Station Investigation Sheet

STATION 1: STATIC

Objective: Discover the way charges interaction with each other.

Materials: hole punches, plastic ruler, piece of wool, and balloons.

Procedure 1:

1. Place a handful of hole punches on the table.
2. Take the plastic ruler and rub it with a piece of wool.
3. Bring the ruler close to the pieces of paper.
4. Observe the effect the ruler has on the scraps of paper.

Observations: Write your observations here. Make sure to address what happens when the ruler comes close to the hole punches; when the ruler touches the hole punches; and any unexpected results.

Analysis:

1. When the ruler and the wool are rubbed together, the ruler gains electrons.
    a. What is the charge on:
        i. the ruler?
        ii. the wood?
        iii. the hole punches?
2. What happens to the negative charges on the hole punches when the ruler is brought next to them?

3. How could a negative object attract a neutral object? Explain in detail.

Procedure 2:

1. Blow up 2 balloons.
2. Rub each balloon in your hair for about 30-45 seconds.
3. Place the balloons on the wall.
4. Observe the interaction of the balloons.

Observations: Write your observations here. Make sure to address what charge the wall is, what charge your hair is, and what happens to your hair when you bring the balloon close.

Analysis:

1. What happens when 2 negatively charged balloons are placed next to each other?

2. What happens when 2 positively charged hairs are next to each other?

Procedure 3:

1. Turn on the plasma ball.
2. Place your finger or hand near the ball. Then touch the ball.

Observations: Write any and all observations here. Make sure to address what you *see, hear, and feel*.

STATION 2: SERIES CIRCUITS

Objective: Discover how to build a series and parallel circuit; investigate how a circuits components interacts together.

Materials: 2 aluminum foil strips, 2 lead wires, 1.5 V D-cell, 2 light bulbs, tape, ruler, scissors

Procedure:

1. Place a piece of paper on the lab table. Cut 2 strips of aluminum foil that are each 1 cm × 10 cm.
2. Tape the end of one lead wire to the positive terminal of the D-cell. Tape the end of the second lead wire to the negative terminal of the D-cell. Use tape to attach the aluminum foil strips to the paper.
3. Poke the free end of one lead wire through the top aluminum strip and tape it in place. Poke the free end of the second lead wire through the bottom aluminum strip and tape it in place.

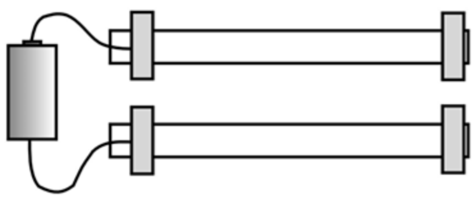

Figure 1

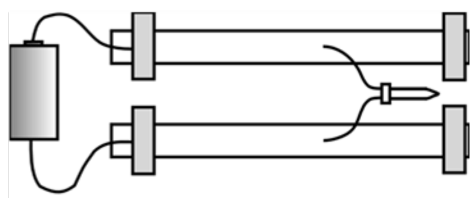

Figure 2

4. Press the exposed end of one lead wire from the light bulb onto the top aluminum strip. Press the other lead wire from the light bulb onto the bottom aluminum strip.
5. *Record your observations of the light on this sheet. Note its brightness.*
6. Cut a 1-cm gap toward the right end of the bottom strip and tape down the ends. *Record your observations of the light.*
7. Insert the second light across the gap in the bottom strip. Press one lead wire onto end segment of the strip.
8. *Record your observations of both lights. Note if the brightness of Light 1 has changed. Compare the current brightness of both lights.*

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9. *Record your prediction of what will happen to Light 2 if Light 1 is removed.* Remove Light 1 and *record your observations*.

Observations:

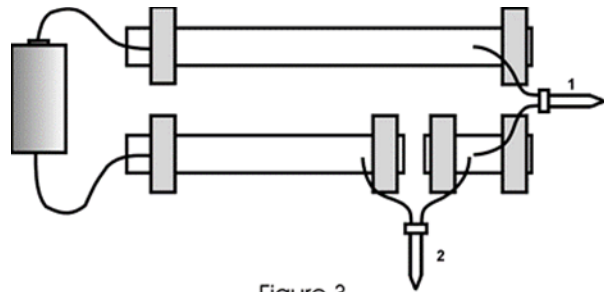


Figure 3

STATION 3: PARALLEL CIRCUITS

1. Place a piece of paper on the lab table. Cut 2 strips of aluminum foil that are each 1 cm × 10 cm.
2. Tape the end of one lead wire to the positive terminal of the D-cell. Tape the end of the second lead wire to the negative terminal of the D-cell. Use tape to attach the aluminum foil strips to the paper.
3. Poke the free end of one lead wire through the top aluminum strip and tape it in place. Poke the free end of the second lead wire through the bottom aluminum strip and tape it in place.

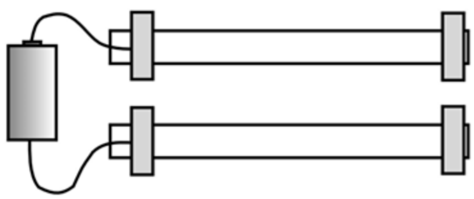


Figure 1

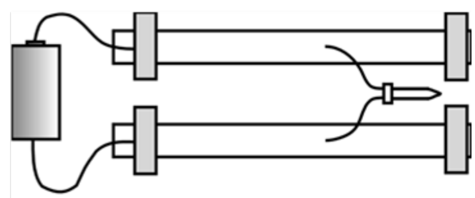


Figure 2

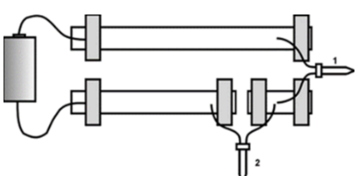


Figure 3

Make sure your circuit looks like Figure 3 before moving on to the next step.

4. Move Light 1 so that it connects the top strip to the left segment of the bottom strip. Attach Light 2 in the same manner as shown in Figure 4.
5. *Record your observations of both lights. Note their brightness.*
6. *Record your prediction of what will happen if Light 1 is removed.* Remove Light 1 and *record your observations.*
7. Replace Light 1 and *record your observations of both lights. Note any change in brightness.*

8. *Record your prediction of what will happen if Light 2 is removed*. Remove Light 2 and *record your observations*

Observations:

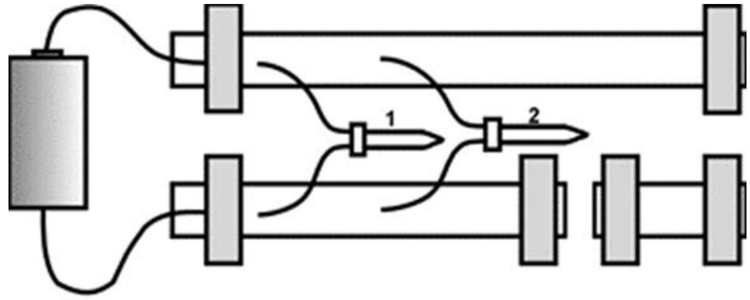


Figure 4

Analysis (for both Series and Parallel Circuits):

The brightness of a light in a circuit is directly related to the current in the part of the circuit containing the light. Use this information to contrast series and parallel circuits in terms of the following properties:

1. What happens to the current when a light is removed from the circuit?

2. What happens to the current when a light is added to the circuit?

3. How much of 1.5-V potential difference is supplied to each light?

4. Houses are wired using parallel circuits. Explain at least TWO disadvantages of wiring a house using series circuits.

STATION 4: OHM'S LAW

Objective: Discover how to calculate the different components of a circuit using Ohm's Law.

Materials: wire with alligator clips, bulbs with bulb holders, 9 volt battery, and a calculator

Procedures:

1. Create a series circuit with 1 bulb, 2 bulbs, and 3 bulbs.
2. Fill out the chart below, calculating the total current of each type of circuit you created?
3. Draw and label a diagram of each circuit below.

(R) Ohm's (Bulbs)	(V) Volts (Battery)	(I) Current (Amps)
1 bulb (1.5 Ω)	9 V	
2 bulbs (3 Ω)	9 V	
3 bulbs (4.5 Ω)	9 V	

- ✓ Battery is 9 volts;
- ✓ Bulbs are 1.5 ohm's of resistance each

Circuit Diagrams:

Analysis:

1. How does the current change with added batteries?

2. What can you say about the efficiency of this circuit? (how bright are the bulbs in each circuit)

3. How do you think numbers would change if you were calculating a parallel circuit?

STATION 5: INSULATORS AND CONDUCTORS

Objective: Students will classify objects as conductors or insulators.

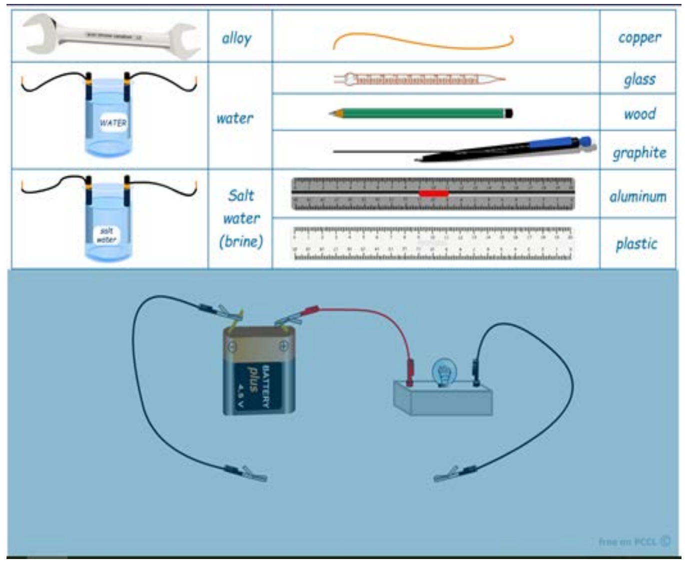
Materials: battery with holder, 3 insulated wires, 1 light bulb with holder, objects to test (wrench, water, saltwater, copper wire, glass, pencil (wood), lead (graphite), aluminum ruler, and plastic ruler)

Procedures:

1. Set up your circuit so you can test each object. See diagram here ❼
2. Fill out the data table, so you can document your results after each test.
3. Test each object to see if the object will light up the bulb (complete the circuit with each object).

Data Table

Object tested	**Did the bulb light up?**
Alloy Wrench	
Water	
Salt Water	
Copper	
Glass	
Wood	
Graphite	
Aluminum Ruler	
Plastic Ruler	



Analysis Questions

1. Which objects conducted electricity well and which did not?

2. How can you tell if an object is an insulator or a conductor in this experiment?

3. Which materials were conductors and which were insulators?

4. How do you think insulators and conductors are different in terms of the flow of electrons?

5. Using your answer from #4, write your own definition for "conductor" and "insulator".

STATION 6: MAGNETISM

Objective: Discover how magnets interact with each other and other objects.

Materials: bar magnets, iron filings, neodymium disc magnets, and various metal objects.

Procedures:

1. This is a playing station. Play with the objects provided to you. Write your observations below.

Things to remember:

- ✓ Magnets do harm electronics so keep your cell phones away from the magnets.
- ✓ Please clean up after yourself.

Observations:

Analysis Questions:

1. Write down 5 things you learned about magnets during this play station.

2. What are 2 things you found shocking after this station?

STATION 7: ELECTROMAGNETS

Objectives: To show the relationship between an electric current and the magnetic field associated with it. To make and use an electromagnet. To apply the principles learned in the unit and create a simple rotating motor to use later in your culminating project.

Materials: Supplies for each group: 4 ceramic magnets, 1 – #30 Magnet wire 200ft, 1 bulb – 1.5 V, 1 cardboard strip - 8 cm x 30.4 cm, 1 large nail – 8 cm in length, sandpaper, and tape.

Procedures:

1. Make the cardboard strip, scoring the cardboard at 3.5 cm and 3.2 cm.

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2. Fold it like this and tape it securely.

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3. Use the nail to poke a hole perfectly straight through the center of the box, going through both sides and all three layers of cardboard. Then pull the nail out and use it to widen all the holes slightly, so when you put the nail back through, it will be a bit loose and able to spin.

(You can find the exact center by drawing an "X" to the corners using a ruler.)

4. At this point you should clamp your four magnets around the nail and give it a spin. This makes sure the box is large enough. The nail and magnets should spin freely. The corners of the magnets should NOT bump the inside of the box as they spin.

5. Pick the spool of #30 magnet wire and tape one end of the wired to the side of the box, then wind all of the wire onto the box as shown. This gives 250 turns. It's OK to cover up the nail hole. Pull the taped end of the wire out, then tape down both ends of the wire so the coil doesn't unwind. You should have about 10 cm of wire sticking out.

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6. Use sandpaper to scrape the thin plastic coating off 2 cm of the wire ends. Remove every bit of red coating, so the wire ends are coppery.

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7. Spread the wire away from the nail hole and tape it in place. Stick the nail back through the holes and make sure it can spin. Take your four magnets, stick them face to face in two pairs, then stick the two pairs inside the box and on either side of the nail so they grab the nail.

Push them around until they are somewhat balanced and even, then spin the nail and see if they turn freely. If you wish, you can stick 2cm squares of cardboard between the magnets to straighten them, and tape the magnets so they don't move around on the nail.

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=================|| NAIL
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    SIDE VIEW OF THE
    NAIL AND MAGNETS
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VIEW FROM THE END
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8. Twist the scraped end of each generator wire securely around the silver tip of each wire from the small light bulb. One generator wire goes to one light bulb wire, the other generator wire goes to the other light bulb wire, and the two twisted wire connections should not touch together. In the twisted wires, metal must touch metal with no plastic in between.

TWIST THE WIRES TOGETHER

Make sure that each end of the generator's wires are totally cleared of red plastic coating. If there is a bit of plastic left, it can act as an insulator which turns off your light bulb circuit.

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TEST IT (This is your analysis part of this station)

Spin the magnet REALLY fast and the bulb will light dimly. If it doesn't work, try spinning it in a dark room so you don't miss the dim glow. If needed, adjust the position of the magnets so they don't hit or scrape the cardboard. This thing has to spin *fast*, and if the magnets whack the cardboard and slow down, you won't see any light. Spin it faster than eight revs per second.

Once you get it to work, try clamping the point of the nail into the chuck of a hand-crank drill. Spin the magnets fast with the drill and the bulb will light brightly. Don't go too fast or you'll burn out the bulb, or maybe fling magnets all over the room. You can try this with an electric drill as well, although electric drills don't spin as fast.

1. Did it work?! Why or why not? Explain what you will do if it doesn't work.