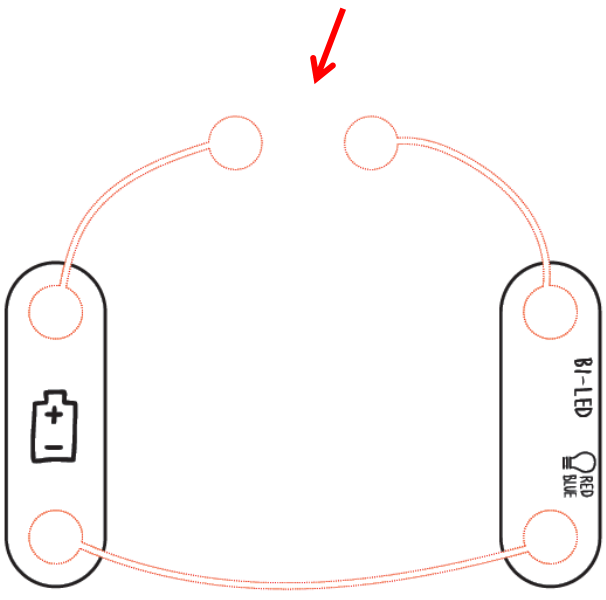
The basic circuit:

Using the figure to the right, draw the circuit on a piece of paper using the silver ink. Place the paper over the steel sheet and place your circuit elements on the paper. The components should snap to the steel sheet.

Use the objects on your table to complete the circuit.

Which one creates the brightest light on the LED? The dimmest light?

Make sure you have this gap!



What happens if you use your fingers to complete the circuit? Why do you think this happens?

Concept check:

If you drew a line between the two circles and then placed objects over the gap as before, what do you think would happen and why?

Discuss with your neighbors. When ready, call a TA/Instructor over and explain your answer to get the NPN transistor for the next activity.

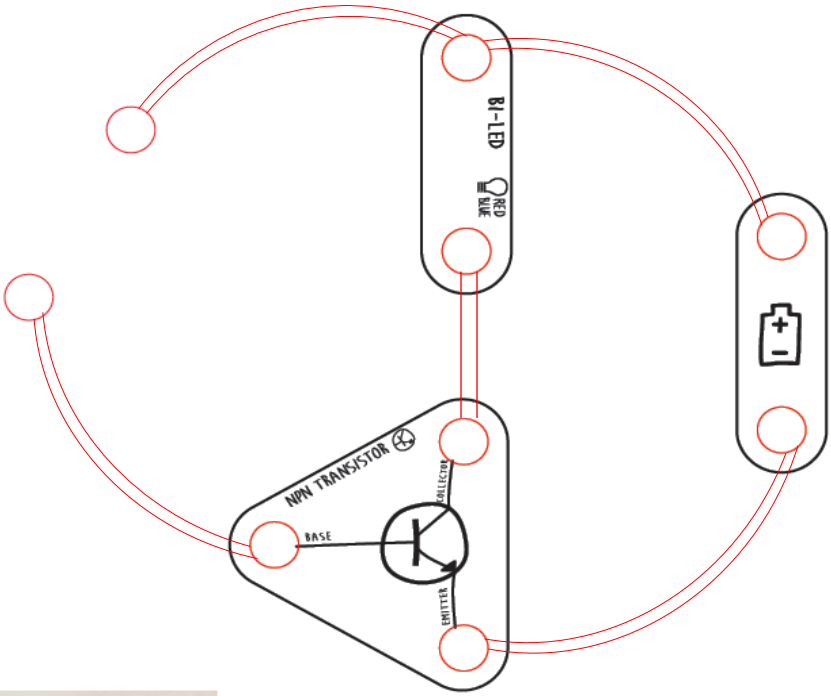
Basic Activity 1: Touch Detector

Simulating a touchscreen:

As you might have seen, human skin is too resistive to light up an LED by itself. However, there are special materials called transistors. They exist in just about every electronic device that depends on a computer. Transistors are useful in amplifying a current so a small signal can be detected by other parts of the circuit.

The basic circuit:

Draw the circuit illustrated in the figure to the right. Place the paper over the steel sheet and place your circuit elements on the paper. The components should snap to the steel sheet.



Make sure to leave a gap so your fingers can complete the circuit!