

A dramatic night sky with dark, heavy clouds and a bright, jagged lightning bolt striking across the horizon. The top of the image features a decorative teal and black wavy border.

“Exploring Electricity”

Squishy Circuits, Lemon Batteries, and
understanding Circuits

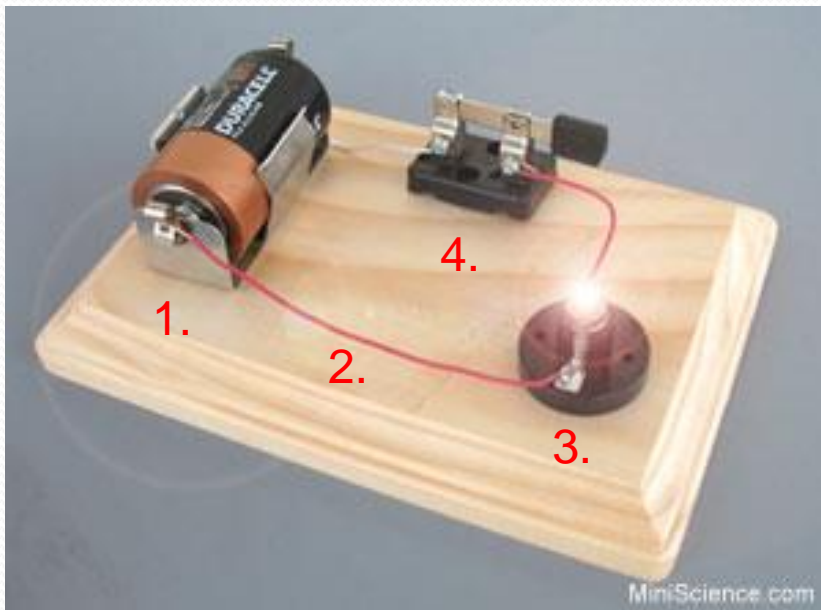
Agenda

- Basic Circuits
- LED's
- Squishy Circuits
- Lemon Batteries
- Tapetricity Card
- Conclusion



Basic Circuits

- What do you have to have for an Electrical Circuit?



1. Energy Source
2. Conducting path
3. Load (Resistance)
4. Switch (not needed, but usually present)

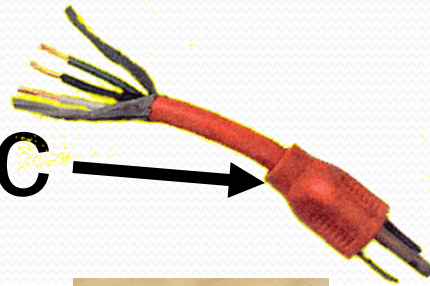
Conductors and Insulators

- **Conductors** – material through which electric current flows **easily**.
- **Insulators** – materials through which electric current **does not move easily**.

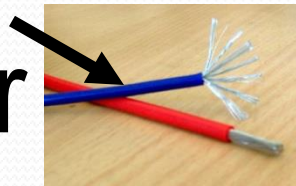
Insulator –

Any material that does not allow electric current to pass through it

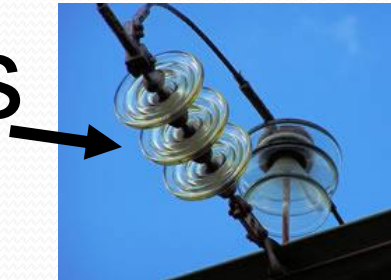
• plastic



• rubber



• glass



• cloth

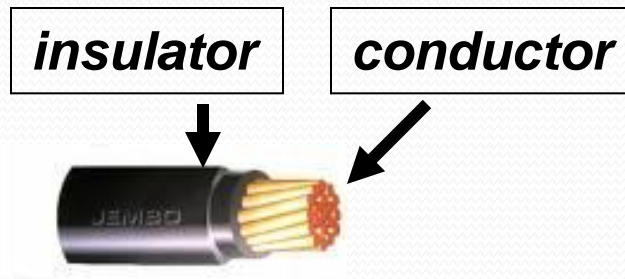


• wood



Conductor –

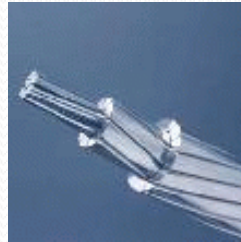
Any material that allows electric current to pass through it



- copper

- aluminum

- steel



- any metal



Semiconductors

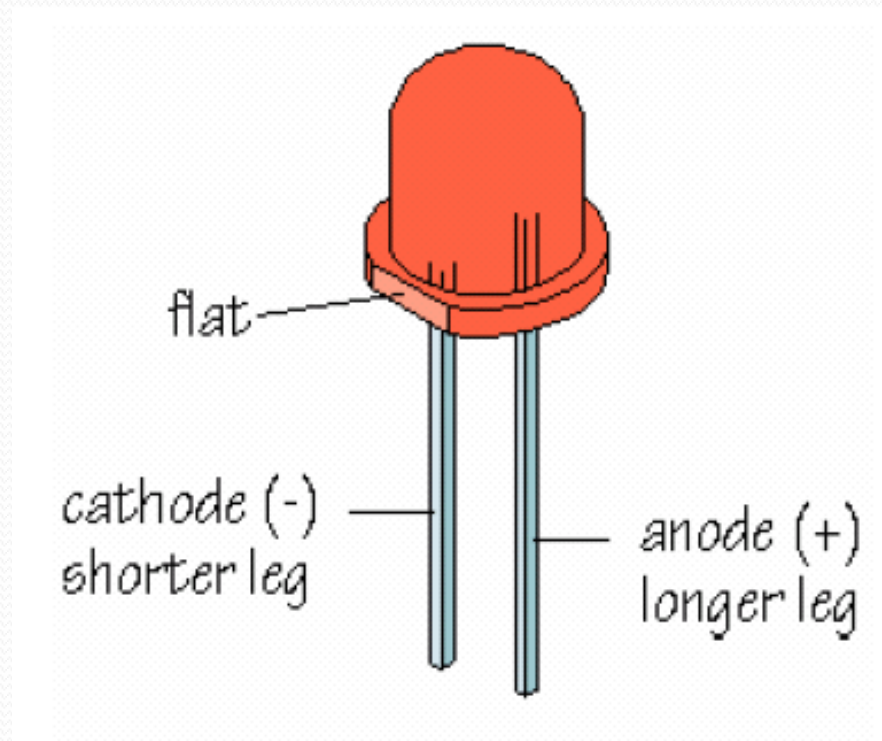
- A semiconductor is a substance, usually a solid chemical element or compound, that can conduct electricity under some conditions but not others, making it a good medium for the control of electrical current.
- Can you think of an example of a semiconductor that we see every day?

LEDS



What is an LED?

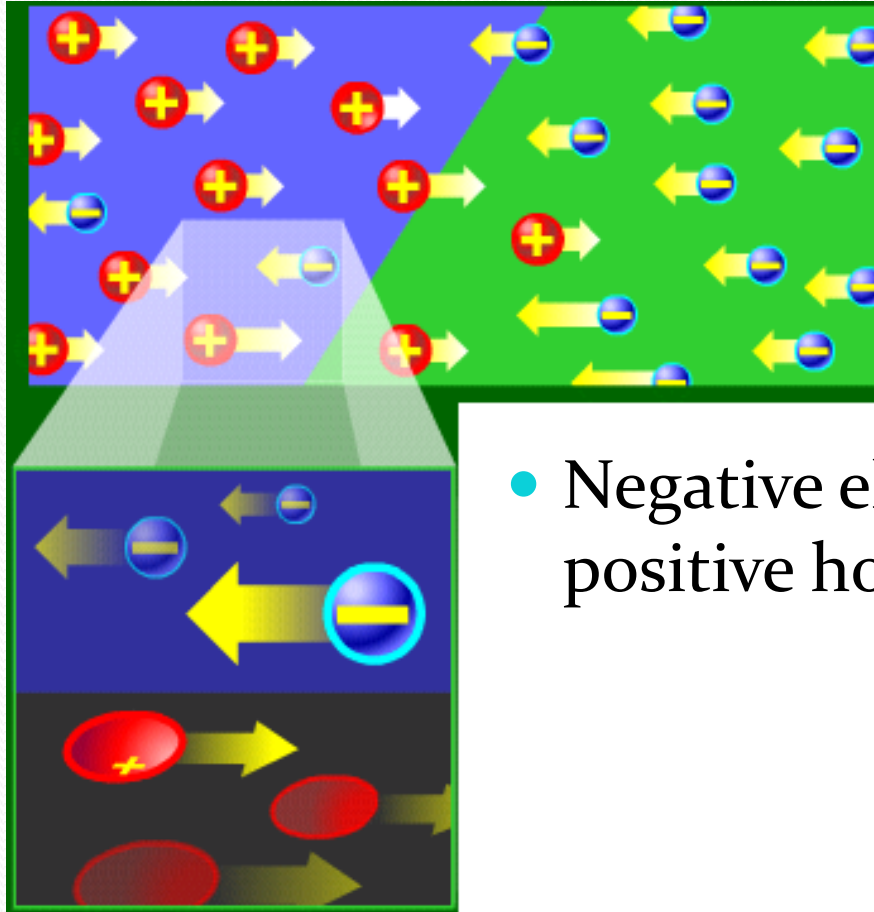
- Light-emitting diode
- Semiconductor
- Has polarity



Applications of LEDs

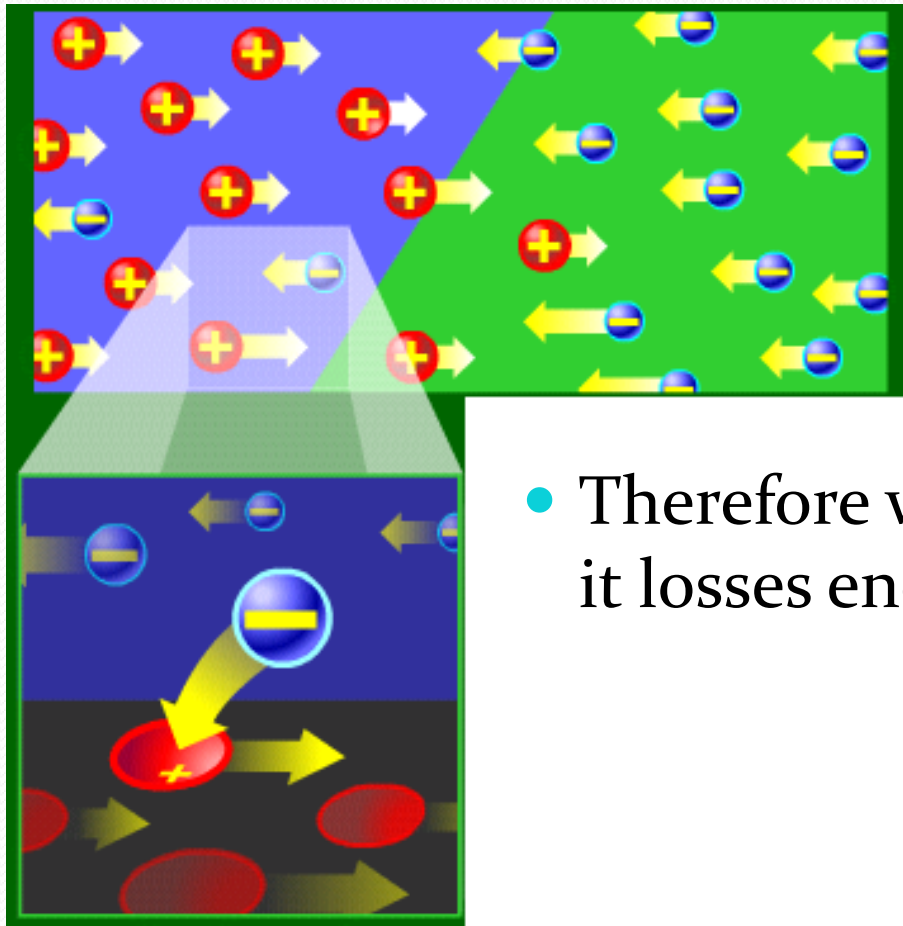


LED: How It Works



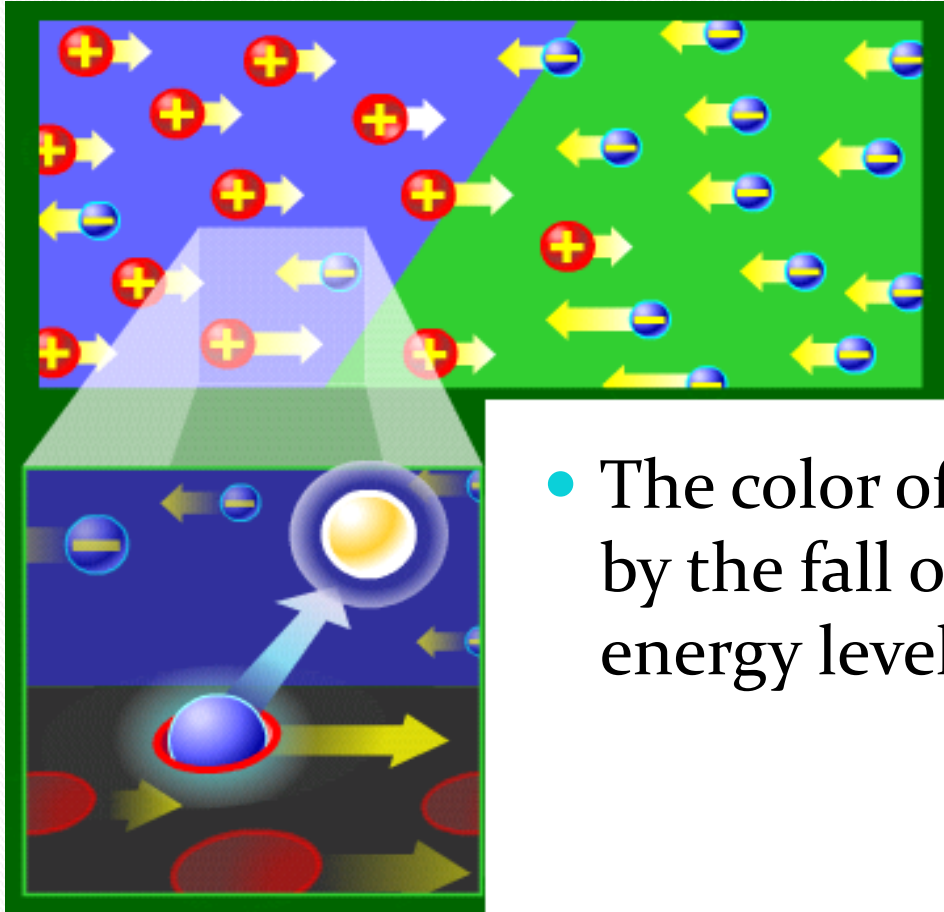
- When current flows across a diode
- Negative electrons move one way and positive holes move the other way

LED: How It Works



- The holes exist at a lower energy level than the free electrons
- Therefore when a free electrons falls it losses energy

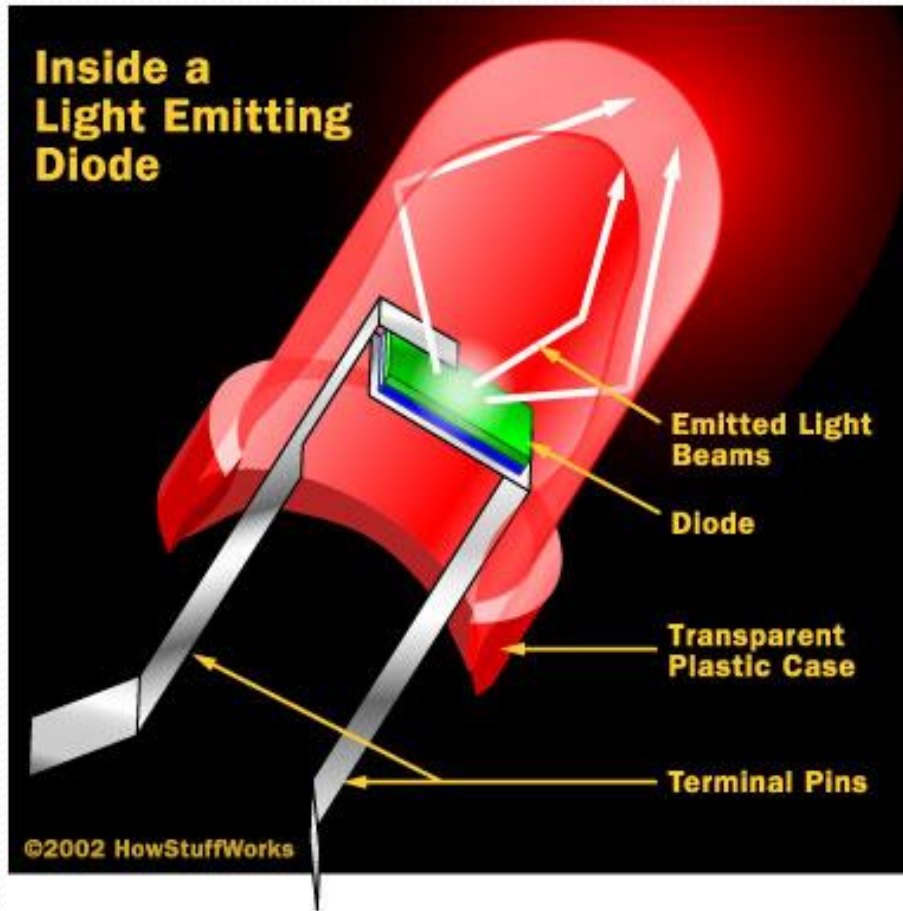
LED: How It Works



- This energy is emitted in a form of a photon, which causes light

- The color of the light is determined by the fall of the electron and hence energy level of the photon

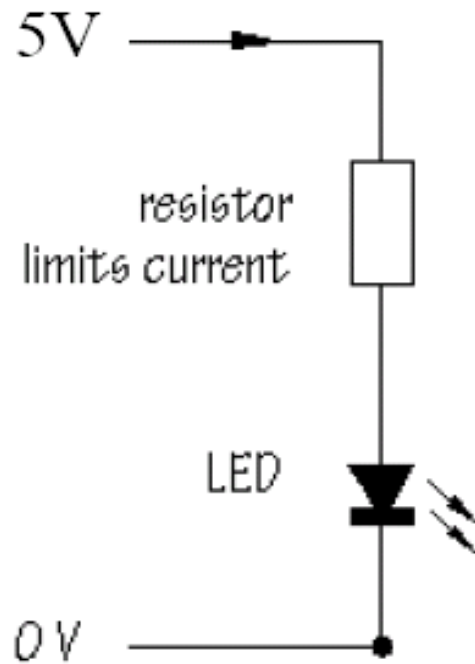
Inside a Light Emitting Diode



1. Transparent Plastic Case
2. Terminal Pins
3. Diode

How to Connect a LED:

- Requires 1.5~2.5V and 10 mA
- To prevent overloading, use resistor 470 Ω



Let's make circuits



Squishy Circuits

Squishy Circuits are a great way to introduce electronics education into your curriculum by using two different doughs as circuit building materials. Because of the playful nature of the dough, this activity is suitable for children of all ages. The doughs are made with readily available ingredients such as flour and salt.

This teacher's guide contains the dough recipes, basic instructions, helpful hints and sample worksheets. All of this material is free and open-source, courtesy of the University of St. Thomas.

If any questions, comments, or concerns arise, we urge you to contact us via our website:

www.StThomas.edu/SquishyCircuits

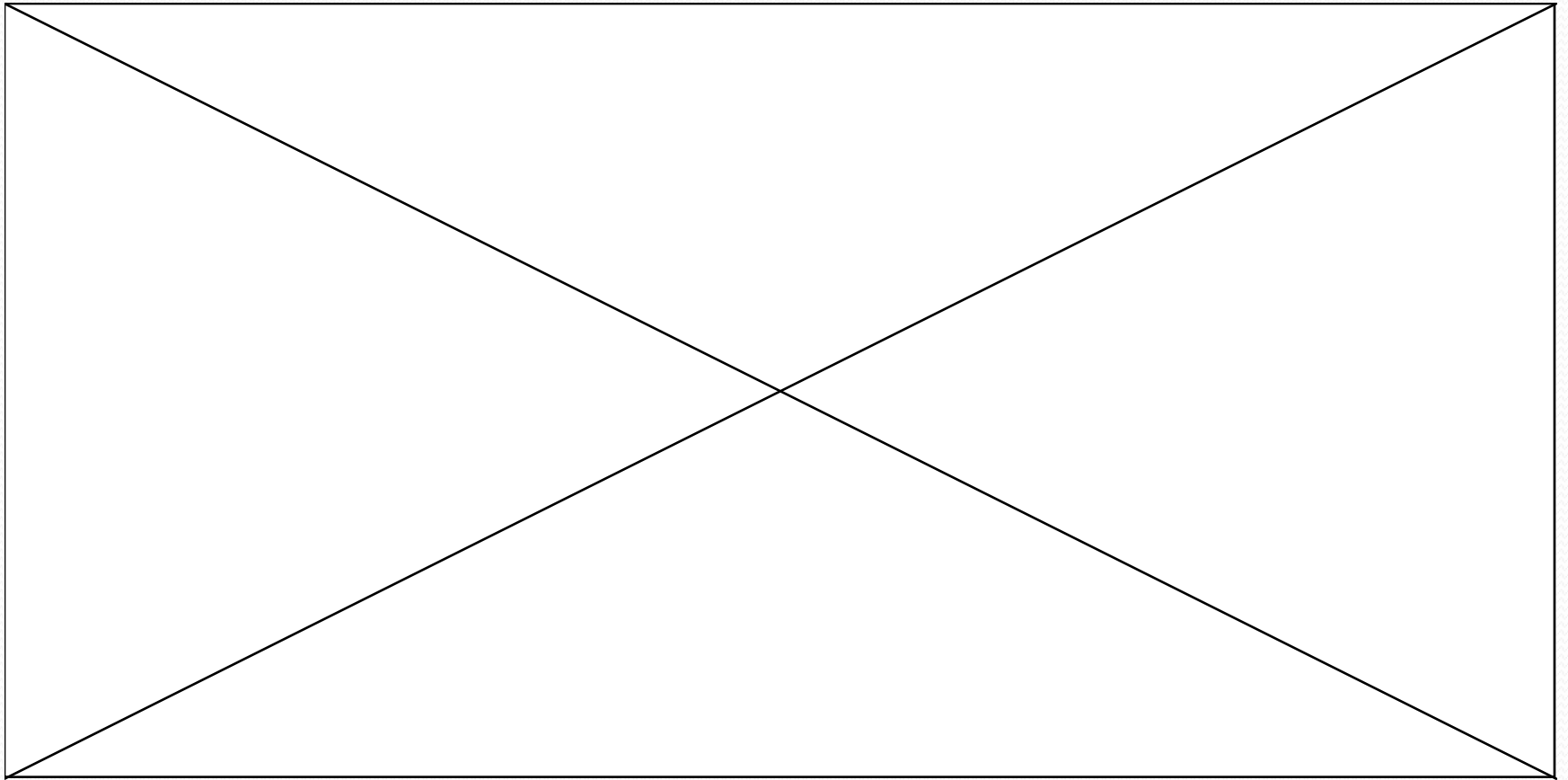
We also have how-to videos and other support materials located there.

[Classroom Guide](#),

<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/PDFs/Squishy%20Circuits%20Classroom%20Guide.pdf>

Conducting Clay

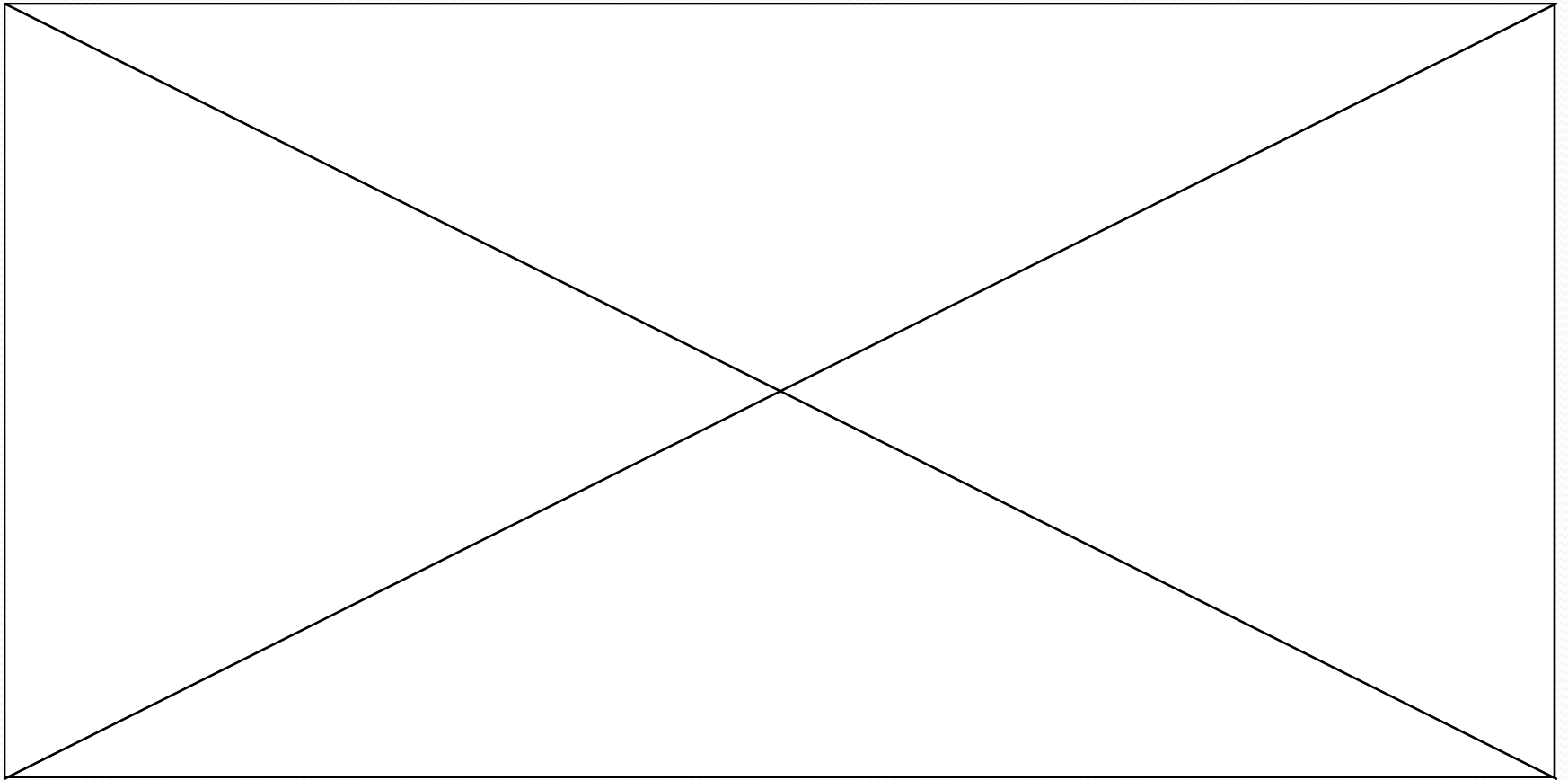
Look at handout instructions and watch video.



If video does not start go to this site: http://www.youtube.com/watch?feature=player_embedded&v=cpUFL5LZpv4

Insulating Clay

Look at handout instructions and watch video.



If video does not start go to this site: http://www.youtube.com/watch?feature=player_embedded&v=Wz8rGNt-iEQ

Squishy Circuits

Make the Clay

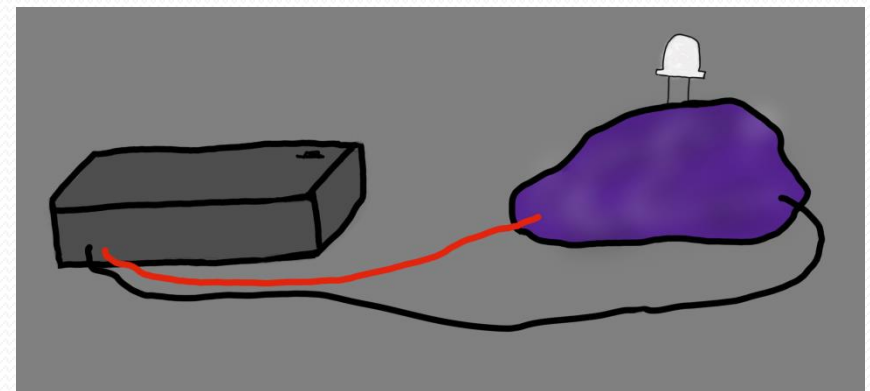
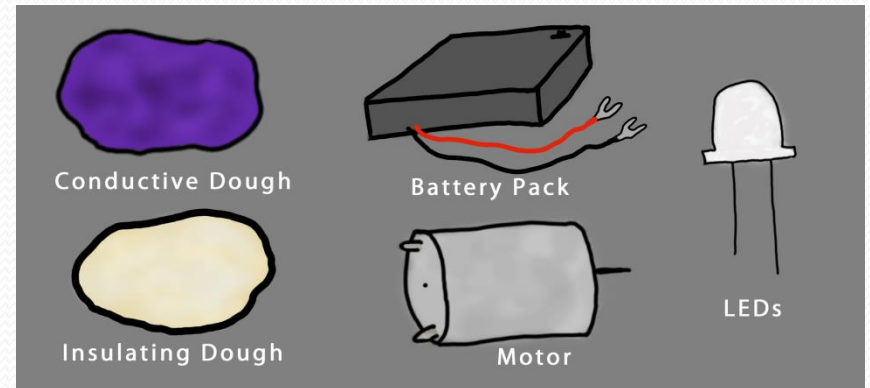


Half make
conductive,
with color.



Half make
insulating,
no color.
Share with
another
group.

Complete the introduction



Challenge

1. **Brainstorm.**

Use conductive and insulating dough to make battery-powered creatures that light up and/or buzz. Ask each group to brainstorm possible creature designs. What do they want the creature to do? (have glowing eyes, make a noise when pressed)

2. Sketch and build. Groups will draw sketches and then agree on one design to build.

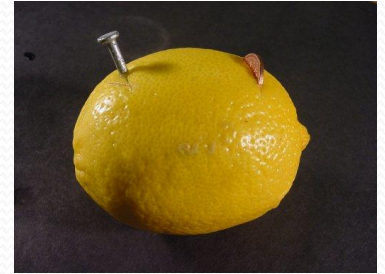
3. Test. Start small, like trying to get one eye to light up, then once you have accomplished this, move on to a more complicated task, such as getting two eyes to light.

4. Share. When everyone is done, have groups demonstrate their creations and discuss.

Pointer: Dough does not conduct as well as metal. You may find it helpful to use short thick chunks of the dough (to reduce resistance) or to increase the surface area of the electrical contacts.

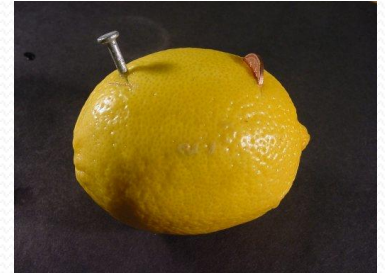
Draw here!

Lemon cell Batteries

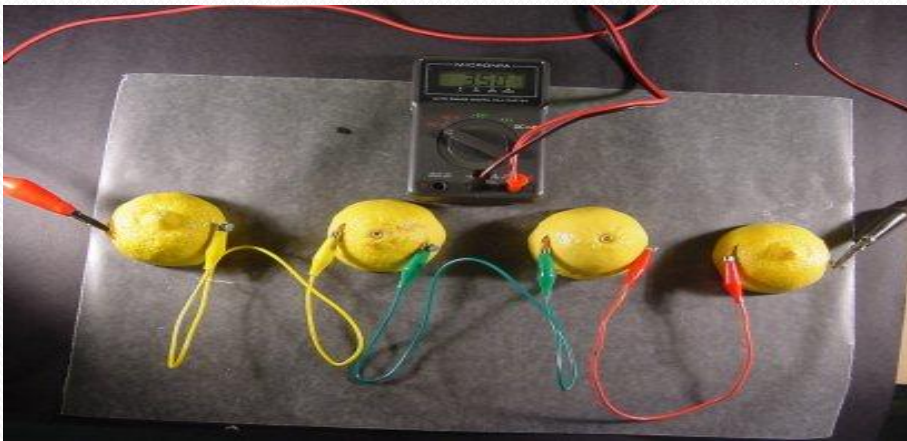


- Go to the next part of your handout.
- For the remainder of our time today we will complete the activities related to lemon cell batteries.
- If you are not familiar with the use of a Digital handheld Multi-meter, a helper will instruct and assist you with these parts of the activity.
- Be careful when cutting the lemons and make sure you have wax paper on the table when doing this activity.
- For the LED part of the lab, use one from the Squishy Circuit kit you used earlier.
- We will use pieces of copper wire instead of pennies.

Batteries- Lemon Cells



- Lemon Battery- hilaroad,
http://hilaroad.com/camp/projects/lemon/lemon_battery.html
- Lemon Battery video- Science Online,
<http://www.youtube.com/watch?gl=CA&hl=en&v=AY9qcDCFeVI>



Tapetricity Card

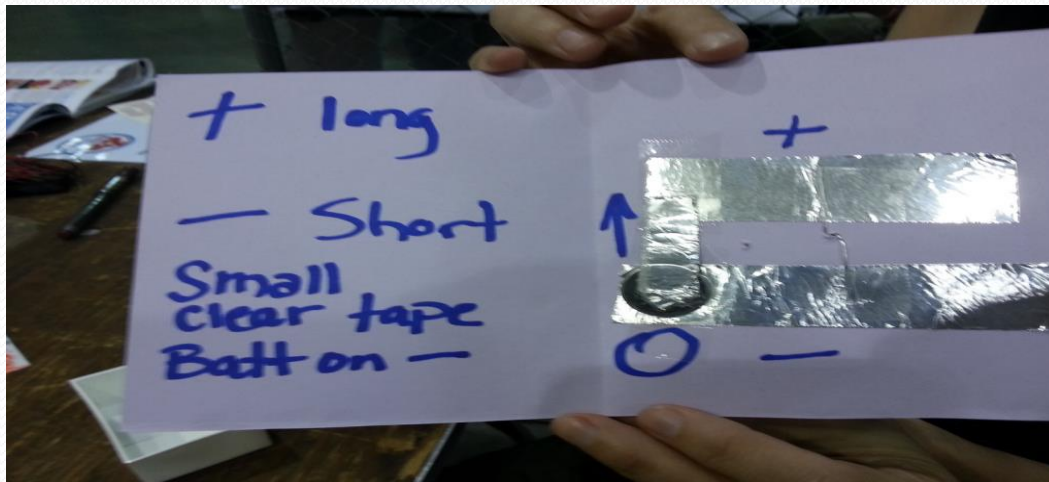


The build is simple:

Draw/create a picture in the medium of your choice: crayon, pen, pencil, or even collage.

Figure out where you want your LED, and punch small side-by-side holes for the legs in that spot.

Tapetricity Card



On the back side, attach parallel strips of aluminum tape on either side of the holes.

Push the LED legs through the holes, and then bend the legs in opposite directions: negative (short leg) on one side, positive (long leg) on the other.

Tape the negative on one strip of aluminum and the positive on the other strip.

Tape a coin cell battery on the end of the negative aluminum tape side, negative side down.

Tape some aluminum from the positive aluminum strip to the positive side of the coin cell battery.

Conclusion

Answer the following Questions:

1. What makes up a simple circuit?
2. Give an example of an insulator and conductor.
3. Name 3 uses for LEDs.
4. What is a short circuit, when did this happen with squishy circuits?
5. Would using lemons be a good way to power electrical devices?
6. Does it make a difference what direction LEDs go in a circuit?

Thank you

