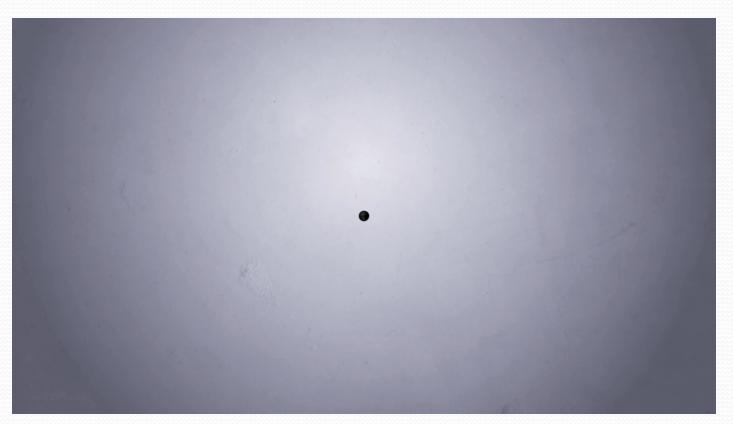
# Nanotechnology and Exploring Electricity

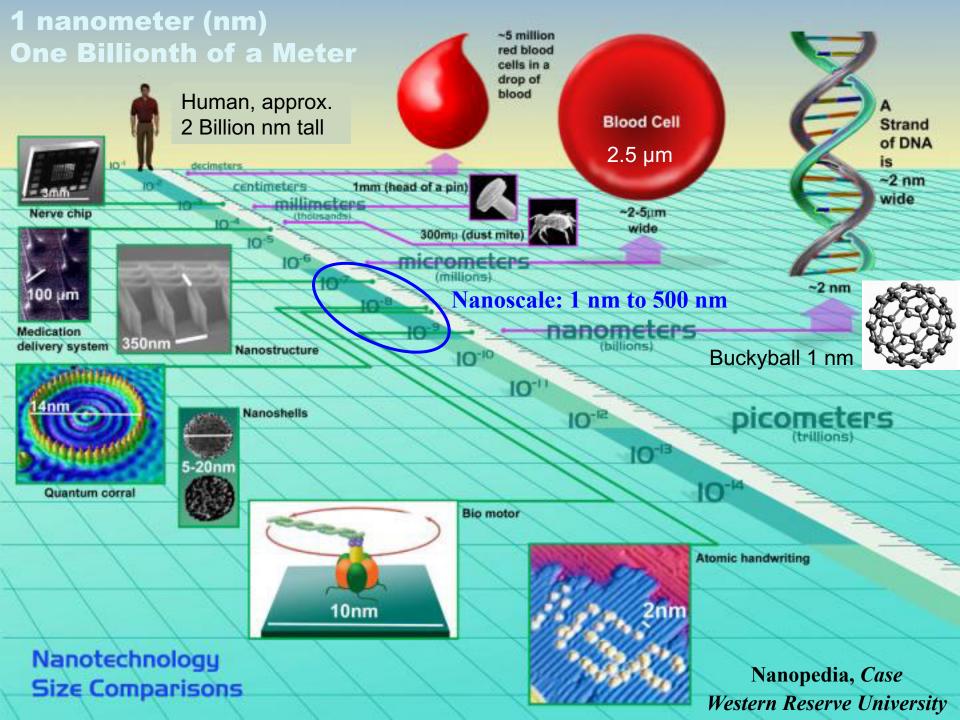
- Presenters: Terese Janovec and Steve Wignall
- Nebraska Center for Materials and Nanoscience

## Intro to Nanotechnology

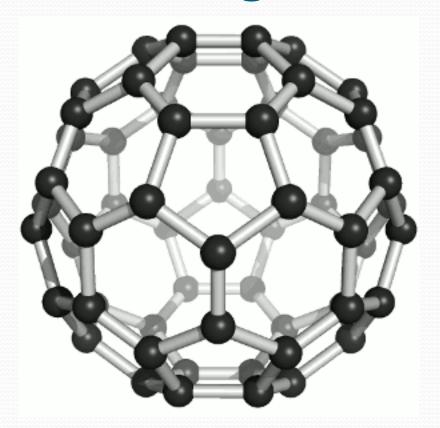


#### Materials and Nanoscience

The following concepts will be an introduction to Nanotechnology and examined through the activities and Nano-Kits.



#### How Big is a Nanometer?



## Carbon Nanoparticle about 1 nm across

Also Called: C-60, Fullerene, Buckyball

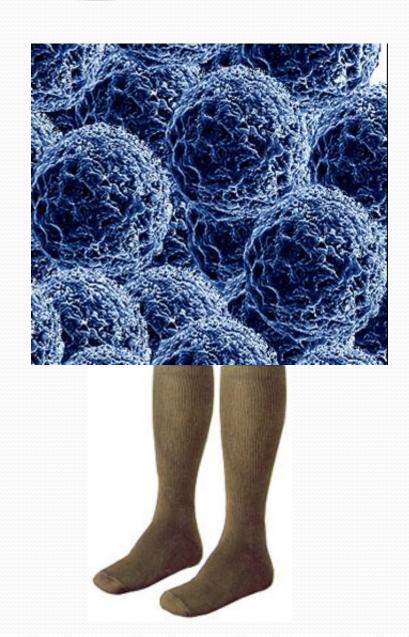
#### Intro to Nano



#### Nano Socks!

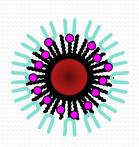
Silver Nanoparticles 19 nm across have antimicrobial properties.

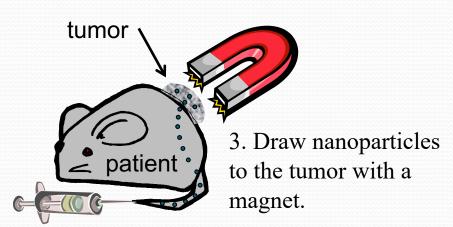
They make ArcticShield™ Socks odor and fungus resistant



#### nanobits... Hyperthermal Therapy

1. Coat magnetic nanoparticles with biocompatible molecules.





2. Inject nanoparticles into the patient.

4. Heat nanoparticles with radio waves.

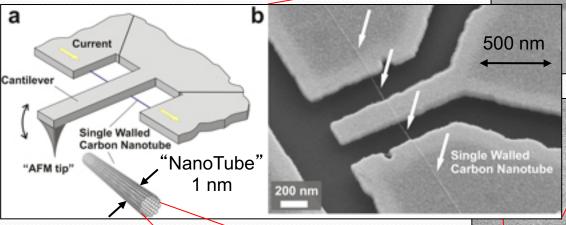


5. Melt your tumor away.

Prof. Diandra Leslie-Pelecky, UNL Department of Physics and Astronomy

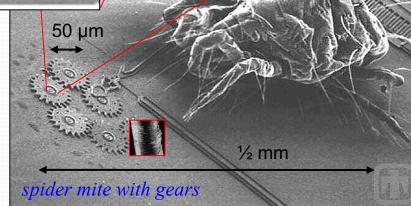
#### NanoTechnology

1959: Richard Feynman kicks off the nanotechnology era with his provocative lecture "There's Room at the Bottom", a scheme for building machines, which build smaller replicas of themselves, which build smaller replicas of themselves, which build



2000: Nano-Electro-Mechanical (NEMS) devices.

1 nm "Buckyball"



5 µm

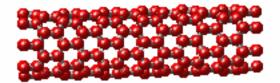
steam engine

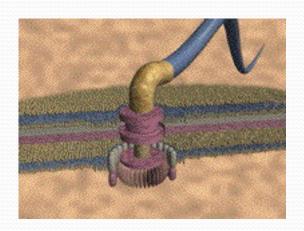
# Nanoscience Research at the University of Nebraska Voelte-Keegan Nanoscience Research Center



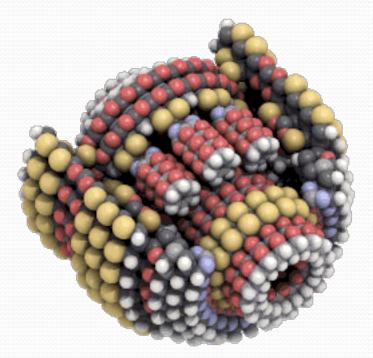
http://research.unl.edu/research\_videos/

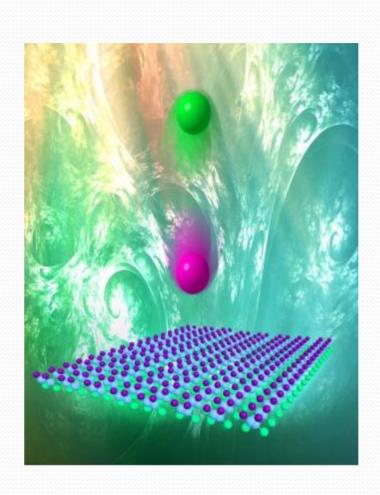
#### NanoMotors





## Carbon Nanotube about 1 nm across

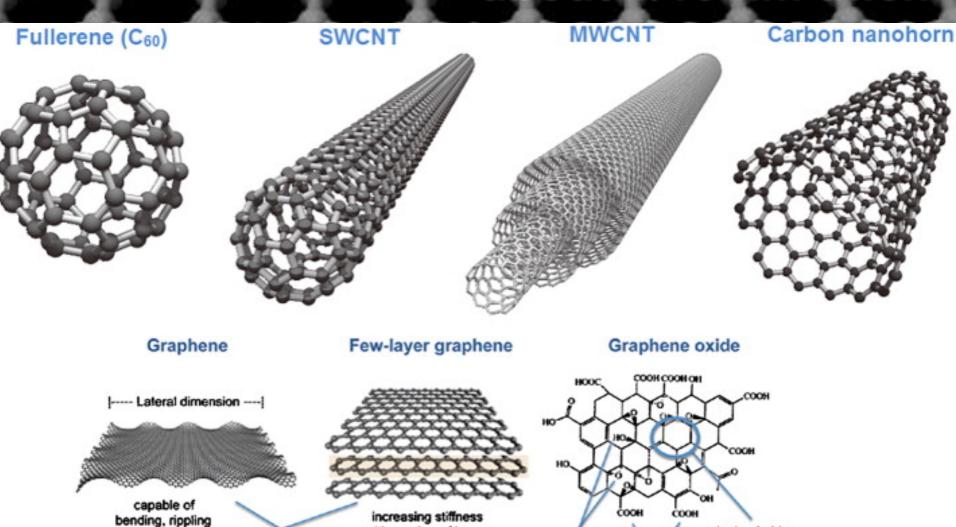


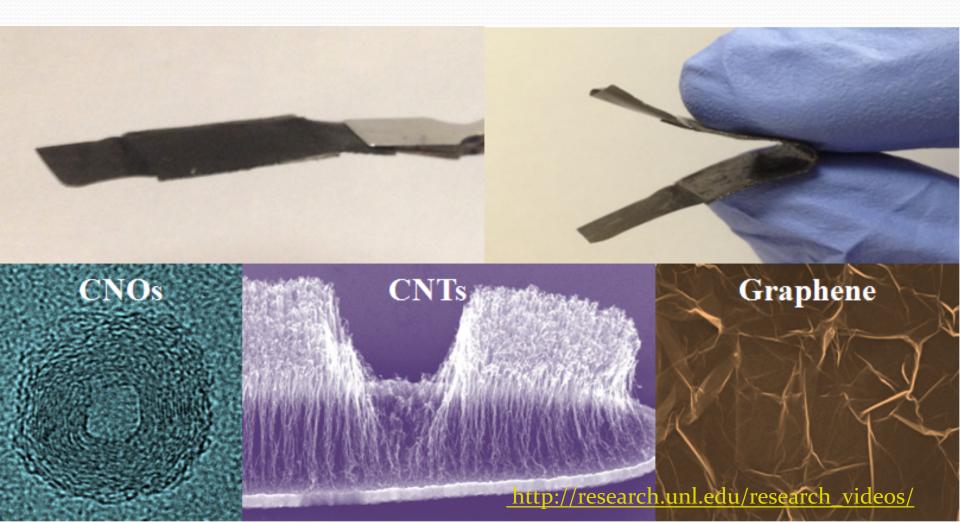


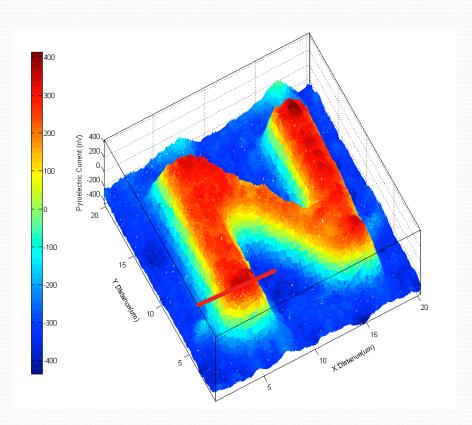
Polymer SolarCells

#### NanoSheets

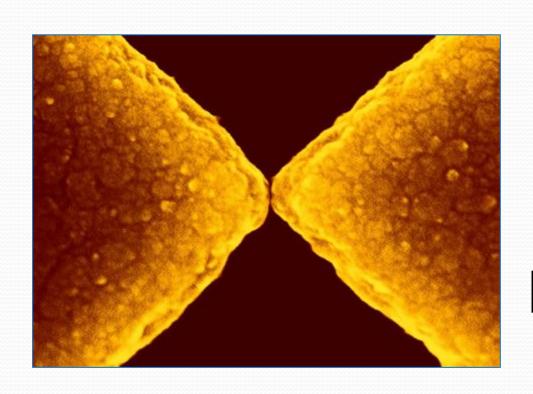
## Graphene Carbon Sheet about 1/10 nm thick







#### NanoPhysics Microscopes



#### Synthetic Bone Replacement

http://www.unl.edu/ncmn/videos.shtml

## Rain Project

Remotely Accessible Instruments for Nanotechnology





#### X-ray fluorescence (XRF)

#### **Remote Accessibility:**

Nebraska Nanoscale Facility - (Rigaku Supermini200 X)

X-ray fluorescence (XRF) is the emission of characteristic "secondary" (or fluorescent) X-rays from a material that has been excited by bombarding with high-energy X-rays or gamma rays. The phenomenon is widely used for elemental analysis and chemical analysis, particularly in the investigation of metals, glass, ceramics and building materials, and for research in geochemistry, forensic science, archaeology and art objects such as paintings and murals.



#### **RAIN Outreach**

#### Nebraska Nanoscale Facility and 4H Summer Partnership



Nebraska Nanoscale Facility (NNF), in partnership with the University of Nebraska Extension Office and 4-H program provided remote analysis services through RAIN to youth in Omaha this summer. Fourteen schools and various programs throughout Omaha participated in the Engineering with Nano Power experience. Students were introduced to how specialized nano equipment can be used to analyze environmental materials and new products being developed in our society. Using the XRF a variety of materials were examined and their compositions discussed in the classroom after utilizing the remote technical capabilities of the XRF. Youth were able to connect and relate with a real nanoscientist using the RAIN platform. A variety of questions helped students engage with the remote session such as: Why is analyzing samples important? What can you do with the info? What does this analysis tell us and how do you become a nanoscientist?

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Over 190 students, 4th-8th grade, were able to experience the RAIN sessions, about 45% were females and 70% from underrepresented groups. We believe the RAIN sessions with enthusiastic teachers and scientists working together can have a positive impact on STEM identity formation and career orientation for youth!

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## "Exploring Electricity"

Squishy Circuits, and understanding Circuits

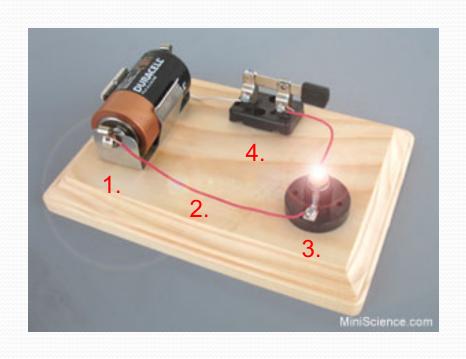
#### Agenda

- Basic Circuits
- LED's
- Squishy Circuits
- Twirlers
- Conclusion



#### **Basic Circuits**

What do you have to have for an Electrical Circuit?



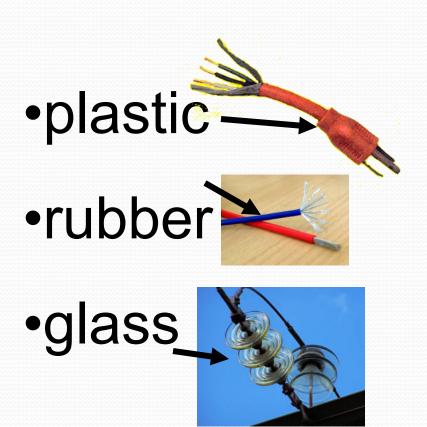
- 1. Energy Source
- 2. Conducting path
- 3. Load (Resistance)
- 4. Switch (not needed, but usually present)

#### Conductors and Insulators

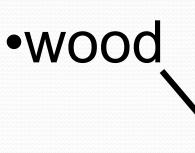
- Conductors material through which electric current flows easily.
- Insulators materials through which electric current does not move easily.

#### nsulator -

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



•cloth





## Conductor — Any material that allows

insulator

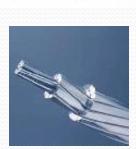
Any material that allows electric current to pass through it

conductor

•copper

•aluminum

steel





any metal



#### Semiconductors

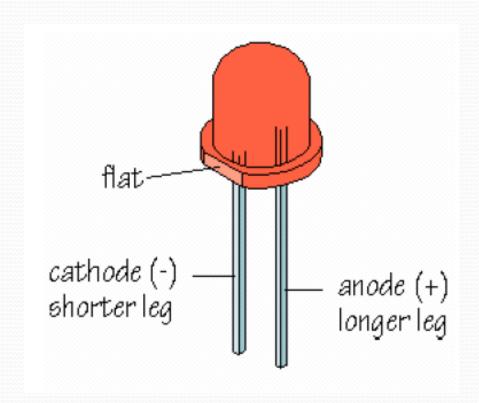
- A semiconductor is a substance, usually a solid chemical element or compound, that can conduct electricity under some conditions but not others, making it a good medium for the control of electrical current.
- Can you think of an example of a semiconductor that we see every day?

## LEDS



#### What is an LED?

- Light-emitting diode
- Semiconductor
- Has polarity



#### Applications of LEDs



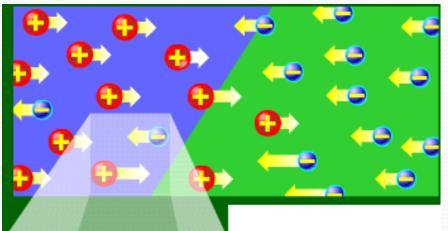




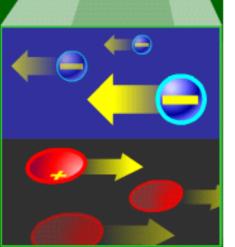




#### **LED: How It Works**

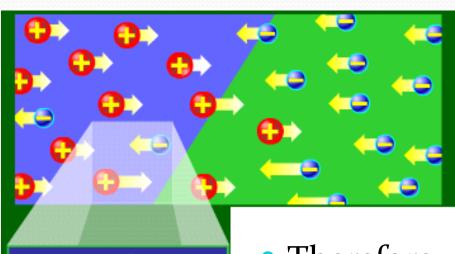


When current flows across a diode

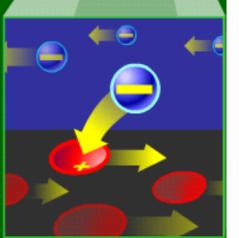


 Negative electrons move one way and positive holes move the other way

#### **LED: How It Works**

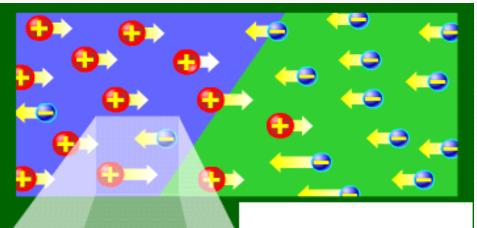


 The holes exist at a lower energy level than the free electrons

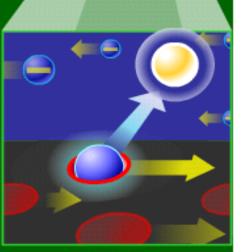


 Therefore when a free electrons falls it losses energy

#### **LED: How It Works**

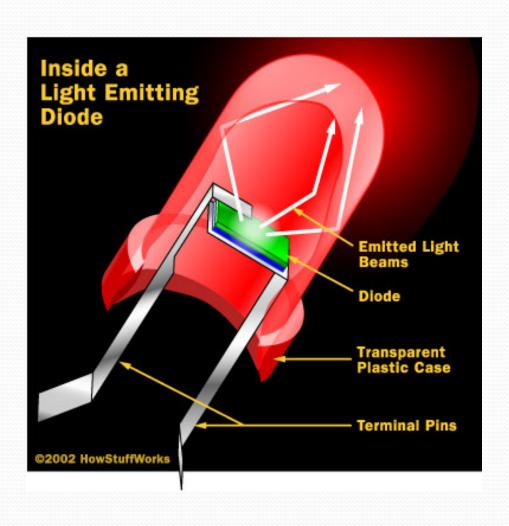


 This energy is emitted in a form of a photon, which causes light



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

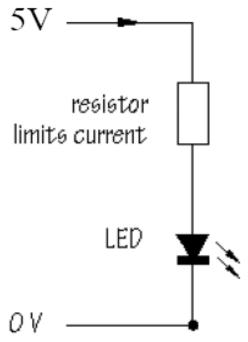
#### **Inside a Light Emitting Diode**



- 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  $\Omega$



#### 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 suitible 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,

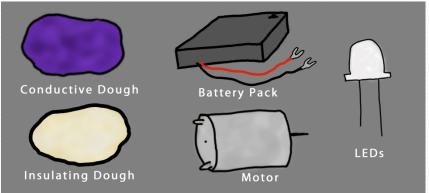
#### **Squishy Circuits**

#### Make the Clay



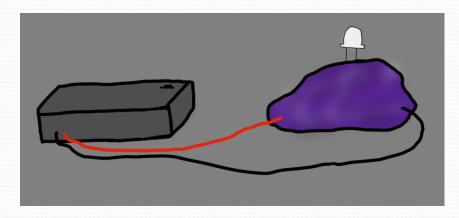
Half make conductive, with color.







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



#### 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!

## LIGHT UP ROTO COPTER

#### WHAT WILL YOU MAKE?

A spinning and flying Roto Copter that

lights up with the help of LEDS.



#### WHAT WILL YOU NEED?

- 1 Sheet of card stock
- 1 Binder clip
- Circuit Stickers
- Copper tape
- CR2032 battery
- Pencil
- Scissors

https://makercamp.com/projects/l
ight-roto-copter/print

# Let's Look at some Nano-Kits!

#### **Kits for Purchase**

Ordering: Visit <a href="http://ncmn.unl.edu/kit-order-form">http://ncmn.unl.edu/kit-order-form</a> to purchase one or more kits for your school (non-profit required for order). We will invoice and ship kits within a few weeks.

**Exploring Materials—Thin Films** 

**Exploring Materials—Graphene** 

**Exploring Products—Nano Sand (State Standards)** 

**Exploring Products—Liquid Crystal Displays (State Standards)** 

**Exploring Properties—Invisibility (State Standards)** 

**Exploring Materials—Memory Metal (State Standards)** 

**Exploring Materials—Ferrofluid (State Standards)** 

**Exploring Materials—Oobleck** 

**Exploring Size—Measure Yourself** 

## Thank you. Any Questions?

#### **Tapetricity Card**

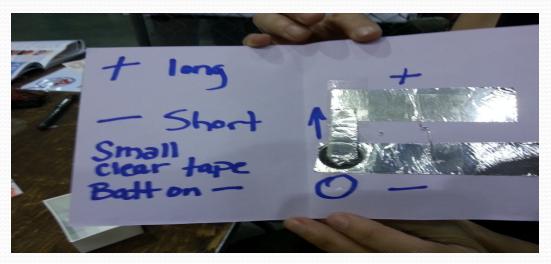


#### The build is simple:

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 sideby-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.

### **Tapetricity Card**

