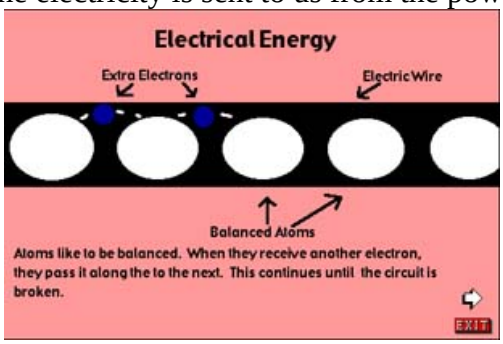
7th Grade Summer Institute

How A Light Bulb Works Lab

Background:

How do we get our electricity? You might say it comes from a power plant. How does the power plant make electricity? Electricity wouldn't be around if it weren't for those atoms that we talk so much about. Remember atoms are made of protons, neutrons, and electrons. Protons are positive and electrons are negative. Atoms like to have the same amount of protons and electrons so it can stay balanced. We learned during 6th grade that atoms can lose electrons and they can gain electrons. When one electron leaves an atom that atom becomes positive. The electron that was lost moved to another atom making it negative. Both atoms are now out of balance. These atoms want to get balanced. The positive atom will attract an electron from another atom. The negative atom will push away the electron it gained. Then it happens again and again and again….making ELECTRICITY! The electricity is sent to us from the power plant using electric wire.



http://www.coe.ufl.edu/courses/edtech/support/teacher/TRL/Andy/hyperstudio.htm (3/7/2004)

There are three kinds of light bulbs humans use: **incandescent, halogen,** and **fluorescent.** We will talk more about these later.

Part 1: Exploring Different Kinds of Light Bulbs

Procedure:

1. Check out the different kinds of light bulbs around the room.
2. In the chart below make your observations – rank the temperature of each bulb (how hot it feels. You may put your hand close to it, but do NOT touch it), rank how bright each bulb is, and draw a picture of the bulb (including what you see inside). Rank bulbs from 1-3. 1 is the brightest or hottest. 3 is the dimmest or the coolest.

Observations:

Bulb Type	Temperature Rank	Brightness Rank	Picture
Incandescent			
Fluorescent			
Halogen			

<u>Part 2</u>: Light Bulb and Electricity Information Walk Around

Station #1: What type of light bulb do most people use in their homes? _____

Station #2: How much of the energy used by incandescent light bulbs is turned into light? ____%. The other ____% is turned into _____ energy.

Station #3: How hot can halogen light bulbs get? _____ degrees Farenheit. This can cause _____.

Station #4: Incandescent bulbs create _____ by running _____ through a _____ _____ until it _____ with _____.

Station #5: Halogen bulbs work the same way as _____ bulbs except they are filled with _____ _____, which makes more _____.

Station #6: Fluorescent bulbs have _____ on the glass inside and are filled with _____ that _____ and give off _____ when they are _____ by electricity.

Station #7: Fluorescent bulbs use approximately _____ the amount of energy needed to make an incandescent bulb work.

Station #8: Fluorescent bulbs last _____ to _____ times longer than incandescent bulbs.

Station #9: One compact fluorescent light bulb can save you approximately _____ dollars!

Station #10: The main way we get electricity is by _____ _____ _____. Burning _____ _____ _____ the air and causes _____ _____.

Station #11: When you use less energy everyday _____ fossil fuels are being _____.

Station #12: If _____ room in every home used a compact fluorescent light bulb, it would keep _____ out of the air. This is the same as keeping _____ cars off the road! Wow…if we did this we would have cleaner air to _____.

Station #13: An incandescent bulb only lasts about _____ hours while a fluorescent light bulb can last up to _____ hours.

Discussion Questions:

1. Which light bulb would you use in your home? _____. Why?

2. What kind of light bulb do you use most in your home? _____

3. What kind of light bulb would be best to use in your home? _____ Why?

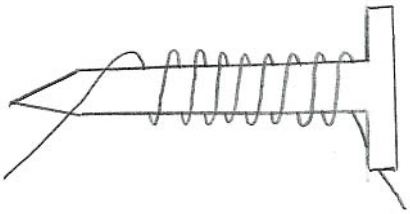
<u>Part 2</u>: Light Bulb and Electricity Information Walk Around

Station #1: Most people use incandescent light bulbs in their homes.	**Station #2:** Most people use incandescent light bulbs in their home.
Station #3: Approximately 90% of the energy used by incandescent bulbs is used to create HEAT and only. The other 10% is turned into light energy.	**Station #4:** Halogen bulbs burn at temperatures as high as 1, 000 degrees. This can cause fires to start in people's homes.
Station #5: Halogen bulbs work the same way as incandescent bulbs except they are filled with halogen gas, which makes more light.	**Station #6:** Fluorescent bulbs have chemicals on the glass inside and are filled with gases that react and give off light when they are excited by electricity.
Station #7: Fluorescent bulbs use approximately ¼ the amount of energy needed to make an incandescent bulb work.	**Station #8:** Fluorescent bulbs last 10 to 20 times longer than incandescent bulbs.
Station #9: One compact fluorescent light bulb can save approximately 108 dollars!	**Station #10:** The main way we get electricity is by burning fossil fuels. Burning fossil fuels pollutes the air and causes global warming.
Station #11: When you use less energy everyday less fossil fuel are being burned.	**Station #12:** If one room in every home used a compact fluorescent light bulb, it would keep greenhouse gases out of the air. This is the same as keeping one million cars off the road! Wow…if we did this we would have cleaner air to breathe.
Station #13: An incandescent bulb only lasts about 1,000 hours while a fluorescent light bulb can last up to 10,000 hours.	**Station #14:** Incandescent bulbs create light by running electricity through a filament wire until it glows with heat.

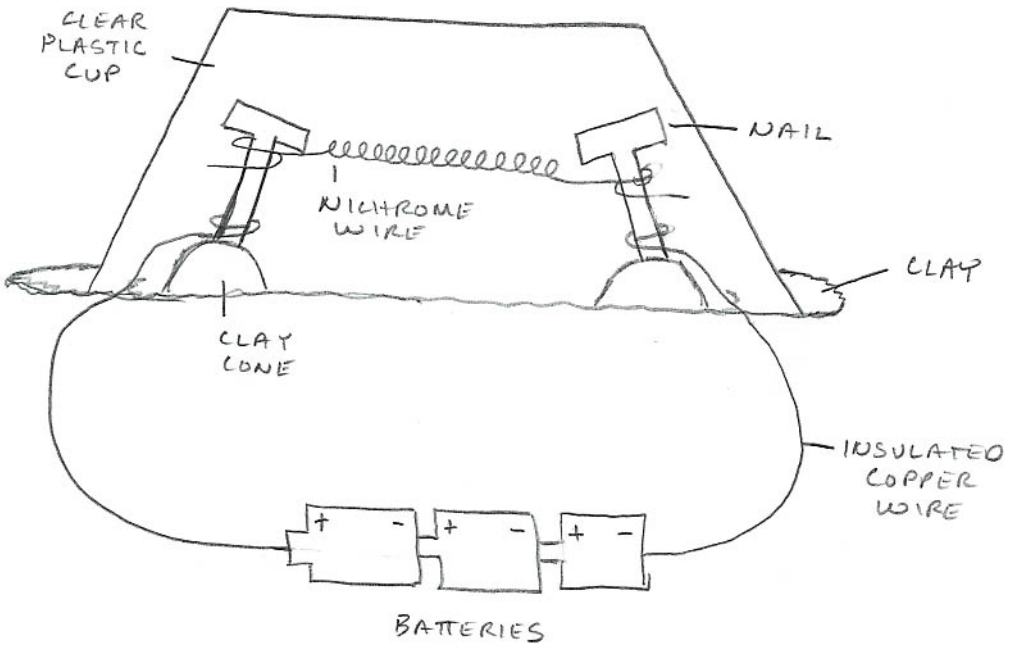
<u>Part 2:</u> Building A Light Bulb
Materials: 10cm Nichrome Wire, 15cm Insulated Copper Wire (2), Batteries (4), Nails (2), Clear Cup, Modeling Clay

Procedure:

1. Wrap the Nichrome Wire around one of the nails. Make sure the coils are close together, but not touching. Leave about 2cm of wire at each end. See picture below.



2. Slide the coil off the nail.
3. Flatten a piece of modeling clay on your tray (like a pancake). Make two little cones using the clay so the nails can stand up in the clay. See picture below.
4. Stick the two nails in the cones and slant them slightly towards the middle.
5. Connect the coil Nichrome Wire to the top of the two nails and connect the metal part of the Insulated Copper Wires to the bottom of the nails. See picture below.
6. Place the cup over your light bulb. See picture below.



7. Connect your wires to one battery and watch for about 10-15 seconds. Record your observations in the data table below by rating the temperature (1 = Cold, 5 = Very Hot) and the amount of light the Nichrome wire gives off (1 – No Light, 5 = Very Bright).
8. Repeat step #7 adding one battery at a time until the filament wire begins to glow. If it takes more than four batteries pair up with another group and share one light bulb. Do not connect more than 8 batteries.

Observation Table:

# Batteries	Temperature Description	Nichrome Wire Observation
1		

# Batteries	Temperature Description	Nichrome Wire Observation
2		
3		
4		
5		
6		
7		
8		

Discussion Questions:

1. How many batteries did it take to see the Nichrome Wire glow? __
2. How many batteries do you think it would take to make this light bulb bright enough to read a book? __
3. What type of light bulb do you think we made? _____
4. Using what you learned in the "Background", draw a picture showing how this light bulb works. Make sure you label your drawing.
5. What happened to the electrons when you disconnected the wire from the battery?
6. Which did you observe first? Heat or light? _____
7. Which do you think there was more of? Heat or light? _____

Light Bulb Lesson

Title: How A Light Bulb Works Lab

Principles Investigated: This activity demonstrates how electrical energy is used in light bulbs as radiant and thermal energy. This activity can be used to demonstrate the following:

- The differences between various types of light bulbs.
- Concept of exciting electrons causing them to shift to a higher energy level and thus, producing energy.
- Methods of energy conservation.

Situating the Lesson:
Students should have some knowledge of atoms. This lesson followed one in which the various forms of energy were explored.

Materials:

- Lamp (3)
- Halogen Bulb
- Fluorescent Bulb
- Incandescent Bulb
- Nichrome Wire
- Insulated Copper Wire
- D Batteries
- Nails
- Clear Cups
- Modeling Clay
- Trays
- Lab Write Up

Procedure:

- This lesson is geared towards English Language Learners.
- This lesson is divided up into three parts:

  DAY 1 (45 MINUTES):
  - Background Information - 5 PowerPoint slides (should take about 15 minutes).
    - Explain how electricity is created and how light is emitted.
  - Part 1 – Exploring Different Types of Light Bulbs (should take about 15 minutes).
    - 3 – 5 minute stations. Each row of tables will have a different set of light bulbs.
    - Have students observe the following kinds of bulbs (turned on): incandescent, fluorescent, halogen.
    - They should rank the temperature (they can feel the heat being emitted, but should not touch it), rank the brightness, and draw a picture of the bulb including the inside.
    - Discuss what the students observed using this as a lead in to part 2.
  - Part 3 – Light Bulb and Electricity Information Walk Around (should take about 15 minutes).
    - Rather than have students sit and read I prefer to complete this task using walk around activities.
    - Place pieces of information re: light bulbs around the room and have students rotate from one station to another (2-3 students per station). They should fill in the blanks on their lab write up.
    - Afterwards, students should answer the discussion questions.

  DAY 2 (50 MINUTES):
  - Part 3 – Building A Light Bulb
    - Explain to students that they will build a light bulb, but do not tell them what kind.
    - Go through the procedure on the lab write-up step by step (using visuals and modeling).

- Students should complete the circuit one battery at a time. They should make observations including temperature and what the nichrome wire looks like (i.e. glowing).
- After students have answered the discussion questions go over what they saw. Ask students to share their drawing of "How a light Bulb works" with two other groups. Using a diagram reinforce students' correct answers/clarify wrong ones.

Explanation:

I have included information from the "How Stuff Works" website - http://howstuffworks.lycoszone.com/fluorescent-lamp7.htm. Information that is discussed includes the following:

- How Light Bulbs Work
- Fluorescent Bulbs
- Halogen Bulbs

** Please note that I do not go into great detail with my English Language Learners. More detailed explanations as well as a more complex lab write up (i.e. use of more vocabulary/in depth discussion questions) should be used in mainstream and higher level classes.

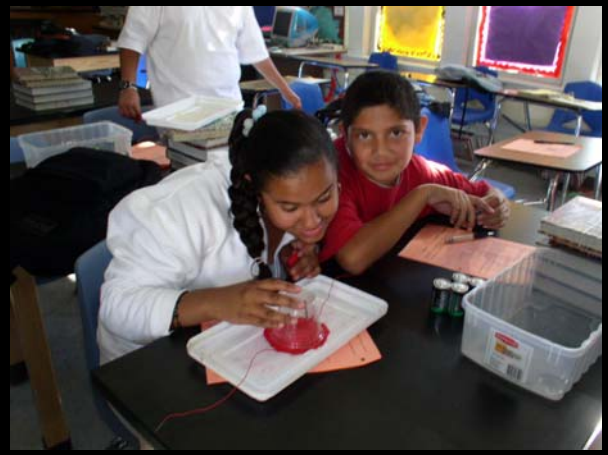
Applications to Everyday Life:

- **Choosing the Right Light Bulb:** Understanding how each type of light bulb works is important in choosing which is best for your home. This activity makes students aware of the advantages/disadvantages of using various types of bulbs (i.e. pollution, energy consumption, cost, etc).
- **Being Energy Efficient:** Students can apply the idea of conserving energy to other appliances in their home. This activity could be used to spur a discussion about other high energy consuming devices, various sources of energy, and methods to conserve our resources.

**** These ideas can be reinforced by performing an experiment at home. Students can log their current energy usage, come up with an idea of how to change their behavior or device to conserve energy, and log how this change affects their electricity bill.**

References:

Energy Coalition - http://www.energycoalition.org
Energy Star - http://www.energystar.gov
How Stuff Works - http://howstuffworks.lycoszone.com/fluorescent-lamp7.htm



Light Bulb Lab

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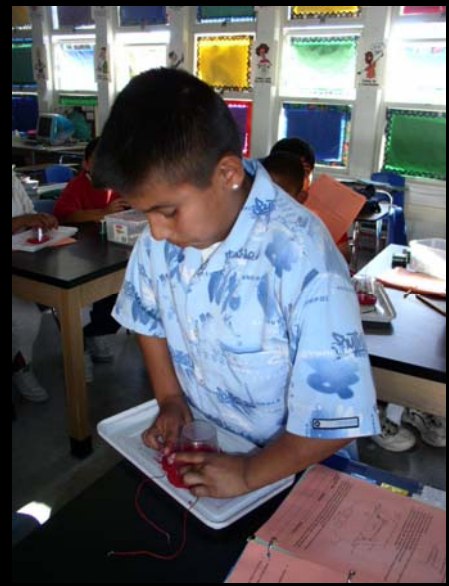

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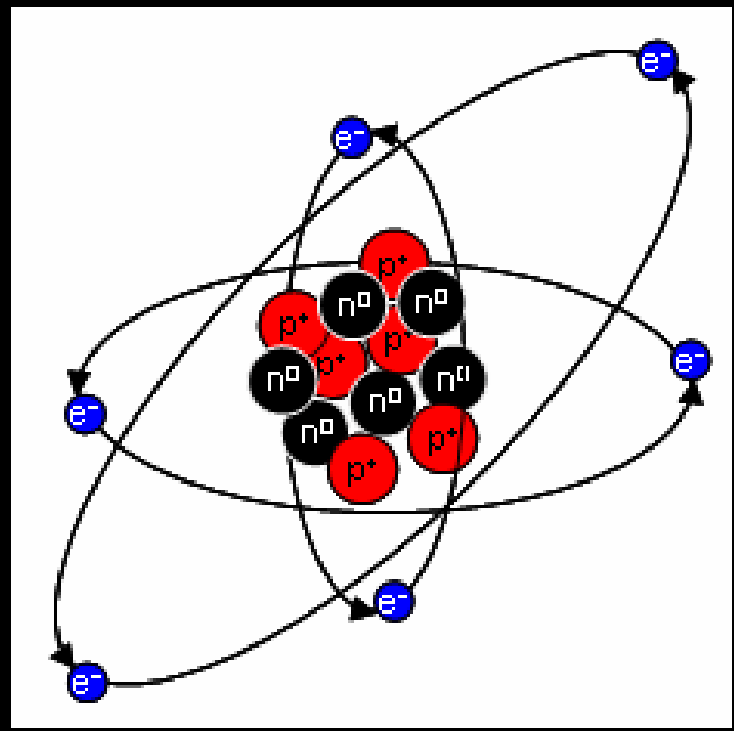
How Do We Get Electricity?

- Remember those atoms?
- What are atoms made up of?
  - Protons
  - Neutrons
  - Electrons
- Protons are **POSITIVE**.
- Neutrons are **NEUTRAL – no charge**.
- Electrons are **NEGATIVE**.



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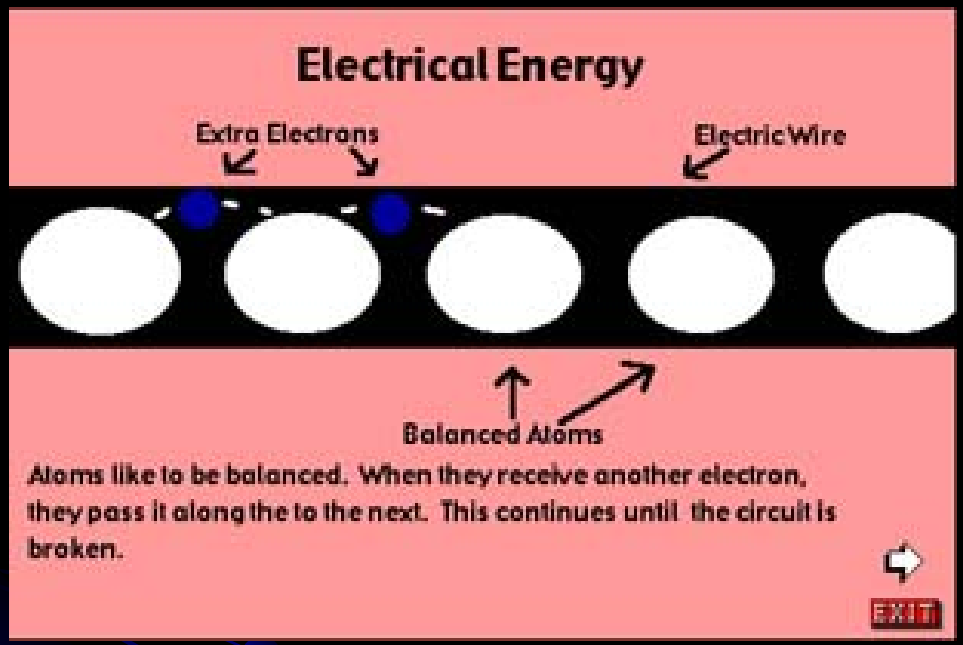
Atoms and Electricity



http://www.coe.ufl.edu/courses/edtech/support/teacher/TRL/Andy/hyperstudio.htm (3/7/2004)

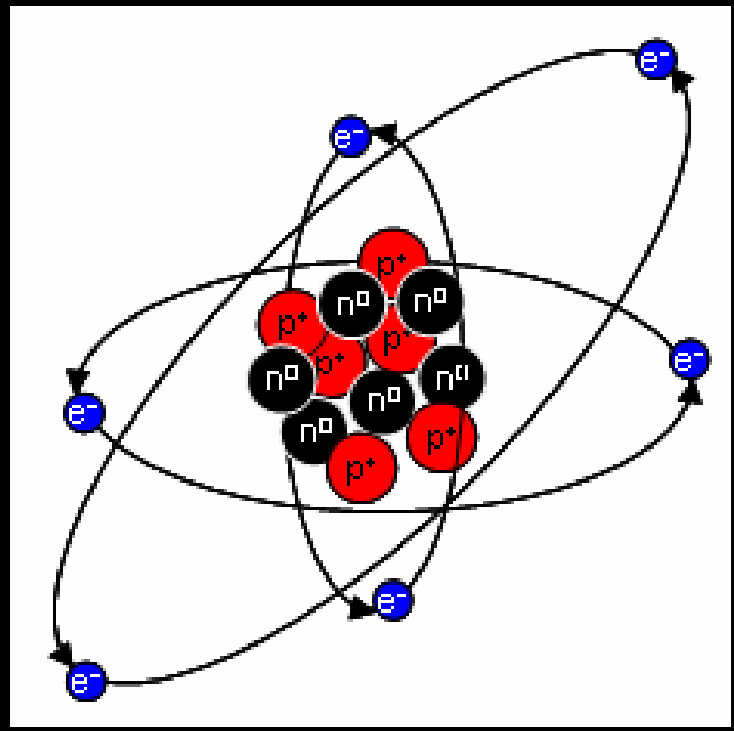
- Atoms can lose and gain electrons.
  - Atoms that lose electrons become positively charged.
  - Atoms that gain electrons become negatively charged.
- Atoms that lose or gain electrons are unbalanced. Atoms want to be balanced!

- Positive atoms attract electrons from other atoms while negative atoms repel the electrons it gained.
- This happens over and over and over making…

ELECTRICITY

Light Basics

- Light = form of energy released by atoms.
- Electrons move around the nucleus in different shells (orbitals).
- Electrons that have a lot of energy travel in orbitals that are farther from the nucleus.



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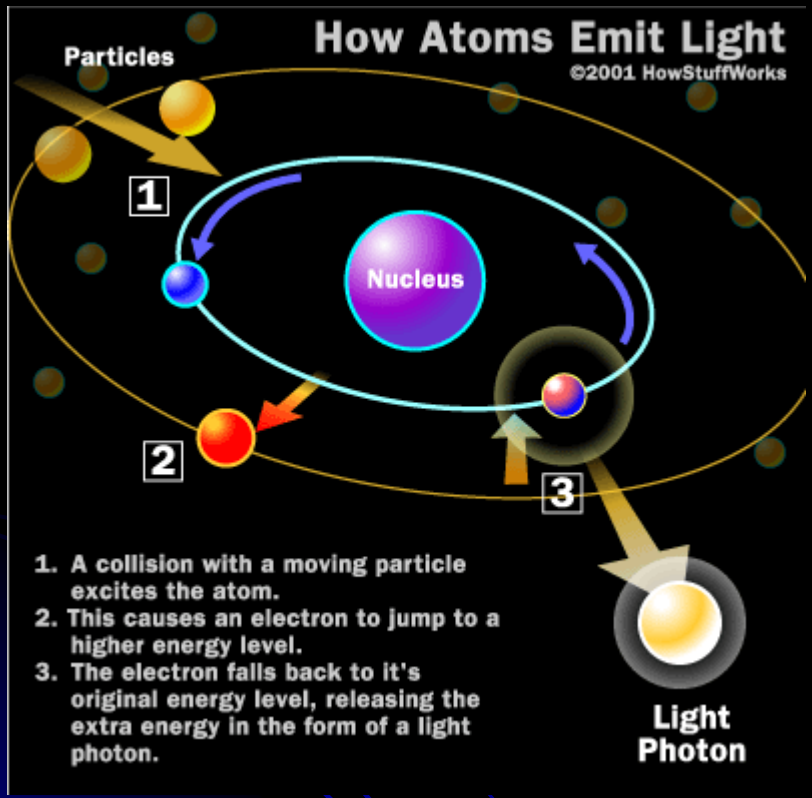
- Electrons close to the nucleus have LITTLE energy.

Light Basics Cont.



http://howstuffworks.lycoszone.com (3/7/2004)

- Electrons can get an energy boost! Where does an electron that gets an energy boost move to?
  - The next orbital.
- The electron will fall back its original orbital releasing the extra energy it had.
- The extra energy is released as light photons, which we can see!

Types of Light Bulbs

- There are three kinds of light bulbs:
  - Incandescent
  - Flourescent
  - Halogen

** Check out the different bulbs around the room.

www.onesourcelighting.com/../ default.asp (3/7/2004)

www.buylighting.com/capsylite-light-bulbs.htm (3/7/2004)

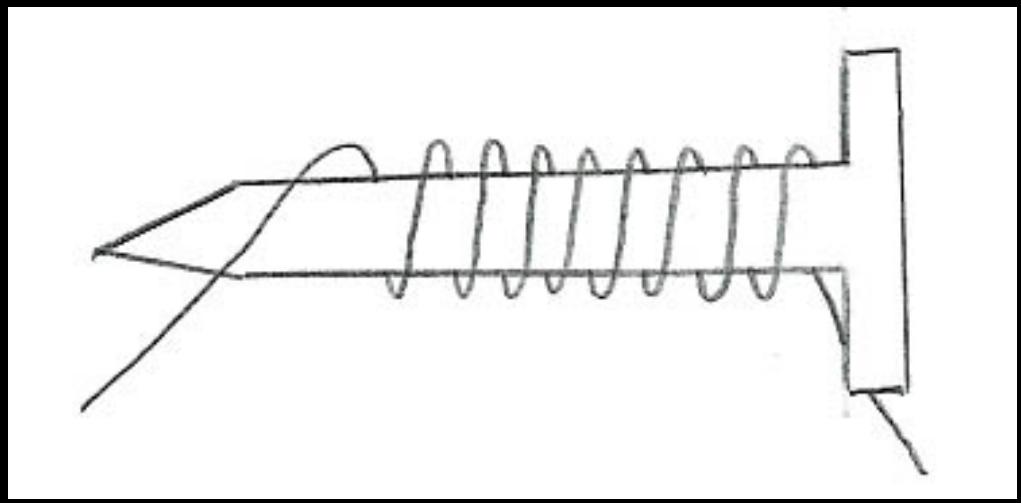
http://www.alliantenergy.com/stellent/groups/public/documents/pub/res_ia_cs_phn_010349.hcsp (3/7/2004)

Building A Light Bulb

- You should have the following in your box:
  - 10cm Nichrome Wire (pre-cut)
  - 15cm Insulated Copper Wire (2) – pre-cut
  - Nails (2)
  - Clear Plastic Cup
  - Modeling Clay
  - Tray
  - D Batteries (4)

Preparing Filament

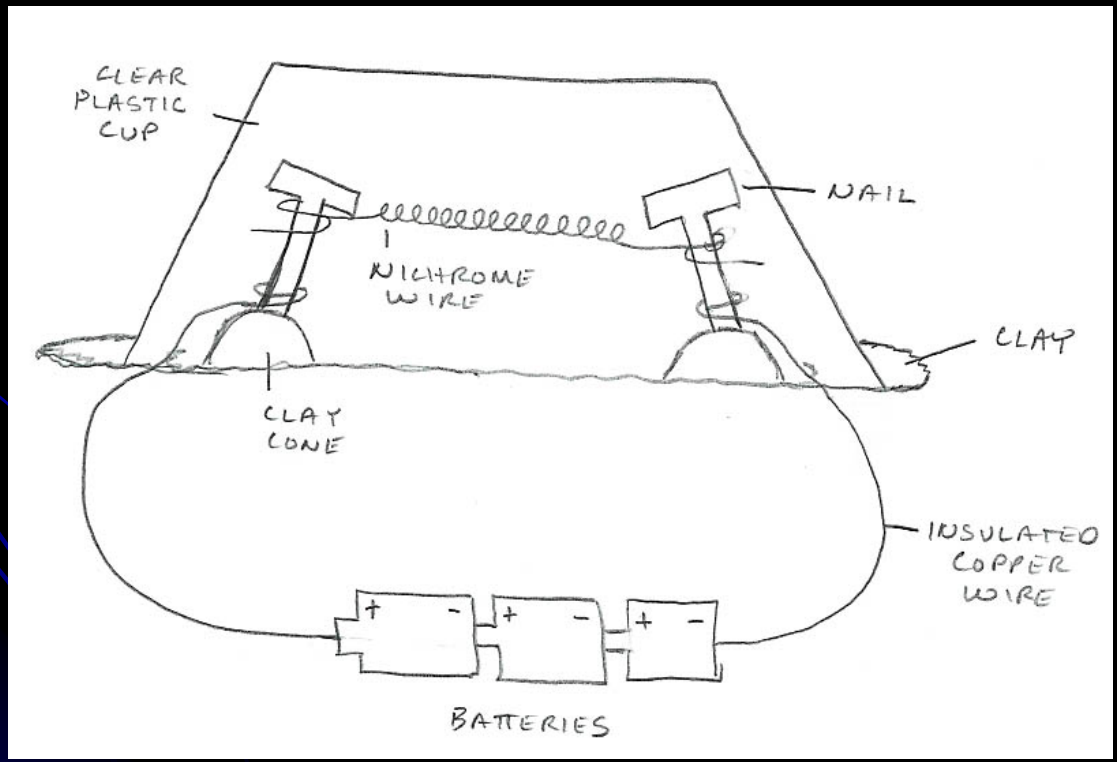
- Wrap the Nichrome Wire around one of the nails. Leave about 2cm of wire at each end.



- Once you are finished slide the coiled wire off the nail.

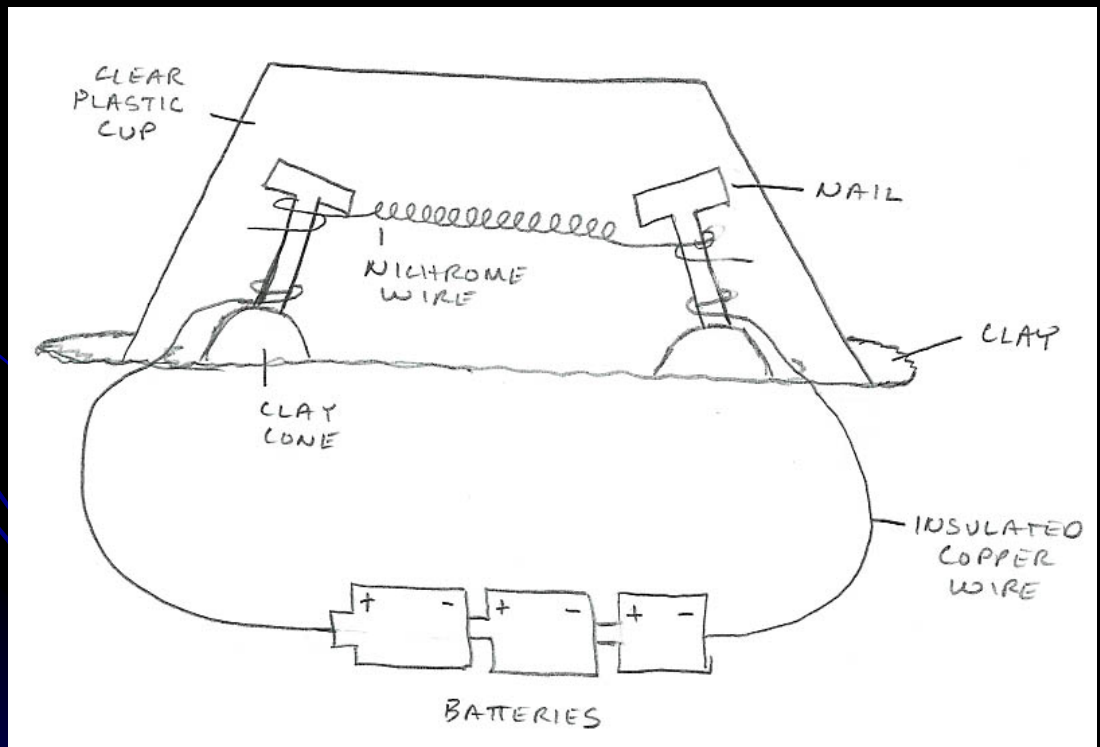
Preparing the Base

- Flatten a piece of clay like a pancake.
- Make two cones using the clay so the nails can stand up in the clay.



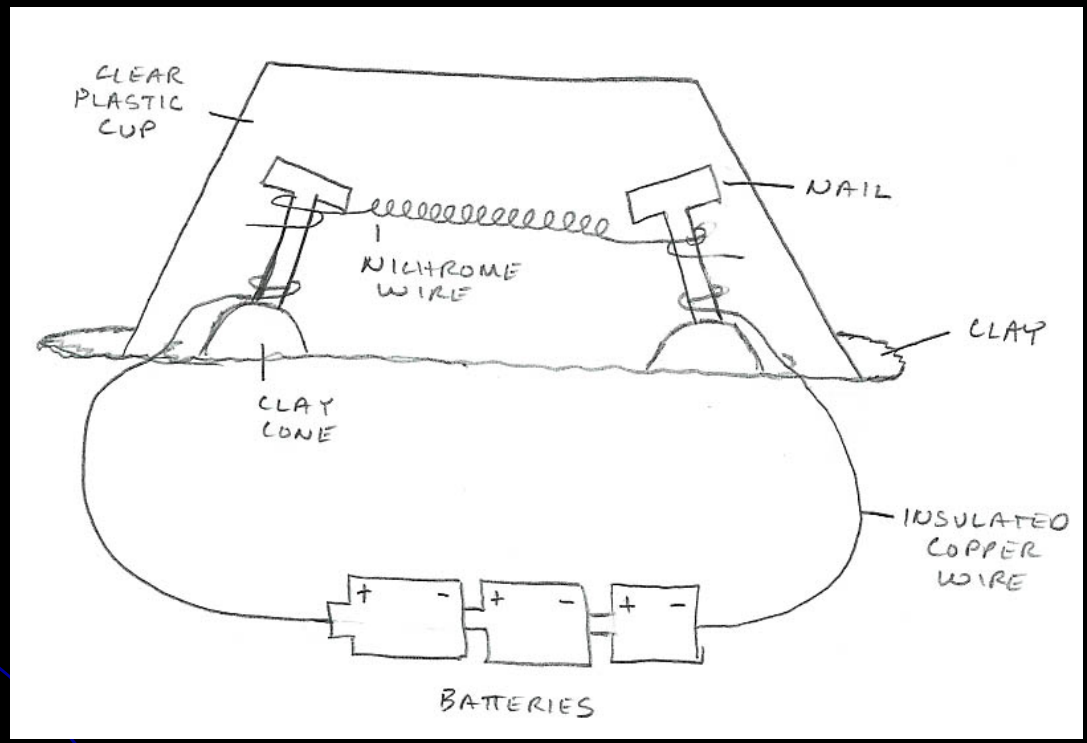
Setting Up the Bulb

- Stick the two nails in the clay cones slanting them slightly toward the middle.
- Attach the Nichrome Wire filament to the two nails.
- Attach the Insulated Copper Wire to the base of the nails.



Connecting the Circuit

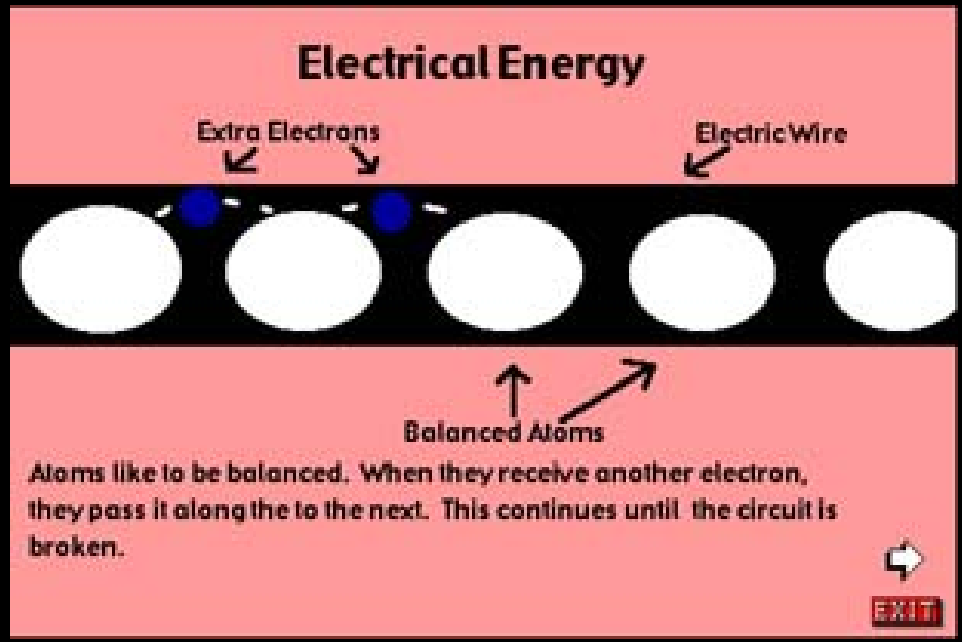
- Place the cup over your light bulb.



- Connect one battery to the circuit and record your observations. Keep adding batteries until you see the Nichrome Wire give off light.

Explanation

- Why was the Nichrome wire able to give off light?
  - Movement of electrons.
    - Atoms lose and gain electrons making them positive or negative = unbalanced.
    - Atoms want to be neutral.
    - Positive atom will attract electrons and the negative atom will push away electrons.
    - This flow of electrons creates electrical energy.



http://www.coe.ufl.edu/courses/edtech/support/teacher/TRL/Andy/hyperstudio.htm (3/7/2004)

- Some of the electrons got an energy boost and then released energy in the form of light photons.