Milwaukee Area Technical College

Recess Project

PHYSICAL SCIENCE EXPERIMENTS

by
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INTRODUCTION

Presently, Physical Science Survey (806-231) is a lecture class. Students are primarily learning scientific facts. Although, they do see some demonstrations of physical phenomena, as well as perform demonstrations themselves, the course in structured in a non-laboratory environment.

To fully gain the skills required to excel in the work and academic environment, these students also need to develop their analytic skills through performing laboratory experiments. In other words, they need to learn how to measure parameters and physical variables, and then to take those measurements, analyze them, and draw conclusions.

This teacher's guide of experiments can be used to enhance the *Physical Science Survey* course with an added laboratory period.

Three types of experiments

There are three type of experiments or reasons to perform experiments:

- **Demonstration**: Show or demonstrate a phenomenon. For example, show how light is made up of colors, or demonstrate how sound reflects off a wall. It answers the question: What happens?
- **Measurement**: Measure or compare with some standard or known quantity. Includes compound measurements such as the speed of an object (measurement of distance and of time). It answers the question: How much?
- **Relationship measurements**: To determine the relationships between objects or phenomenon, so that the student can analyze the data and draw conclusions or establish rules. For example, determine the relationship between heat and volume of a balloon. It answers the question: What is the relationship and the resulting law?

Typically, the instructor provides demonstrations to the class. Learning to measure is important for the students, especially because it is applied in determining the relationship between two or more phenomena. Studying the relationships is where the analytic thinking skills are them developed.

Equipment needed

All of the following experiments require the simplest of equipment. Much of it can be found at home. The philosophy here is:

1. There may not be equipment available in the MATC laboratories.
2. Students would be able to perform experiments on their own or at home.

1.0 Experiments with Basic Measurements

Introduction

Why measure things?

The reason people want to measure objects is to compare similar items, to organize them, and perhaps to classify the material. For example, you may want to compare the weight of several objects, to organize children according to height, or to classify rocks according to their size and weight.

About measurement

The basic characteristics to measure in the world around you are:

- length (which leads to distance, area, volume, and size)
- weight or mass
- time

All measurement is relative to a unit of measurement, such as the inch, the meter, the gram, or the second.

Other measurement considerations

Since measurement is relative to an arbitrary unit of measurement, you often may have to convert from the unit used by person or country to that system used by another. The example of this is converting from the English system to the metric system.

Another aspect of measurement is accuracy. Often measurements must be repeated to ensure they are sufficiently accurate. This is especially true with very small or very large values.

Finally, there are many quantities that are a combination of other measurements. For example velocity is determined by measuring distance and time. Other common combinations include acceleration, density, energy, momentum, and force.

Experiment 1.1: Determine metric to English conversion factor

Question:
How many centimeters are in one inch?

Material:
Yard stick
Meter stick
Table

Steps:
1. Measure the length of a table in inches.
2. Measure the length of a table in centimeters.
3. Determine the ratio of centimeters to inches.

Outcome:

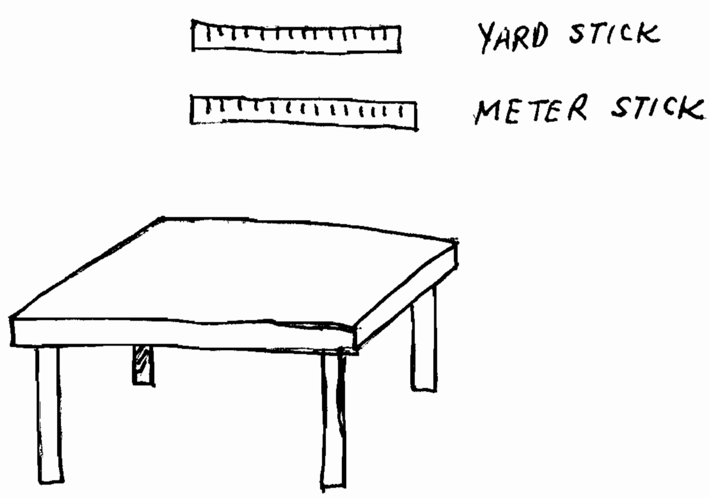

Figure 1.1 Measuring a table

Experiment 1.2: Make a simple scale

Question:

How can you measure the relative weight of an object?

Materials:

Stick
String
"Standard weight" (may be arbitrary)
Ruler
Weight to measure

Steps:

1. Loop a string at the measured the center of the stick.
2. Tie your standard weight at one end of the stick and the weight to measure at the other end.
3. Adjust the center loop one way or the other on the stick until the weights are balanced.
4. Measure the lengths from the ends of the stick to the loop.
5. Determine the relative weight of the object by the relationship: $w = WL/l$

Outcome:

How does this scale work?
Where does the equation come from?

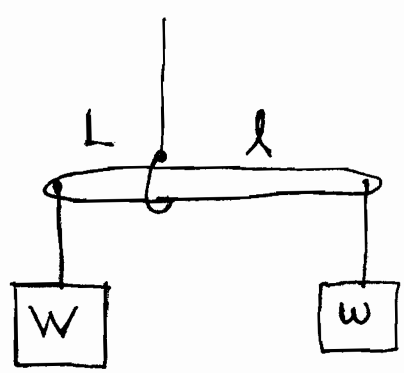

Figure1.2: Make a simple scale

Experiment 1.3: Measure the weight of a liquid

Question:

How can you measure the weight of a quantity of water, when it will just flow off the scale?

Materials:

Water in beaker
Scale
Second beaker

Steps:

1. On the scale, measure weight of a quantity of water in a beaker.
2. Pour water into second beaker.
3. Measure the weight of the first beaker.
4. Determine the weight of the water.

Outcome:

Why did you have to measure the weight of the beaker?

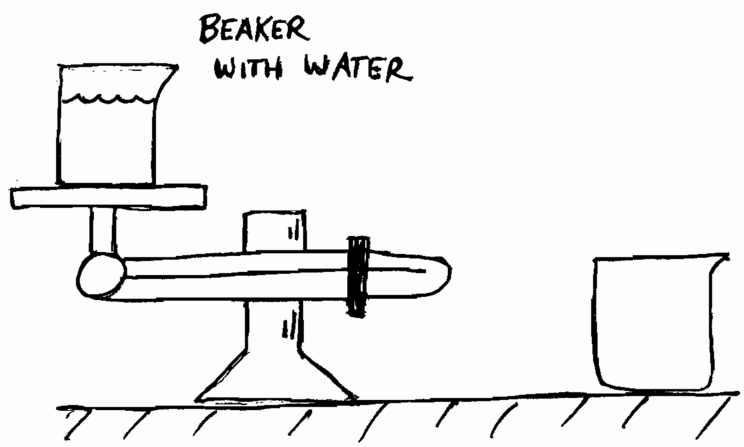

Figure 1.3: Measure the weight of a liquid

Experiment 1.4: Measure the density of an object

Background:

Density is related to other measurements. It is defined as the ratio of an object's weight per unit volume. In other words, density is determined from measuring both the weight and volume of an object.

Material:

Rectangular object
Scale
Ruler

Steps:

1. Weigh the object.
2. Measure the object's sides and determine its volume.
3. Calculate its density.

Outcome:

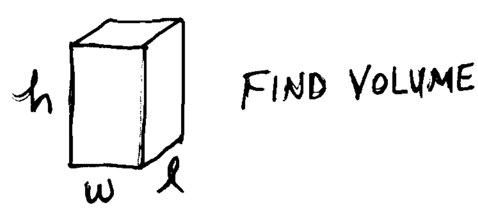

Figure 1.4: Measure the density of an object

Experiment 1.5: Measure the average velocity of a moving object

Background:

Velocity is related to the measurement of distance over a given time. In other words, velocity is defined as *distance traveled / period of time.* This is also the *Average Velocity* if the velocity changes over the distance.

Material:

Stopwatch
Tape measure
Ramp
Rolling object

Steps:

1. Measure the length of a ramp.
2. Let the object roll down the ramp.
3. With the stopwatch, measure the time from the beginning to the end of the run.
4. Repeat experiment, as necessary.
5. Calculate the average velocity of object.

Outcome:

What was the initial velocity?
What was the final velocity?

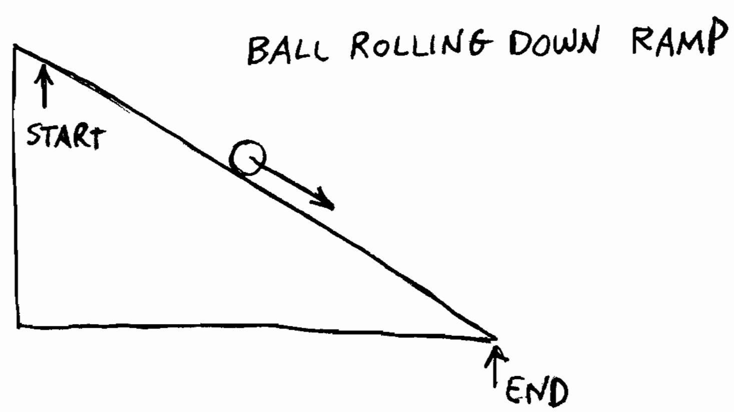

Figure 1.5: Measure the average velocity of an object

2.0 Experiments with Newton's Laws of Motion

Background

Newton's Laws are difficult to prove or verify, because they concern an ideal environment without air resistance or friction. Most experiments showing Newton's Laws are only approximations with resistive forces minimized as much as possible.

A simple definition of a force is a push or pull on an object. Energy is defined as the ability to move matter.

Newton's Laws

Newton's Laws may be summarized as:

1. Objects at rest tend to stay at rest unless acted upon by a force.
2. Objects in motion keep moving in a straight line unless acted upon by a force.
3. A force acting on a mass causes it to accelerate (or decelerate)
4. The energy and momentum in a closed system remains constant (Law of the conservation of energy and momentum)

Experiment 2.1 Determine relationships in centrifugal force

Question:

What is the relationship between speed and force, when spinning a weight on a string?

Material:

Weight
String
Spring scale
Stop watch
Tape measure or ruler

Steps:

1. Tie weight to one end of string and spring scale to other end
2. Measure distance from weight to end of scale.
3. Holding end of scale, swing weight at a regular rate and parallel to the ground.
4. Observe the force or weight pulling on the scale.
5. Another person measure the time to go around one revolution (perhaps measure time for several rotations and divide by the number of rotations).
6. Repeat steps 3 to 5 at a different speeds.
7. Calculate velocity or speed of weight (circumference / time for one revolution).
8. Plot Force vs. Velocity.

Outcome:

What is the circumference of the circle?
What rule can you determine from this experiment?

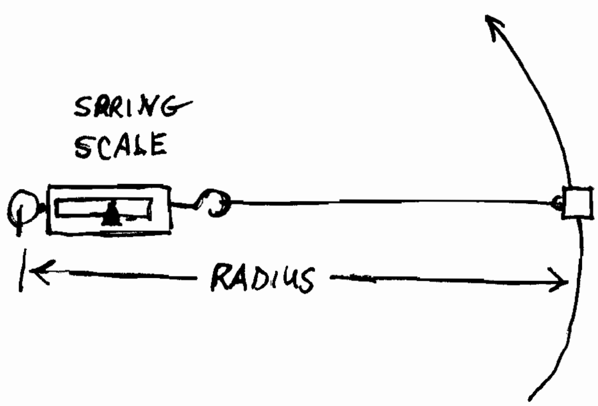

Figure 2.1 Determine relationships in centrifugal force

3.0 Experiments with the Force of Gravity

Experiment 3.1: Show relationship between velocity and distance traveled

Question:

Does a falling object increase in speed or stay at the same speed as it falls?

Material:

An object to drop
Stopwatch
Tape measure

Steps:

1. Have the ability to drop the object at different measured heights.
2. Measure the distance to drop the object.
3. Drop the object and measure the time it takes to hit the ground.
4. Repeat the measurement for accuracy.
5. Change the distance and repeat steps 2 - 4.
6. Calculate the average velocity for each height.
7. Plot a graph of average velocity vs. height.

Outcome:

What conclusion or rule can you determine from this experiment?

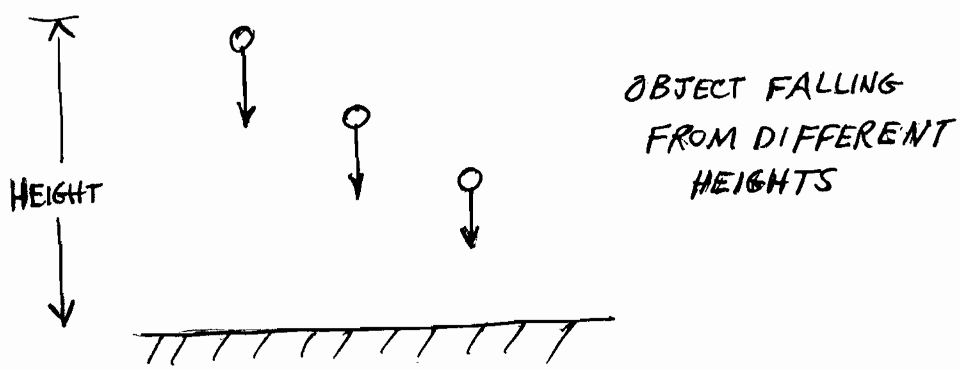

Figure 3.1: Show relationship between velocity and distance traveled

Experiment 3.2: Determine the relationship between the weight of an object and its rate of fall

Question:

If you drop two objects, with one weighing twice as much as the other, from the same height, which one would hit the ground first?

Material:

Several objects of different weights (not real light, like paper or such)
Scale

Steps:

1. Weigh objects.
2. Drop two objects at exactly the same time from the same height.
3. Note which one hits the ground first.
4. Try at different heights.
5. Repeat experiment, as necessary.

Outcome:

Show the relationship between weight, height, and rate of fall of objects.
What conclusion or rule can you draw from this experiment?

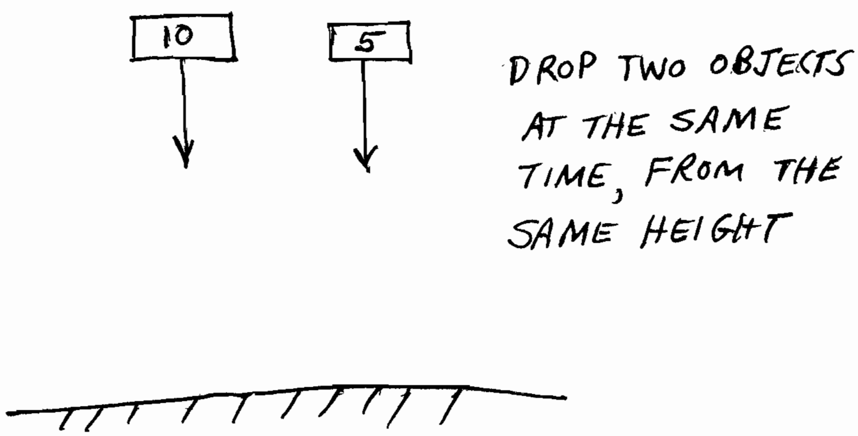

Figure 3.2: Determine the relationship between the weight of an object and its rate of fall

Experiment 3.3: Show the relationship between the rate of fall of an object and its sideways motion.

Question:

Which will hit the ground first? A bullet shot from a gun parallel to the earth, or a bullet dropped from the same height at the same time?

Material:

Two objects of the same weight (two coins, two balls etc.)
A platform from which to drop.

Steps:

1. Place one object near the edge of the platform or table, and hold the other one away from the platform at the same height.
2. At the same time, flick the object on the platform out and drop the other object.
3. Observe which one hits the ground first.
4. Repeat, as necessary, to get an accurate reading.

Outcome:

What conclusion or rule can you draw from this experiment?

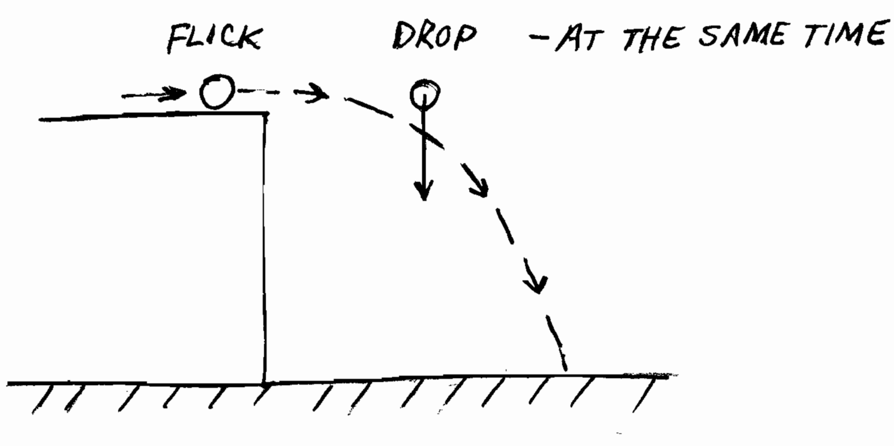

Figure 3.3: Show the relationship between the rate of fall of an object and its sideways motion

4.0 Experiments with the Resistive Force of Friction

Background

If you push or pull on an object, it should accelerate according to the force. Once the force is stopped, it should continue to move at a certain velocity.
If the object is moving at a velocity and there is a constant force applied in the direction opposite its movement, it will slow down.
Such a force is considered a resistive force. Air resistance and friction are examples of such a force.
Friction is the resistance caused by surfaces rubbing together.
It is independent of speed but dependent on how hard the surfaces are pushing against each other. Thus a heavy object is more difficult to slide than a light object. Also, that is the principle of brakes on a car.

There is sliding friction and sticking friction.

Experiment 4.1: Show the relationship between friction and weight

Question:

What would happen to the force to overcome friction if you would double the weight of an object?

Material:

Spring scale
String
Board
Weights

Steps:

1. Weigh the board.
2. Attach the string to the board and the scale.
3. Pull the board parallel to the ground at a constant velocity.
4. Observe the force required to pull the board.
5. Add a weight on the board.
6. Repeat steps 3 to 5 for several different weights.
7. Plot the total weight of the board and its weights vs: the force required to pull it.

Outcome:

What is the rule concerning force and friction?
How does this apply to automobiles?

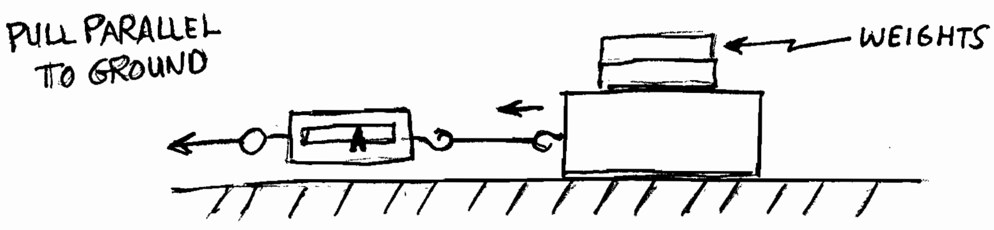

Figure 4.1: Show the relationship between friction and weight

5.0 Experiments with Periodic Wave Motion

Experiment 5.1: Measure time with a pendulum

Question:
How can a pendulum be used to measure time?

Material
Weight
Long length of string
Stop watch
Ladder

Steps:
1. Attach the weight to the end of a long string.
2. Stand on a ladder, holding the end of the string, so that the weight will swing (this is a pendulum).
3. With the stop watch, measure how long the pendulum takes to go back and forth (its period).
4. Adjust the length of the string until the period of the pendulum is a multiple of seconds.
5. Use the pendulum to determine time.

Outcome:

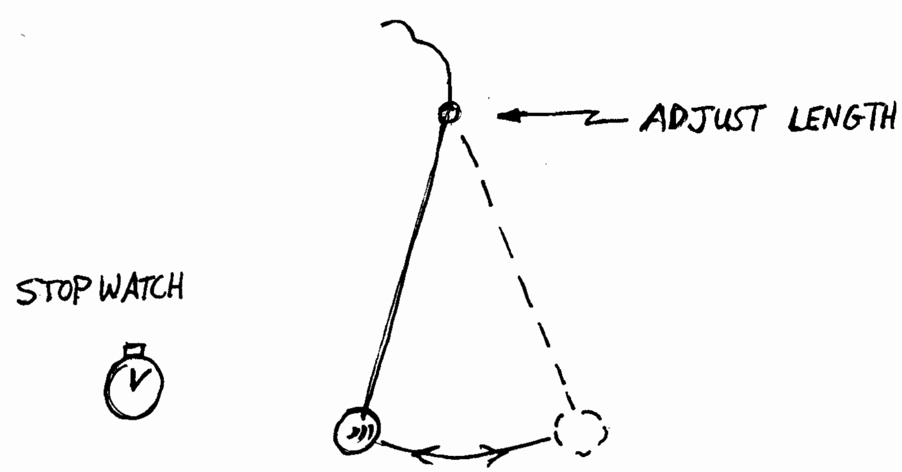

Figure 5.1: Measure time with a pendulum

Experiment 5.2: Demonstrate a pulse wave, a longitudinal wave, and a compression wave

Question:
What do the various types of waves look like?

Material:
Slinky

Steps:
1. Stretch Slinky between two people.
2. Give it a sharp back and forth motion to show an impulse.
3. Repeat the back and forth motions to show compression waves.
4. Repeat sideways motions to show longitudinal waves.

Outcome:

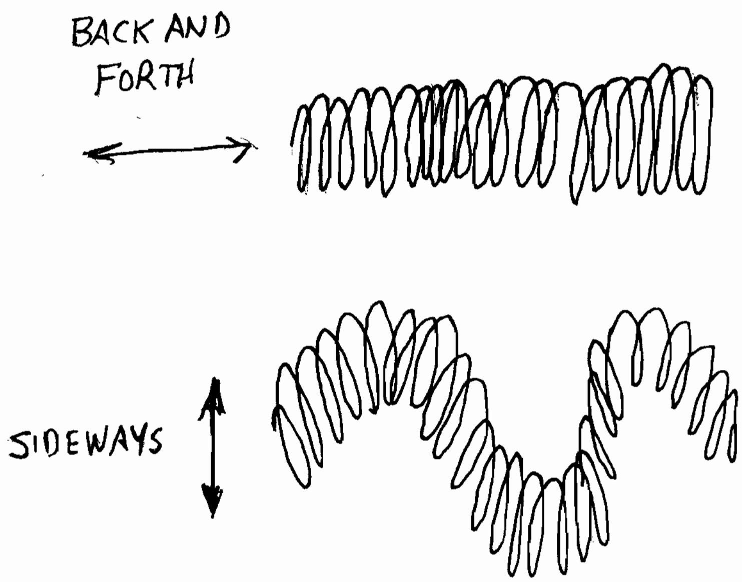

Figure 5.2: Demonstrate a pulse wave, a longitudinal wave, and a compression wave

Experiment 5.3: Determine the relationship between amplitude and velocity of a wave

Question: How does the velocity of a wave vary with it amplitude?

Suppose you increased the amplitude of a wave. Would the speed increase, decrease, or stay the same?

Materials

Slinky or rope
Ruler
Stopwatch
Several people are required

Steps

1. Loosely hold a length of rope between two people.
2. On one end, the person should move the rope up and down once to make an impulse wave.
3. Another person should make an "eyeball measurement" of the amplitude of the wave. (Perhaps compare with a scale in the background)
4. A third (or fourth) person should measure the time it takes the wave to go from the first person to the end of the rope.
5. Repeat the experiment with other relative amplitudes.
6. Plot the velocity vs. the amplitude.

Outcome

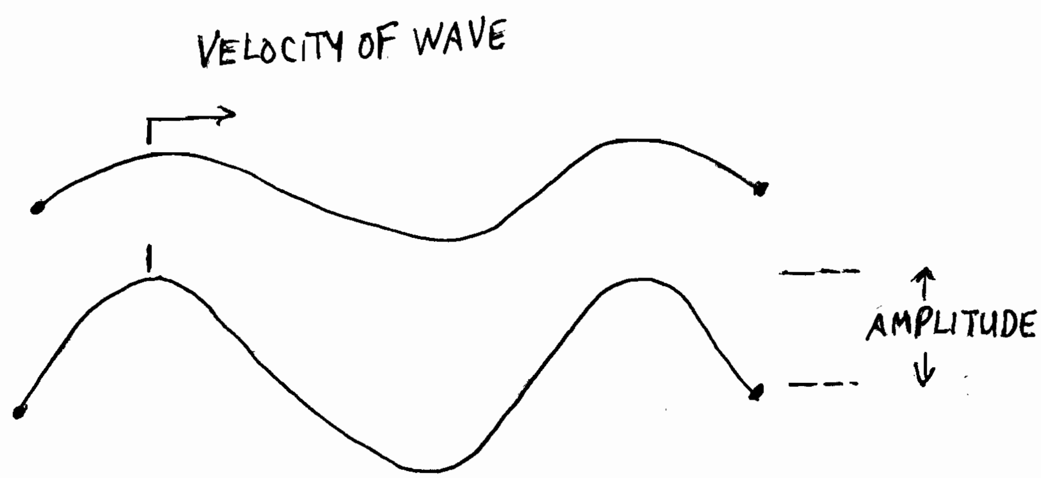

Figure 5.3: Determine the relationship between amplitude and velocity of a wave

Experiment 5.4: Demonstrate standing waves

Question:

What is a standing wave?

Material:

Rope

Steps:

1. Stretch the rope between to people.
2. Move one end back and forth in a sideways direction to create longitudinal waves.
3. Adjust the rate of motion to create only one wave form.
4. Adjust the rate of motion to create only two wave forms.
5. Adjust the rate of motion to create only three wave forms.

Outcome:

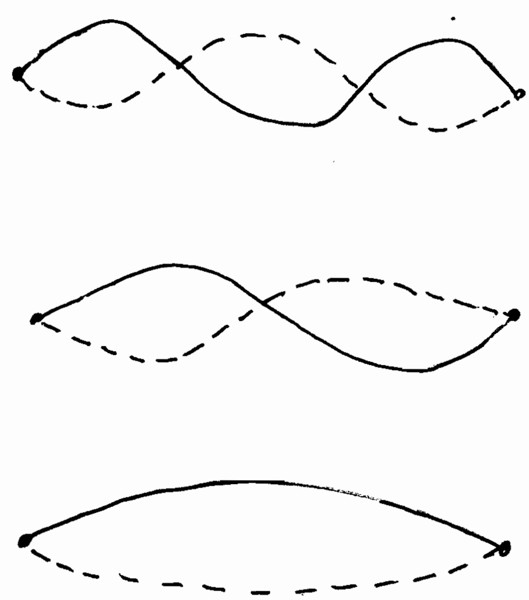

Figure 5.4: Demonstrate standing waves

6.0 Experiments with Sound

Experiment 6.1: List observations about sound

List various types of sources of sounds in your personal environment.

Classify any common factors on how those objects create sounds.

List various ways to detect sounds.

Does sound travel in other materials besides air? If so, list some examples.

List some special characteristics of sound that you have observed.

Experiment 6.2: Measure the speed of sound in air

Question:
How fast does light travel?

Materials:
Stopwatch
Yardstick or tape measure
Gong or other noise-maker and hammer

Steps:
1. One person with a hammer and gong or other source of sharp sound stands at a measured distance (at least a block away) from a second person with a stopwatch.
2. When the first person is seen hitting the gong, the second person starts the watch.
3. When the sound is heard, the watch is stopped.
4. Determine the speed or velocity of sound from the equation: $v = d/t$
5. Repeat the experiment several times to get an average reading.

Results:

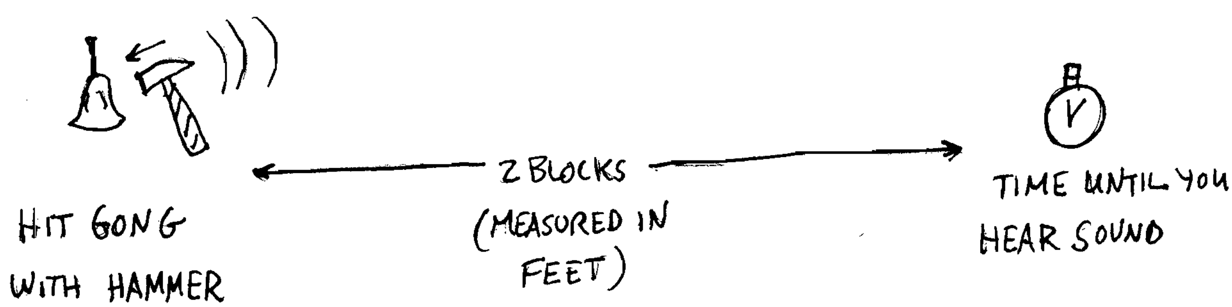

Figure 6.2: Measure the speed of sound in air

Experiment 6.3: Measure the relative loudness or amplitude of a sound in air

Question:

How can you measure how loud a sound is?

Material:

Microphone
Hi-fi amplifier with AU meter
"Standard" source of sound (repeats same volume each time)
Ruler or yardstick
Other sources of sound

Steps:

1. Set up amplifier at a given gain and volume.
2. Set your "standard" source of sound at a given distance from microphone.
3. Measure reading on AU meter. (If the meter goes off scale, adjust the gain, volume, and/or distance so the reading is mid-range).
4. Measure the readings for other sound sources at the same distance from the microphone.

Results:

Determine the relative loudness of each sound source, with respect to your standard.

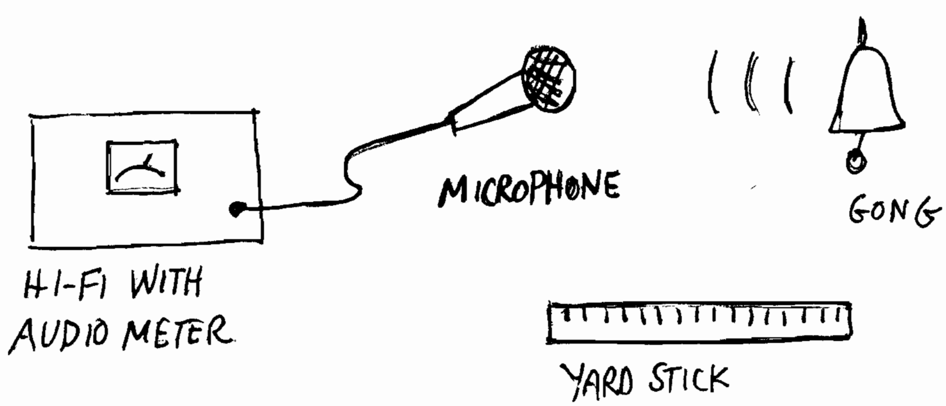

Figure 6.3: Measure the relative loudness or amplitude of a sound in air

Experiment 6.4: Determine the relationship of loudness vs. distance

Questions:

How does loudness vary with distance?
What is your guess on the relationship?
Can you predict the loudness if the distance is doubled?
Can you predict the loudness if the distance is cut in half?

Material

microphone
hi-fi amplifier with AU meter
"standard" source of sound (repeats same volume each time)
ruler or yardstick

Steps

1. Set up amplifier at a given gain and volume.
2. Set your "standard" source of sound at a given distance from microphone.
3. Measure reading on AU meter. (If the meter goes off scale, adjust the gain, volume, and/or distance so the reading is mid-range).
4. Set the standard source at twice the distance from the microphone and note its reading on the AU meter.
5. Set the standard source at half the original distance from the microphone and note its reading on the AU meter.
6. Try a few other distances.
7. Plot a graph of meter reading vs. distance

Results

Outcome:

What conclusions or rules can you draw from the results of this experiment?

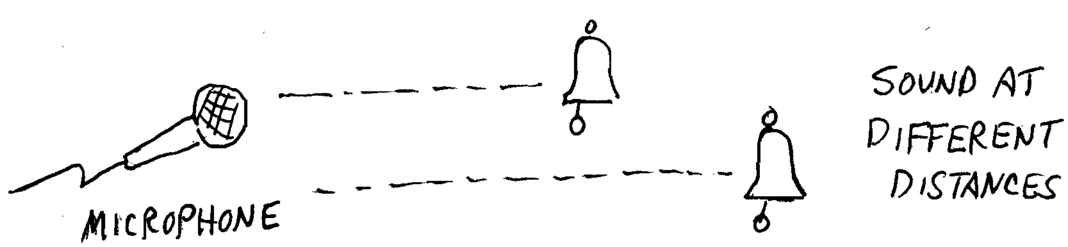

Figure 6.4: Determine the relationship of loudness vs. distance

Experiment 6.5: Demonstrate the energy of sound

Question:

Does sound have energy?
If so, can sound actually move and object?

Material:

Hi-fi system with large speaker (or a drum and drumstick)
Light paper cone

Steps:

1. Put light paper cone in front of loud speaker or drum.
2. Bang the drum or crank up the volume on the speaker.
3. Observe the effect on the paper cone.
4. Repeat experiment with the cone a different distances from the source of sound.

Outcome:

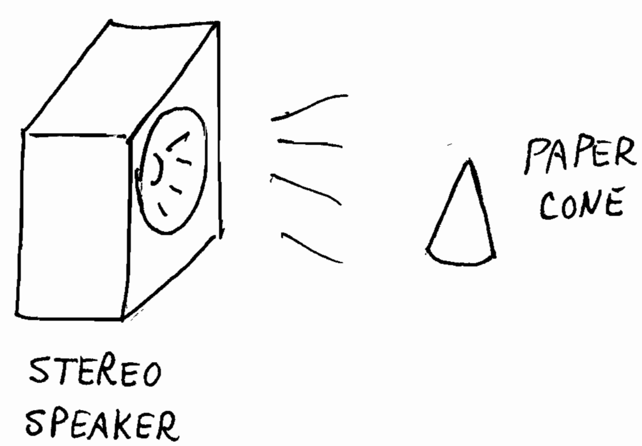

Figure 6.5: Demonstrate the energy of sound

7.0 Experiments with Visible Light

Experiment 7.1: List observations about visible light

This is the first type of experiments people can do. They look at their environment around them and perhaps try things out to learn more about the phenomenon.

Look around and list various types of sources of light in your personal environment.

Examine sources and try to classify any common factors on how those objects create light.

Look around and list various natural or manmade devices used to detect light.

List materials that light passes through. Experiment with different material to see of light will pass through them.

List some special characteristics of light that you have observed.

Experiment 7.2: Compare how different colors absorb and hold heat energy

Question: What is the relationship between color and absorption of light energy?
Guess which color absorbs more heat: red, white, or dark blue?

Material
Different colored metals (different colored cars may be used)
Sunlight

Steps
1. Feel pieces of metal (such as the hood a cars) of different colors that have been in the sun.
2. Compare the temperature (relative to your touch) with the color of the metal.

Outcome

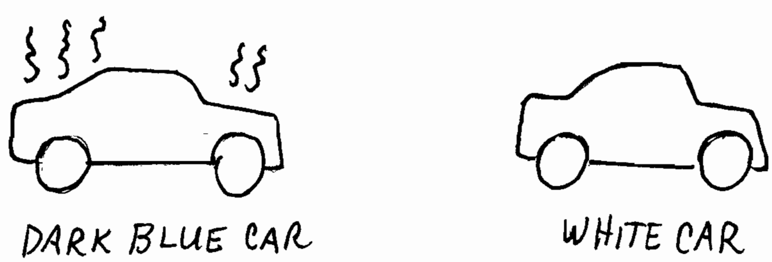

Figure 7.2: Compare how different colors absorb and hold heat energy

Experiment 7.3: Determine the relationship between brightness and distance

Question: How does brightness vary with distance?

How would the brightness change if a light source was twice as far away?
How would the brightness change if a light source was half the distance as an initial reading?
What is the relationship between brightness and distance?

Material

Flashlight
Light meter
Yardstick

Steps

1. Shine a flashlight on a light meter at a given distance. (If necessary, make adjustments in distance or on the meter so that the reading is in the middle of the meter scale.)
2. Measure the reading at different distances.
3. Plot a curve of relative brightness vs. distance between the light source and the meter.

Outcome

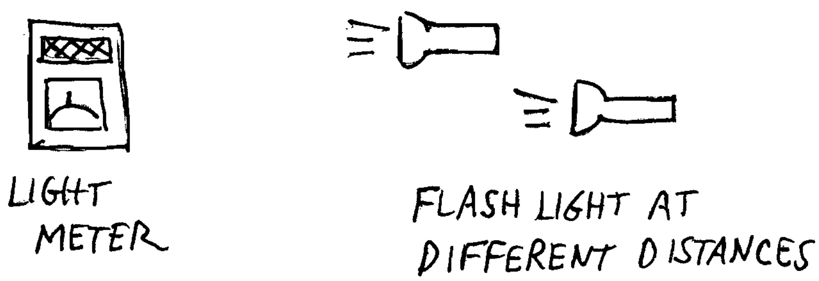

Figure 7.3: Determine the relationship between brightness and distance

Experiment 7.4: Demonstrate that white light consists of different colors

Question:
Does white light consist of colors?

Materials:
Flashlight
Slit
Prism
Viewing screen

Steps:
1. Shine light through slit and prism, onto the viewing screen.
2. Observe the colors.
3. Put a colored filter in front of the light source.
4. Observe what happens.

Outcome:

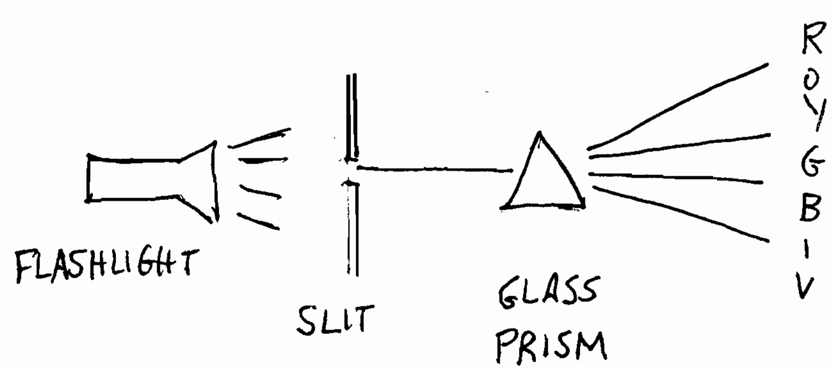

Figure 7.4: Demonstrate that white light consists of different colors

8.0 Experiments with Physical Optics

Experiment 8.1: Show how a material can bend a beam of light

Question:
Does light always go straight, or can it bend?

Material:
Glass of water
Pencil

Steps:
1. Put pencil in a glass of water.
2. Look at the view of the pencil both in and out of the water.

Outcome:
Why does it appear that the pencil is bent?

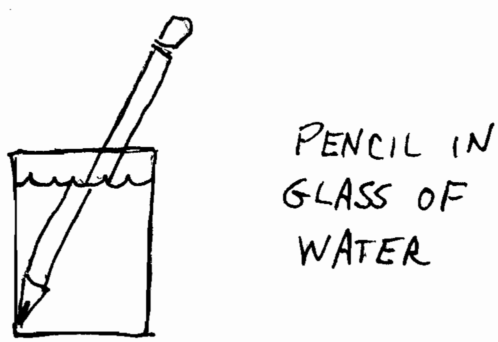

Figure 8.1: Show how a material can bend a beam of light

Experiment 8.2: Determine the focal point of a magnifying lens

Question:

How do you find the focal point of a magnifying glass?

Material:

Magnifying glass
Object to look at
Ruler

Steps:

1. Look at an object very close in a magnifying glass.
2. Move away from the object until its image suddenly gets very large and then reverses orientation.
3. At the point that the image fills the lens, measure the distance from the center of the lens to the object.

Outcome:

Why does the image reverse?
Why does the image get real big?

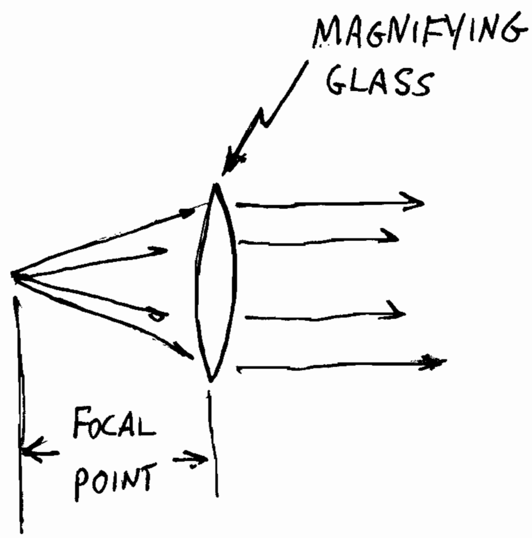

Figure 8.2: Determine the focal point of a magnifying lens

Experiment 8.3: Make a simple camera

Question:

How does a camera work?

Material:

Box
Pin
Scissors
Wax paper
Tape

Steps:

1. Cut a hole in one end of a small box.
2. Tape wax paper over the hole.
3. Put a pinhole in the other end of the box.
4. Point the pinhole at a bright object such as a window.
5. Observe the image projected on the wax paper.

Outcome:

What happens?

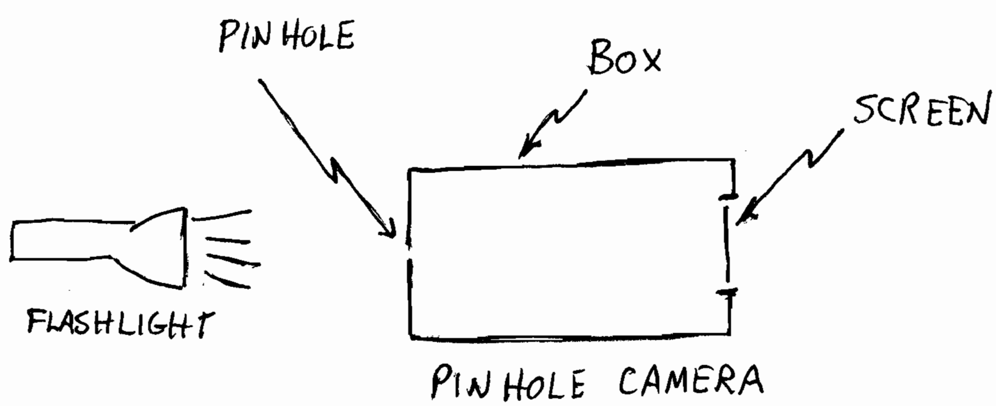

Figure 8.3: Make a simple camera

9.0 Experiments with Static Electricity

Experiment 9.1: List observations about static electricity

List various types of sources of static electricity in your personal environment.

Classify any common factors on how those objects create static electricity.

List some ways to detect static electricity.

List materials that static electricity passes through.

List some special characteristics of static electricity that you have observed.

Experiment 9.2: Demonstrate the attractive force of static electricity

Question:
How strong is the attractive force of static electricity?

Materials:
Mail scale
Balloon
Wool

Steps:
1. Blow up the balloon.
2. Weigh the balloon.
3. Rub the balloon on some wool.
4. Put the balloon up to the wall.
5. Observe what happens.
6. Calculate the force required to hold up the balloon.

Outcome:

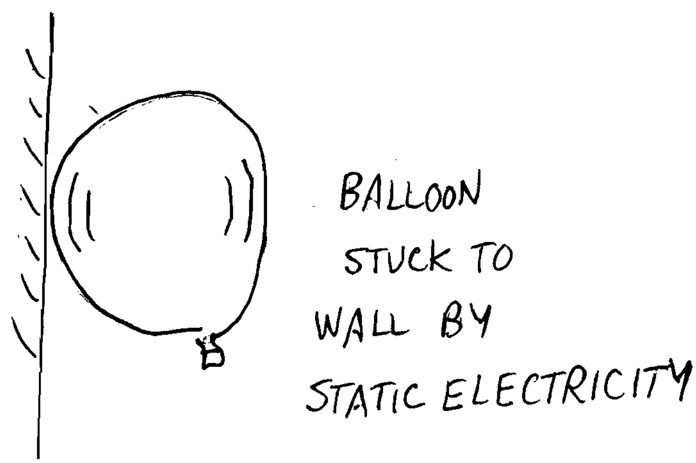

Figure 9.2: Demonstrate the attractive force of static electricity

11.0 Experiments with Electricity

Experiment 11.1: List observations about electricity

List various types of sources of electricity in your personal environment.

List various ways to detect electricity.

Classify any common factors on how those objects create electricity.

List materials that electricity easily passes through.

List some special characteristics of electricity that you have observed.

Experiment 11.2: Verify people are conductors of electricity

Question:

Can electricity pass through several people holding hands?

Materials:

Ohmmeter

Steps:

1. Have class stand in a semi-circle, holding hands.
2. Turn on the ohmmeter and adjust it for a high resistance.
3. Have each of the two people on the ends grab the two wires on the ohm meter.
4. Observe the reading on the ohmmeter.
5. Have someone let go of the other's hand.
6. Observe the reading.

Outcome:

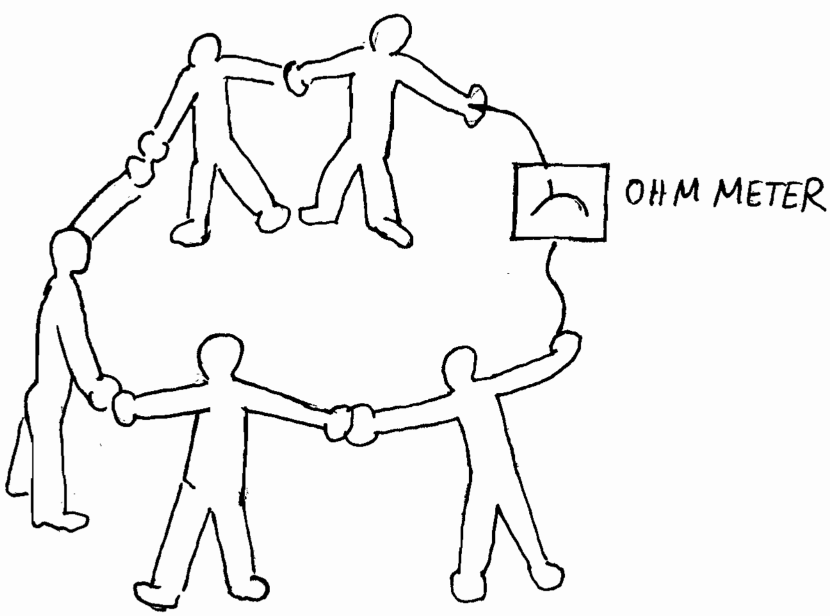

Figure 11.2: Verify people are conductors of electricity

Experiment 11.3: Determine the relationship between resistance and length of a wire at a given diameter

Question:

What happens to the resistance of a wire if you double its length?

Materials:

Several lengths of wire
Ruler
Battery
Ohmmeter

Steps:

1. Measure a length of wire.
2. Create a circuit with a battery, ohmmeter and length of wire.
3. Observe the reading on the ohmmeter.
4. Repeat steps 1 to 3 with different lengths of wire.
5. Plot a graph of length of wire vs. resistance.

Outcome:

What law or rule can you derive from this experiment?

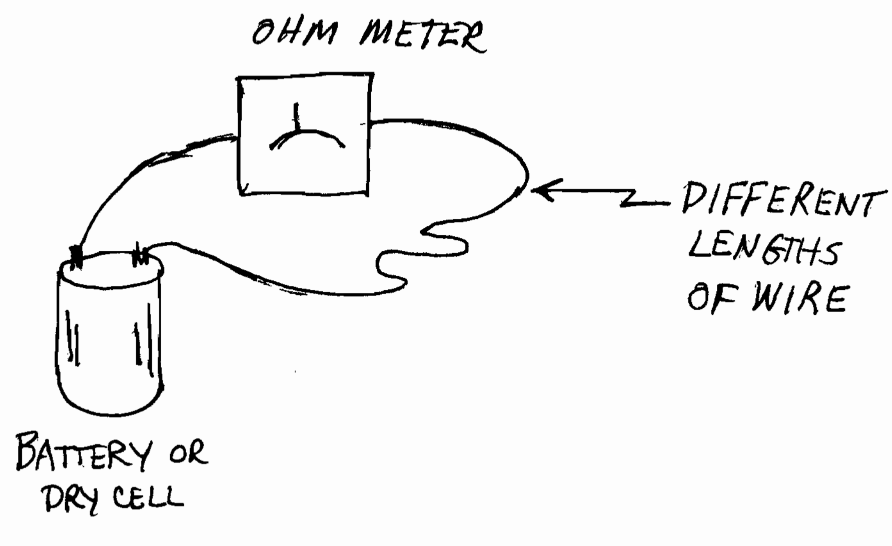

Figure 11.3: Determine the relationship between resistance and length of a wire at a given diameter

Experiment 11.4: Determine the relationship between current and resistance at a given voltage

Question:

If the resistance in an electrical circuit is doubled, what happens to the current passing through the wire?

Materials:

Battery
Wire
Several resistors
Ammeter

Steps:

1. Connect an ammeter and a given resistor in series in a circuit powered by a battery.
2. Observe the reading on the ammeter.
3. Repeat the experiment with a resistor of other values.
4. Plot a graph of amperes vs. ohms.

Outcome:

What law or rule can you derive from this experiment?

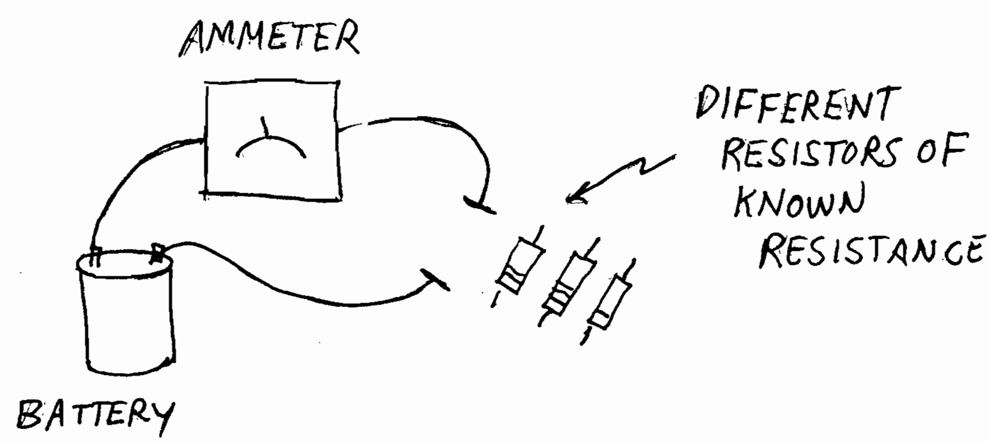

Figure 11.4: Determine the relationship between current and resistance at a given voltage

12.0 Experiments with Magnetism

Experiment 12.1: List observations about magnetism

List various types of sources of magnetism in your personal environment.

List various ways to detect magnetism.

Classify any common factors on how objects create magnetism.

List materials that magnetism passes through.

List materials that magnetism doesn't pass through.

List some special characteristics of magnetism that you have observed.

Experiment 12.2: Determine the relationship between magnetic force of repulsion and distance

Question:

How does the repulsive force to two similar magnets vary with distance?

Materials:

Two magnetic wafers with holes in the center
Pencil
Scale
Weights
Ruler

Steps:

1. Place the pencil through the hole in one magnet.
2. Measure the weight of the second magnet.
3. Slip the second magnet on the pencil, such that it repels the first magnet.
4. Measure the distance between the magnets.
5. Add a small weight on top of the second magnet.
6. Measure the distance between the magnets.
7. Repeat as necessary.
8. Graph the relationship between weight and distance.

Outcome:

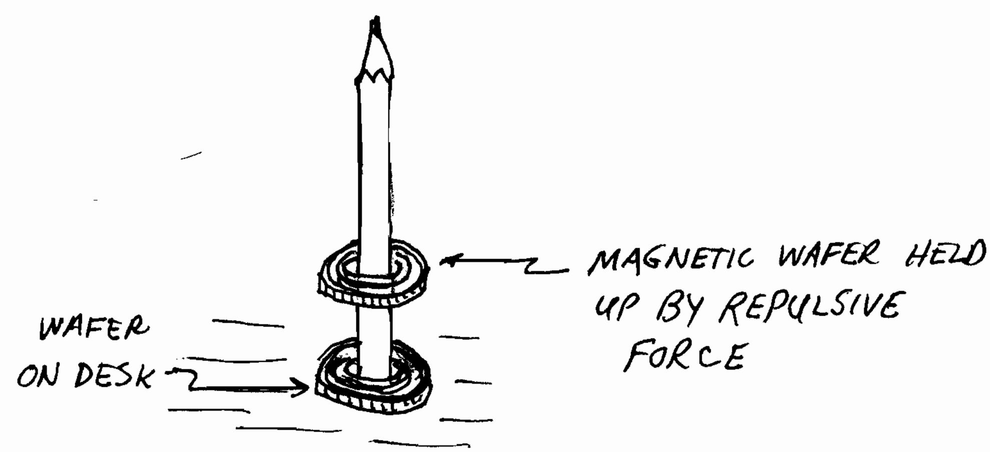

Figure 12.2: Determine the relationship between magnetic force of repulsion and distance

Experiment 12.3: Show the lines of magnetic force

Question:

What do the lines of force of a magnetic field look like?

Material:

Magnet
Sheet of heavy white paper
Fine iron filings

Steps:

1. Sprinkle iron filings on paper.
2. Bring magnet close to bottom side of paper.
3. Observe the pattern of the filings.

Outcome:

What did you observe?

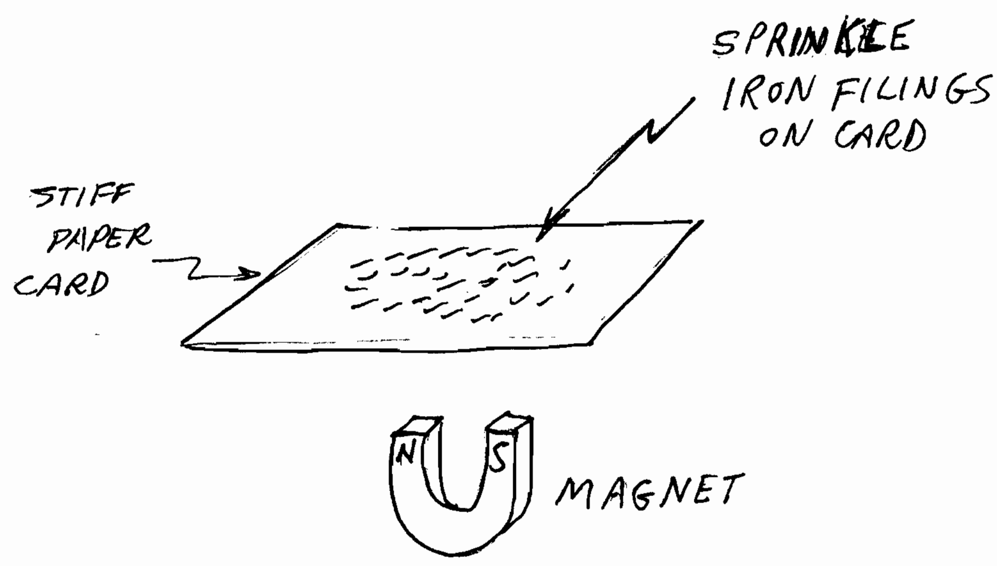

Figure 12.3: Show the lines of magnetic force

Experiment 12.4: Show how to detect a magnetic field

Question:

How can you detect a magnetic field?

Materials:

Sewing needle
Magnet
Container of water

Steps:

1. Magnetize needle by stroking it in one direction with the magnet.
2. Float needle on the water surface or on a piece of paper floating on the water.

Outcome:

How can you tell when it is a compass?

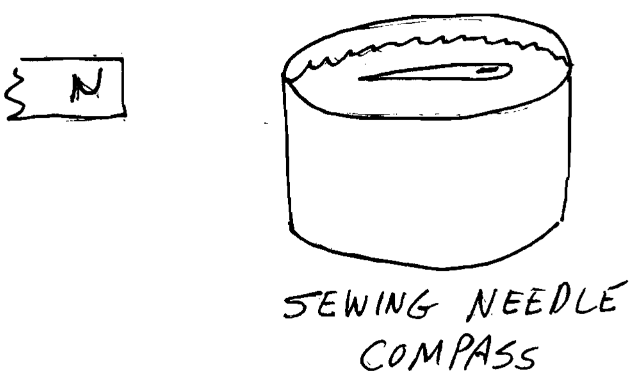

Figure 12.4: Show how to detect a magnetic field

Experiment 12.5: Show that electric current creates a magnetic field

Question:

Does electricity create magnetism?

Materials:

Battery or dry cell
Length of wire
Compass

Steps:

1. Place a compass near a wire not yet connected to a battery.
2. Connect the wire to battery, causing electric current to pass through the wire.
3. Observe the compass.
4. Disconnect the wire.
5. Observe the compass.

Outcome:

What can you conclude from this experiment?

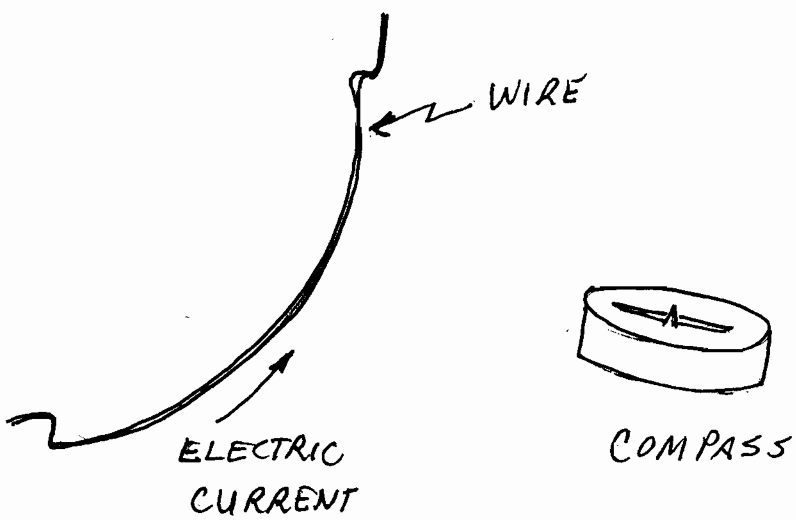

Figure 12.5: Show that electric current creates a magnetic field

Experiment 12.6: Show how to control magnetism

Question:

Can magnetism be turned off and on at will?

Material:

Battery
Long length of wire
Large nail
Paper clips

Steps:

1. Wrap wire a large number of times around the nail.
2. Connect ends of wire to battery.
3. Pick up paper clips with nail.
4. Disconnect wire from battery.
5. Observe what happens to paper clips.
6. Repeat steps 2 to 5, as necessary.

Outcome:

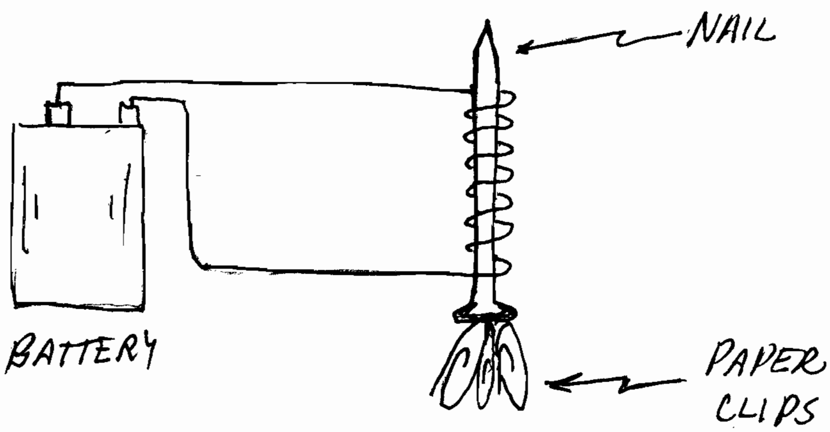

Figure 12.6: Show how to control magnetism

Experiment 12.7: Determine the relationship between distance and strength of a magnetic field

Question:

What is the relationship between distance and strength of a magnetic field?

Materials:

Battery
Wire
Compass
Ruler

Steps:

1. Put compass a measured distance from the battery.
2. Connect the wire to the battery and observe the compass.
3. If the compass doesn't move, shorten the distance and repeat experiment.
4. If the compass moves, put it further away from the wire and repeat the experiment.
5. Note the distances and what happens.

Outcome:

What conclusions can you draw about the effect distance has on the strength of the magnetic field?

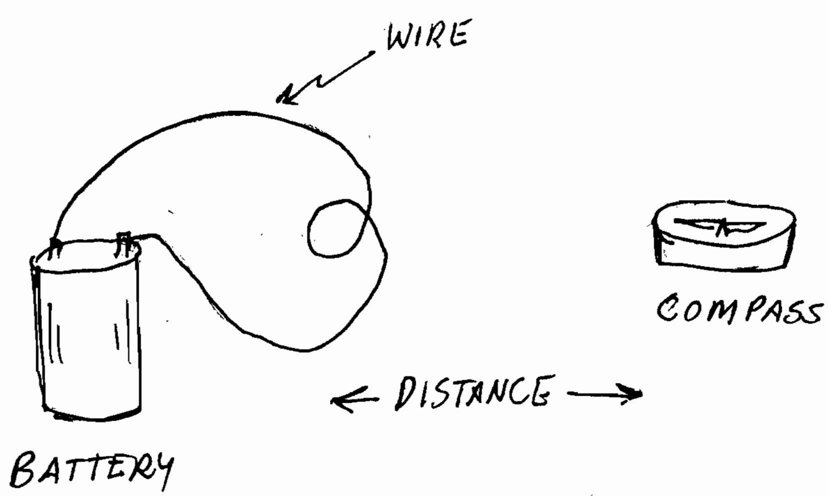

Figure 12.7: Determine the relationship between distance and strength of a magnetic field

13.0 Experiments with Fluids

Experiment 13.1: Measure the volume of an irregularly shaped object

Question:

How can you determine the volume of something too complex to measure?

Material:

Irregularly shaped object
Container full of water
Gradated flask to measure volume of liquid

Steps:

1. Carefully place object in water.
2. Collect overflow.
3. Measure volume of overflow water.

Outcome:

Why is the volume of the water the same as that of the object displaced?

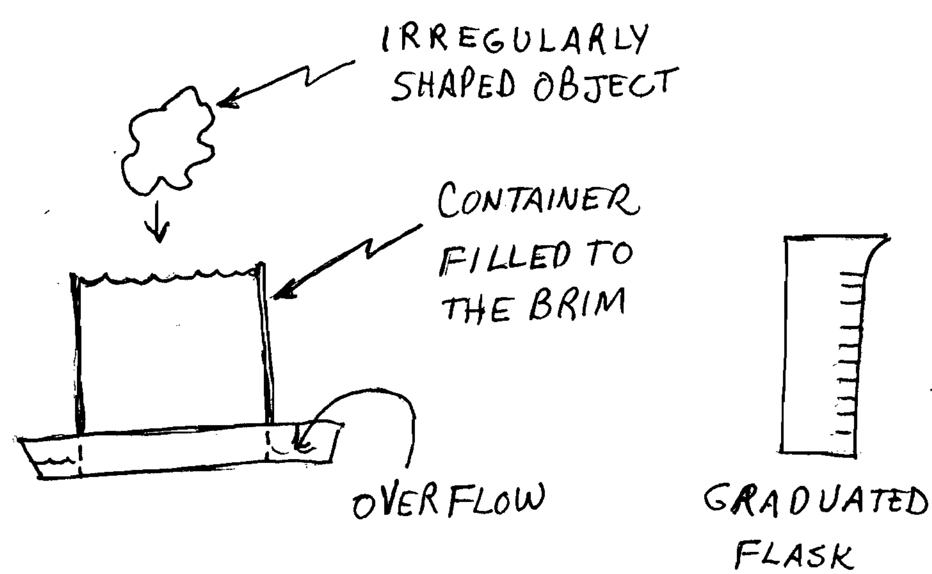

Figure 13.1: Measure the volume of an irregularly shaped object

Experiment 13.2: Determine relationship between water pressure and depth

Question:

How does water pressure vary with depth?

Materials:

Large tin can
Hammer and nail
Ruler

Steps:

1. Punch holes in side of tin can at one inch intervals.
2. Fill can with water.
3. Measure the distance from the can the water squirts out of each hole.
4. Plot a graph of depth (distance of hole from top of water level) vs. distance from can

Outcome:

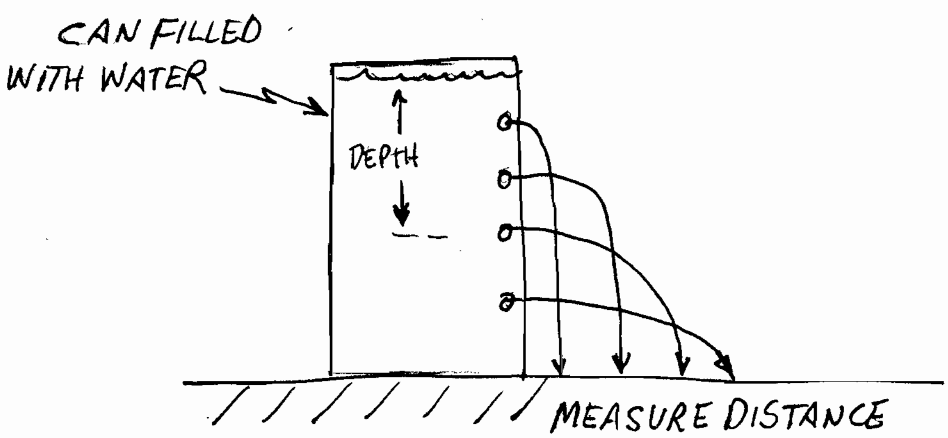

Figure 13.2: Determine relationship between water pressure and depth

Experiment 13.3: Compare the density of two different liquids

Question:

What happens when a dense liquid is put in one with less density (assuming they are liquids that don't mix)?

Materials:

Vegetable oil
Water
Two similar graduated beakers
One larger beaker
Scale

Steps:

1. Weigh each of the similar beakers.
2. Pour an equal volume of oil and water into two separate beakers.
3. Weigh each beaker with its liquid.
4. Determine the density of each liquid.
5. Pour the lower density liquid into the third beaker.
6. Pour the higher density liquid into the beaker.
7. Observe what happens.

Outcome:

What conclusion can you draw about these liquids?

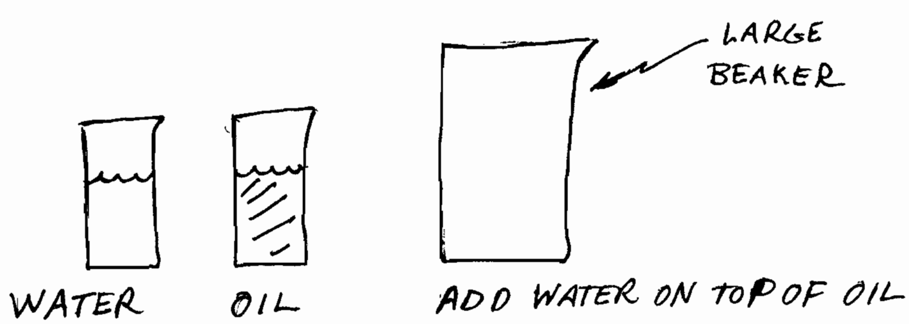

Figure 13.3: Compare the density of two different liquids

Experiment 13.4: Show the relationship between weight in water and weight in air

Question:

Can you lift more weight in water or on land?
Why or why not?

Materials:

Full bucket of water
Pan to catch overflow
Spring scale
Weight

Steps:

1. Weigh the full bucket of water.
2. Weigh the weight in air.
3. Immerse the weight in the water, allowing excess to overflow into pan.
4. Weigh the weight in the water (but not setting on the bottom of the bucket nor touching the sides).
5. Remove the weight from the bucket.
6. Weigh the bucket again, without the overflow water.
7. Determine the weight of the overflow water.
8. Determine the difference between the weight of the object in and out of the water.
9. Compare the weight of the overflow water with the weight difference of the object.

Outcome:

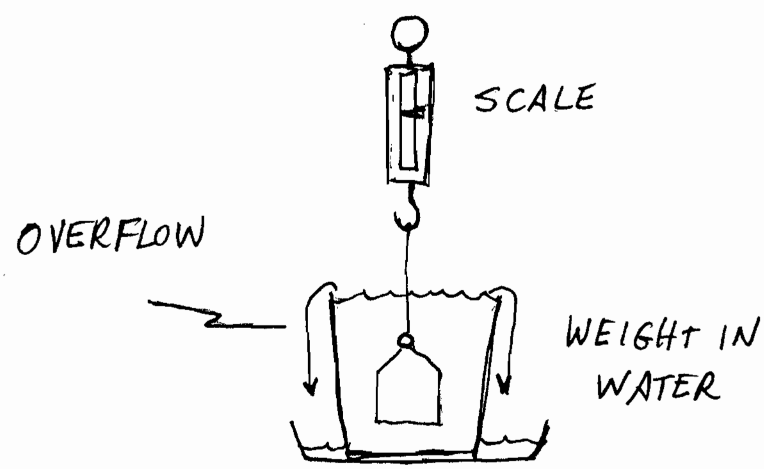

Figure13.4: Show the relationship between weight in water and weight in air

Conclusion

There are many other experiments that can – and should – be done to enlighten the Physical Science student. Those listed in this manual provide a good start for both the student to effectively learn the subject and for the teacher to effective teach it.