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ABSTRACT

Instructional materials are provided for a course that covers basic concepts of physics and chemistry. Designed for use in a workplace literacy project developed by Mercer County Community College (New Jersey) and its partners, the course describes applications of these concepts to real-life situations, with an emphasis on applications of relevance to General Motors workers. A one-page course outline lists objectives and provides a topical outline. Fourteen topics are covered: measurement, density, scientific method, gravity, inertia and Newton's Laws of Motion, friction, simple machines (planes, levers, pulleys), center of gravity, chemistry (matter, radiation, polymers), pH, electricity, and fire fighting. For each topic, content, comments, and experiment(s) are provided. Appendixes include a list of other topics, review sheets and review questions, a quiz, and sources for additional experiments. (YLB)

BASIC SCIENCE

Prepared Under a United States Department of Education
National Workplace Literacy Program Grant to
MERCER COUNTY COMMUNITY COLLEGE
Center for Training and Development
1200 Old Trenton Road
Trenton, NJ 08690

Elaine S. Weinberg
Director, Workplace Skills Project

OVERVIEW OF WORKPLACE LITERACY PROJECT

Skills for Tomorrow, NOW

The Workplace Literacy Project resulted from a Department of Education grant, plus in-kind contributions from a partnership with General Motors Inland Fisher Guide Plant, Princeton Plasma Physics Laboratory, and St. Francis Medical Center. The project is an attempt to find solutions to the growing "skills gap" in industry today. More than 25 million Americans cannot read the front page of a newspaper. In addition, workers whose average ages are rising, must produce in a technological environment that may not have existed when they began working. This lack of knowledge makes it difficult to compete in a technologically changing workplace. Moreover, an increasing number of immigrants have entered the workforce with limited English communication skills. In response to this growing need, the Federal government provided a grant to Mercer County Community College and its partners to develop ways to enrich and expand employees' basic workplace knowledge. The aim of the project was also to improve the self-esteem of the participants.

Support for the project was solicited from all levels of company management and the unions. In addition, an advisory council, comprising key management and employees from each company determined the design, goals, and time-frame of the project. Each company provided a liaison person from their site, and MCCC hired a director to manage the program. Employee release time for classes was site-specific.

Participation in the program was voluntary. Information about classes was disseminated through company letters, flyers, union notices, notices included with paychecks, and open forums with supervisors and employees.

The ABLE test was used for normative pre and post testing. Other types of evaluations varied from course to course. MCCC counselors met with each student to discuss present and future educational objectives.

Courses were offered in reading, business writing, math, science, and English as a Second Language. In addition, there were workshops in problem solving, stress management, and other work survival skills. The curricula for the courses were customized for each worksite to be as job focused as possible.

It is our hope that this program will serve as a model for other organizations to empower their employees with the skills needed to succeed in the changing technological workplace, today and in the future.

COURSE OUTLINE

BASIC SCIENCE

Covers basic concepts of physics and chemistry. Describes applications of these concepts to real-life situations, with an emphasis on applications of relevance to GM workers.

OBJECTIVES

Upon completion of this course, students will be able to:

- Understand basic concepts of physics and chemistry
- Identify applications of these concepts to real-life situations
- Identify jobs where these concepts are put to daily use

TOPICAL OUTLINE

- Measurement
- Density
- The Scientific Method
- Gravity
- Inertia and Newton's Laws of Motion
- Friction
- Simple machines
  - planes
  - levers
  - pulleys
- Center of gravity
- Chemistry
  - matter
  - radiation
  - polymers
- pH
- Electricity
- Fire fighting

OTHER

- 50 hours

SOURCES

Macullo, David. Houghton Mifflin, 1988.

CONCEPT #1 - MEASUREMENT

Concept #1 - Measurement "Man is the measurer of all things"

1. What do you measure?
   - -Home
   - -Work
   - -What cannot be measured? - Love, Fear, Pain, Desire, IQ?

2. Why study measurement?
   - -Experiment-Measuring metrically
   - -The need for standards
   - -Why Metric?
   - -Should the US go metric?

3. Tools used to measure

4. Experiment - How much oxygen is in air?

COMMENTS-

I have the students talk about what they measure on their jobs at GM. Some in the painting section measure dirt spots and whether the part is clean enough for shipping. Others measure hole sizes for bolts using dowel rods. Generally, the students do not use calipers or other measuring tools to measure at GM. They use dowel rods or examples of good and bad parts. I discuss things that cannot be measured. Can cleanliness be measured? The plating process uses rinse water pH to measure cleanliness of parts.

EXPERIMENT - Measuring metrically I pass out the rulers and have the students measure their notebooks using both metric and English units. <u>You must show students how to read metric side of ruler.</u> Many catch on quickly that metric is easier to use.

I discuss the U.S. going metric and ask what they think about it (the idea of one measuring system for the whole world).

I try to get students to decide why we should have standards. Examples such as being able to buy one shoe size at every store seem to help students understand the concept.

This is a good section in which to discuss the measuring tools necessary for calibration and the importance of treating tools with care. I talk about using caliper gauges such as screw drivers and seeing how long they stay calibrated.

EXPERIMENT - How much Oz in Air?

-Use combustion property of oxygen to determine amount in air.

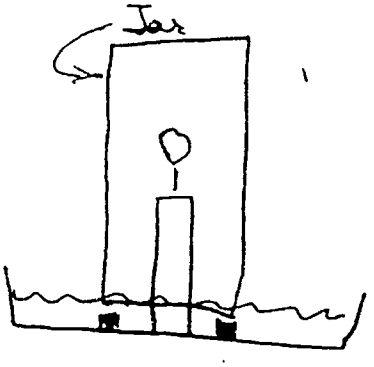
-This experiment looks like magic and helps wake up students.

Need: Candle and candle support

Narrow or skinny jar

Pad of water and Food coloring

Put candle in pan of water. Add several drops of food coloring. (I let students choose color). Light candle. Place jar over candle. Jar must be supported so that the water can move under the jar (I support jar on a nutcracker). As candle uses up oxygen, the pressure drops and the water moves up jar.



Concept #2 - Density

1. What is density?
   -Weight per Volume

2. What affects density?
   -Type of material
   -Temperature
   -Experiment - The water volcano
   -Pressure

3. Does material concentration affect density?

4. How is density measured?
   -Experiment - Make your own hydrometer
   -Experiment - Calibrate your hydrometer

5. Why is density important?
   -Lighter cars
   -Fermentation- The alcohol level in wine
   -Super Bowl and the Goodyear Blimp
   -Safety- The story of manholes
   -Experiment- Is carbon dioxide denser than air?

There is a density handout. I start class by passing around 2 similar boxes. One box contains lead weight and the other cotton balls. I ask which one is heavier and which one is denser.

I pass around 2 pieces of wood, one little and one big, and tell them they were cut from the same board. Which is heavier? Which is denser?

I pass around a bag of cotton balls and an eraser. Both weigh the same. Which is heavier? Which is denser?

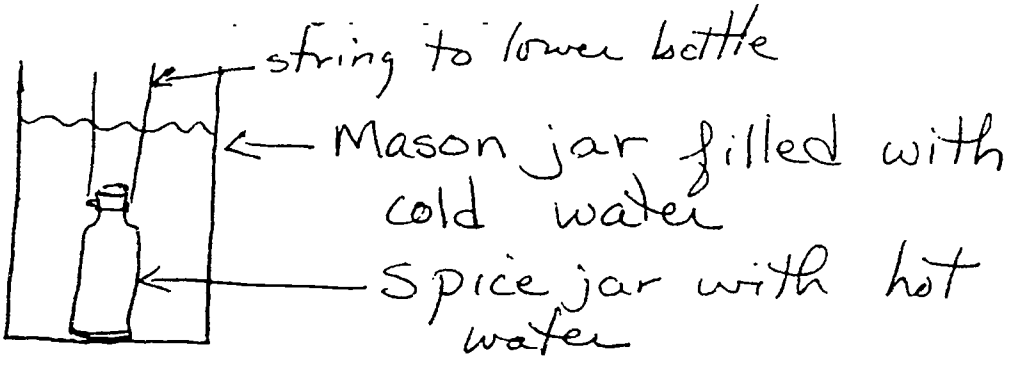
Density is weight per volume (pounds per cubic ft)

What affects density:

- I give list of density of common objects to show that the type of material affects density.
- Experiment - Water Volcano

Need: small jar (small spice jar works well)
large jar (Mason jar)

Tie string around tip of small jar so you can lower it into mason jar. Fill mason jar with cold water (you may want to add ice to get really cold water). Have student get a jar of hot water from coffee machine in cafeteria. Fill spice jar with hot water and add some food coloring. Carefully place spice jar into mason jar with cold water. The hot water comes out of spice jar and rises to surface. You can see the colored hot water rise. I usually do this experiment several times.



Pressure affects density

- Talk about pressure affecting gas density and density of porous solids
- Pressure does not greatly affect density of liquids or non-porous solids

How Do You Make an Egg Float?

No—this is not a riddle! Find out why it's easier to swim in the ocean than in a freshwater lake or pool!

You need:

an egg a glass of water
12 tablespoons or more of salt (180 mL)

What to do:

1. Put an egg in a glass half full of water. Notice what happens. Add several tablespoons of salt, stir gently, and observe what happens.

2. To half a glass of salty water (10 tablespoons or more of salt), slowly add half a glass of fresh water. Don't stir. Gently lower in the egg.

What happens:

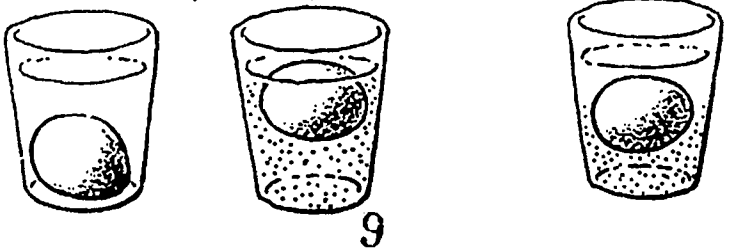
1. In the fresh water the egg sinks. As you add salt, it floats higher and higher.

2. When you add fresh water to the very salty water, the egg is suspended in the middle!

Why:

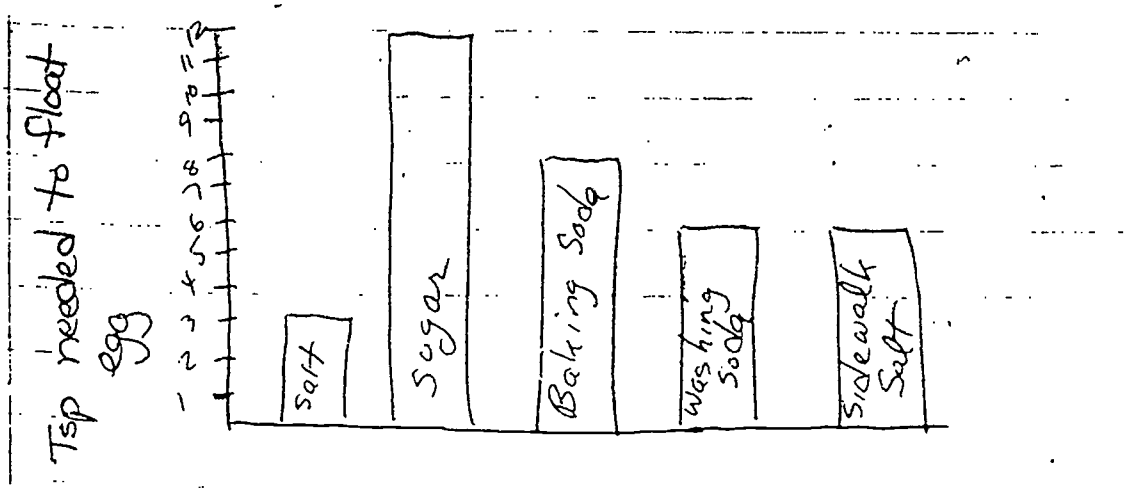
1. The denser the liquid the greater its upward lift (or buoyancy). Salt makes the water denser.

2. When you add fresh water to the salty water, it remains on top. The egg sinks through it and floats on the lower, denser, salty water.



I use salt, sugar, baking soda, and dirt. You can also let students color eggs with vinegar and food coloring before starting it does make eggs easier to see. Make sure the water is somewhat hot (I get hot coffee water from cafeteria and mix with some cold water).

I have students measure how many spoonfuls of salt, etc it takes for egg to float. I like to have the experiment duplicated by another set of students for discussion of experimental error. I have students make a bar graph of results.



Egg doesn't float in dirty water. I let students decide how they will construct graph as far as the order they will put bars in. I show the students different graphs and when you want to plot in ascending or descending order. Point out that graphs are a more powerful way to present data.

Experiment- Make your own hydrometer

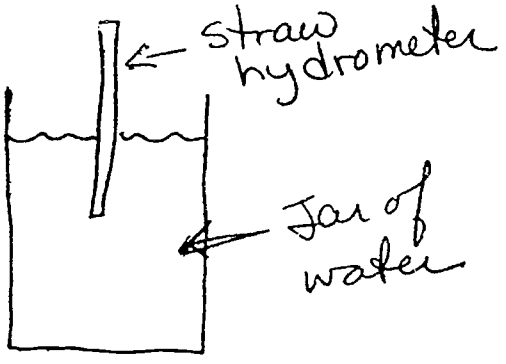
Need: Straws, play dough, split shot (lead fishing weights), jars of water, rubbing alcohol and antifreeze solution

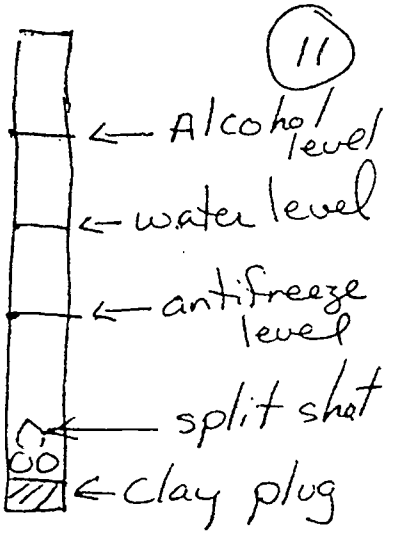
Plug one end of the straw with play dough. Put 2 or 3 split shots in straw. Be sure they fall through straw and are resting on top of play dough. "Float" the straw in jar of water. Mark water level on straw. "Float" in antifreeze and alcohol. Mark level. You could calibrate straw by knowing the density of water = alcohol = 0.718.

I don't know if you want to calibrate the hydrometer. If the students are having problems with concepts, skip calibration. It's easy to lose the class here.

Why is density important?

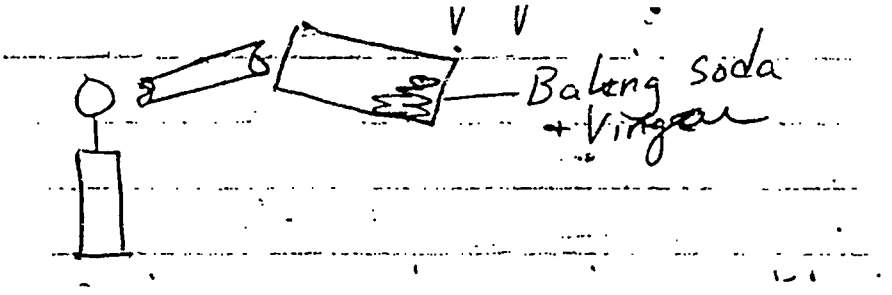
I mix up yeast in sugar water and let it rise to show that biological processes give off CO2. I use the next experiment to discuss that some gases are heavier than air. Confined spaces can collect CO2 and be safety problems. (Example- sewers and crawl spaces).





Need: Candle, Jar, vinegar (make sure its 5% acetic acid), baking soda and toilet paper tube

Mix up soda and vinegar and tilt jar towards lighted candle. Direct gases towards flame. Flame goes out since CO2 is heavier than air.



CONCEPT #3 - SCIENTIFIC METHOD

Concept #3-The Scientific Method

1. Experiment- Puzzles

2. The Method
   (1) State the problem
   (2) Guess an answer
   (3) Predict the consequences
   (4) Run experiment (s)
   (5) Formulate a theory about the experiment's outcome.

3. Experiment - Clay in water
   -Does shape affect the experiment?

4. Application- Why is the method important?
   -Use in everyday life-cooking, fixing car, etc.
   -Scientific discoveries
   -Improving processes

I make puzzles by cutting pictures into 8 pieces. Pictures containing many small objects work well since you want students to work at these puzzles for a while. I then discuss how students use scientific method to solve puzzle.

Experiment - Clay in water
Question- Does shape affect experiment?

I pass out clay or chalk and jars of water. I have students decide on shapes. Usually someone makes a boat. This shows that the shape will change the experiments results.

There is a handout on floating to explain why things float.

Concept #4 - Gravity

1. What is it?
   Attractive force
   -Depends on the distance between the objects
   -Depends on the mass of the objects

2. Application
   -Spaceships getting too close to the sun
   -Comets
   -Satellites falling to Earth
   -Tides

3. Mass vs Weight
   -Mass is the amount of matter
   -Weight is the force of gravity

4. Discussion - Where would you weigh the most/least?
   -Earth-on a mountain top
   -Earth-at sea level
   -On the moon's surface
   -In a spaceship circling the Earth
   -Standing on Jupiter's surface

5. Experiment - The famous apple experiment
   -Galileos experiment
   -Do all objects fall to earth at the same speed?

I give brief history of Aristotle and his idea of no experimentation (BC 300) and how this put science behind. I then do the famous Apple experiment by dropping lead weight and cotton ball. Lead hits ground first. I then put lead and cotton into similar box and note they hit the ground at the same time.
Conclusion: Objects of different mass fall at the same rate of acceleration except for wind resistance.

I then talk about Newton and his gravitation attraction equation

$$\frac{\text{Force} = \text{constant mass. mass2}}{(\text{distance})2}$$

Go over the idea of directly proportional and inversely proportional
   -Direct proportion - the more I eat, the more I weigh
   -Inverse proportion - (smell) as distance increases, the smell is less

CONCEPT #5 - INERTIA AND NEWTON'S LAWS OF MOTION

Concept #5 - Inertia and Newton's Laws of Motion

1. Newton's First Law and Inertia
   - -What is inertia?
   - -"Let sleeping dogs lie"
   - -Experiment - Measuring forces-Use fish weight scale
   - -Experiment - The spinning egg
   - -Experiment - Spear a potato

2. Applications of Inertia - seat belts / turntables / flywheels

3. Newton's Second Law
   - -When a force acts on an object, the object will accelerate (as long as the force is not canceled out)
   - -Force = Mass X Acceleration
   - -Experiment - Shooting balls

4. Newton's Third Law
   - -The Action/Reaction Law
   - -Experiment - Shooting Pool
   - -Experiment - Balancing Forces

I use a fish weighing scale to measure forces. I show students how this works. I pass out raw eggs and hard boiled eggs and ask students how to tell the eggs apart. (Usually someone wants to break the eggs, which I won't allow). See spinning egg experiment.

I use empty jelly jars to show model of experiment. Fill one jar half full of water and leave the other empty. Put lids on jars and spin on floor. Empty jar spins better.

This is a good section to discuss scale models for presenting ideas or designing cars.

Some students complain that GM doesn't listen to their ideas. I tell students to present ideas using numbers or graphs. "Data talks."

Experiment- Spearing potato

-This is like the Tropicana orange juice commercial, where a woman spears an orange with a straw. I have speared an orange: if the orange's skin is soft, it works.

Experiment- Shooting Balls

-I hit balls of different size/mass with the same force. The balls with greater mass go a shorter distance.

Experiment- Shooting Pool

-I hit a stationary ball with a moving ball to show action-reaction. You may want to show the effect of hitting the stationary ball with different mass.

Experiment- Balancing Forces

-See experiment "String Balance"

-Have students find center of ruler where ruler will balance

-Give students paper clips. Put 2-3 clips on one side of ruler, several inches from balance point. Position clips on other side of ruler so that the ruler balances. How far is the second group of clips from the balance point? If results are different, discuss experimental error with the experiment.

What are some of the reasons for the unacceptable parts on their jobs?

How could some of this be controlled?

Concept #6 - Friction

1. What is friction?
   -Force that tends to oppose sliding movement
   -Frictional force is proportional to the weight of the object

2. Experiment - Empty/full box
   -Which is easier to move?
   -Does the amount of contact area affect how hard it is to move the box?
   Using the force gauge I show that the contact area is not important

3. Rollers
   -Do they make a box easier to move?

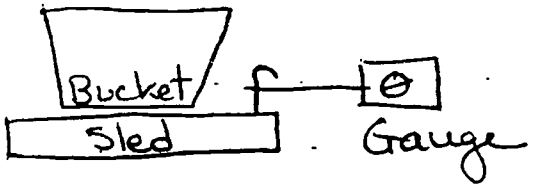
4. Oil and lubricants
   -Why does oil make something move easier?

5. Discussion
   -Auto tires-Why is it better to have trend on your tires especially during a rain storm?
   -How do you catch a greased pig?
   -Why do you put sand on icy sidewalks?

6. Application
   -Ball bearings
   -Car lubricants

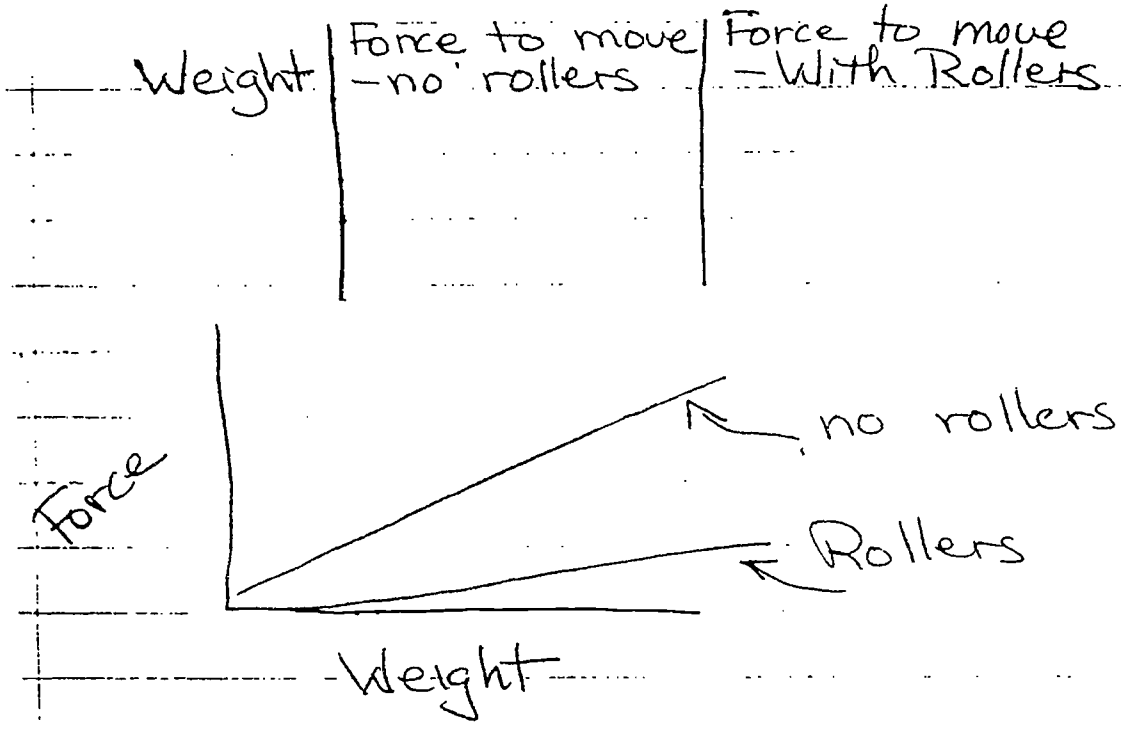
Experiment- Rollers

-I have a wooden sled that I put a bucket on. I put different weights in bucket and measure the force needed to move these weights. I then put round pencils under the sled and measure force needed to move weights.



I make a table of data and then have students plot the data

Some students do not know how to graph, so watch for those needing help. I brought in different colored stars so we could make "pretty graphs". This helped to keep the students' interest.



Experiment- Oils and lubricants

-I take a cookie sheet and grease half of the back with cooking oil. I put the sheet at an angle using books for support. I then slide 2 similar weighted boxes down the cookie sheet. If done correctly, the greased side box goes faster. If there's too much oil, the box sticks to it. See friction handout

CONCEPT #7 - PLANES

Concept #7 - Simple Machines-Planes

1. Why did man invent machines?

2. Planes
   - -Why is it easier to move an object on a plane?
   - -What you gain in effort you loose in distance
   - -Experiment- Planes vs Lifting

3. Applications
   - -Building the pyramids
   - -Parking carriages
   - -"Switchback " roads

4. Wedges - The moving inclined plane

5. Applications
   - -Plows
   - -Zippers

Experiment- Planes vs Lifting

-Using the fish weighting scale, I show that pulling a weight up an incline takes less force that lifting a weight upwards.

Handout- Zippers and Locks and Keys

Concept #8- Simple Machines-Levers

1. What is a lever?
   -A simple bar that moves freely around a fixed fulcrum

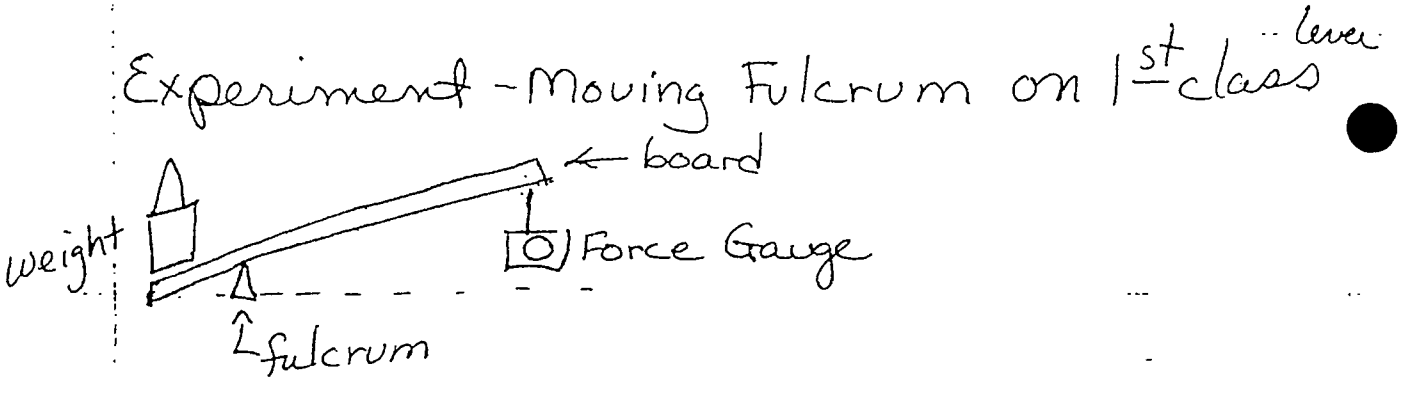
2. Types of levers
   -Depends on the position of the parts
   -Experiment- Name that lever

3. Experiment- Lifting a box with a lever
   -Does it matter where we put the fulcrum?
   -How does a first class lever compare to a second class lever?

Experiment- Name that Lever

-I bring in for demonstration, examples for the 3 types of levers. I have students name the type of lever. (See next 2 pages on lever examples - these are not included with student handouts).

Experiment- Moving Fulcrum on 1st class lever



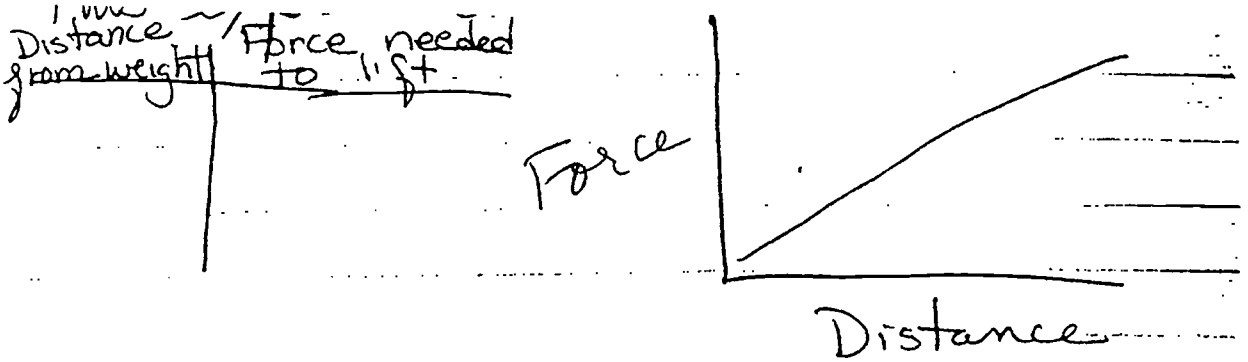
I move the fulcrum away from the weight and measure the force needed to lift the weight.

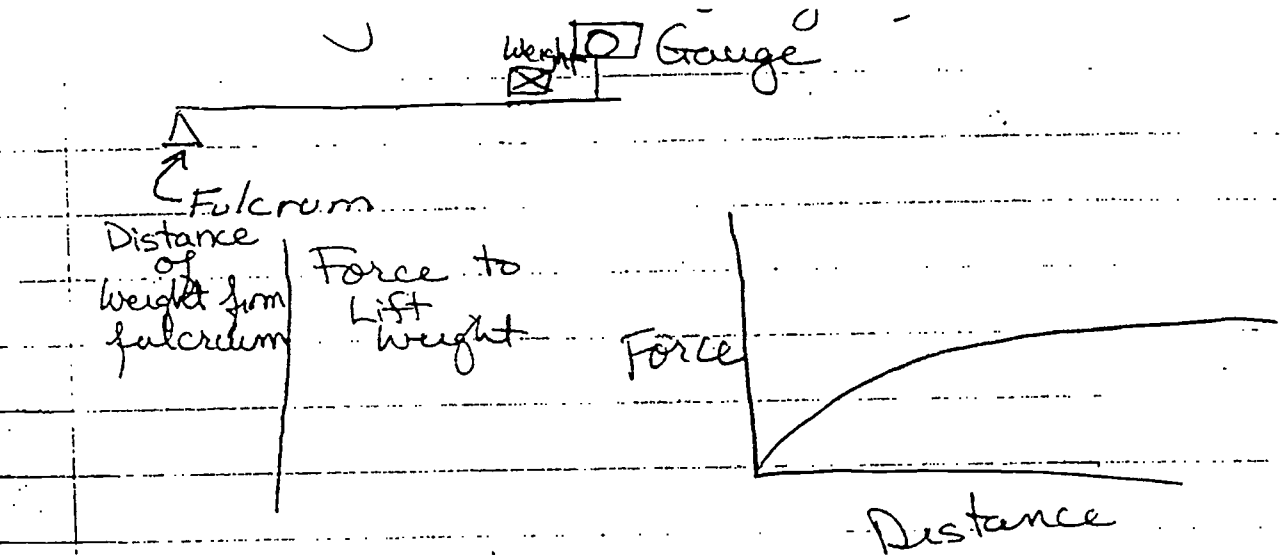
I keep the weight the same during this experiment

This can be graphed to give students more practice graphing.

This experiment can be repeated using a second class lever and moving the load (weight)

There is a lever handout.





→ There is a lever handout.

CONCEPT #9 - SIMPLE MACHINES - PULLEYS

Concept #9 - Simple Machine-Pulleys

1. What is a pulley?
   -Combines two ideas - (1) Rolling friction is less than sliding friction and (2) What you gain in effort you loose in distance

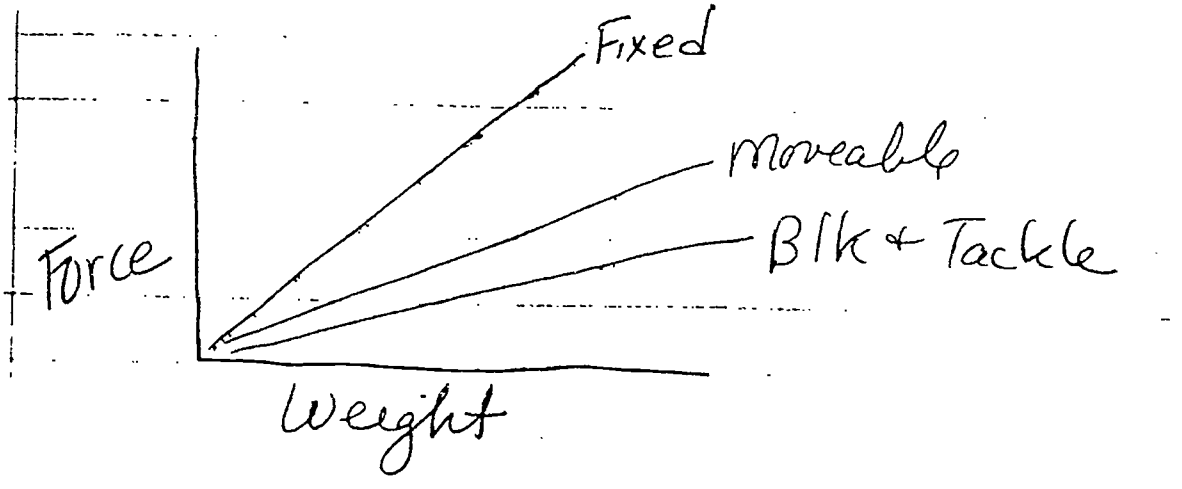
2. Experiment - Raising weights using pulleys
   -Does the size of the pulleys make a difference?
   -Does the type of pulley (moveable vs fixed) make a difference?
   -Does the number of pulleys make a difference?

3. Application
   -Cranes
   -Block and Tackle
   -See 3 pulley handouts

Experiments - Using pulleys
   -I use a fixed pulley and moveable pulley and measure the force needed to lift 3 or 4 different weights. If you have a block and tackle, use this. I also measure the force needed to raise weights.

Weight	Force to Lift Using Fixed Pulley	Force to lift using moveable Pulley	Force to lift using Block + Tackle

At this point the students are getting very tired of graphing, so any ways that make graphing more fun - stickers for data point, for example - are needed.

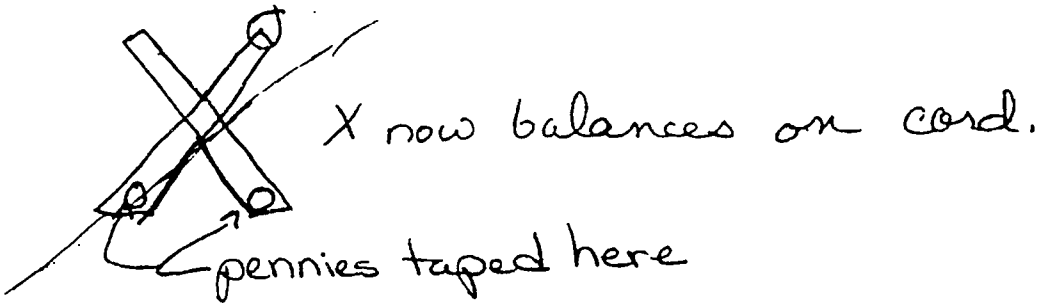


Concept #10 - Center of Gravity

1. What is the center of gravity?
   -The place where the whole weight of an object seems to center

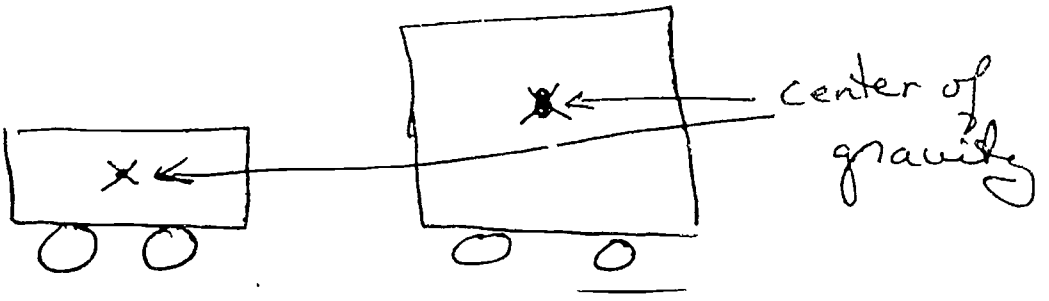
2. Experiment- Finding the center of gravity

3. Why is the center of gravity important?
   -A tale of two carts
   -Safety and stability
   -I make an X out of lightweight cardboard. I show that this doesn't balance very well on string that is stretched between two chairs. However the X will balance if I put a penny on the bottom legs of X.



-I make 2 carts out of cardboard and show how the center of gravity moves upwards as the cart is loaded higher.

-I discuss stability of cart based on the location of the center of gravity.
-There is a handout on center of gravity
-See next page for experiment on how to determine the center of gravity.



Concept #11 - Chemistry

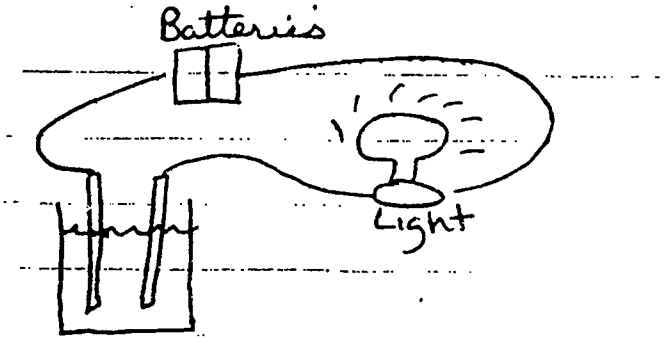
1. The makeup of matter
   - -A (very) brief history
   - -What is an atom?
   - -What is a molecule?
   - -Experiment- Splitting water-see next page.

2. Molecule ID
   - -Parts of an atom

3. Radiation
   - -Changing an atom's identity
   - -Losing protons and neutrons

4. How matter stays together
   - -Covalent bonds-"Playing nice"
   - -Ionic bonds-Electron hogs
   - -Metallic bonds-The social state
   - -Other bonds

5. Experiment - Are there ions out there?
   - -Bring in your samples



6. Polymers
   - -The stuff of plastic
   - -Monster molecules
   - -A (very brief) history of polymers
   - -Applications

7. Material Safety Data Sheets (MSDS)

-I use a felt cloth and attach different colored felt circles to show the parts of the atom and how the number of protons determines the element.

Experiment- Are there ions out there?
Need: Jar for liquid sample, 2 batteries, light bulb, 2 metal pieces to into sample, wires to connect together

Only solutions that contain ionic substances will conduct a current. I try: water, vinegar, lemon juice, salt water, sugar water, baking soda mixed in water, coffee and anything else we can think of.

-MSDS Sheets- I try to point out the hems they should look for: density flammability, exposure, etc.

The safety issue is very important, so stress it.

Concept #12 - pH

1. What is pH?
   -A measure of how acidic or basic something is

2. Experiment - Make your own pH paper

3. Experiment - Measuring pH

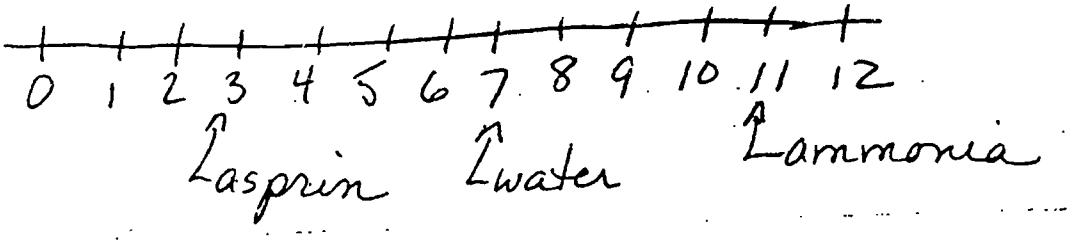
4. Why is pH important?
   -Farming
   -Processes at GM

Experiment - Make your own pH paper

-I have the students make pH paper using red cabbage juice. I make up the juice at home and bring it in with me. This is a good experiment because you can separate items tested into either acid or base. We test anything you can think of, but include aspirin and malox if possible.

-I then have the students make pH paper by soaking it in a solution of laxative dissolved in a little water. Be sure to buy laxative containing phenol phihalein. I want to show that there are different types of indicator solutions. If possible, bring in a pool test kit or aquarium test kit.

-I then get out the pH paper and use that to get a pH number for vinegar, alcohol, etc. I put that information on line graph on the board.



Concept #13 - Electricity

1. What is static electricity?
   - -Experiment- Creating static electricity
   - -Lightning-The ultimate in static electricity

2. Applications of static electricity
   - -Lightning rods
   - -The electrostatic air cleaners

3. Current electricity- What conducts electricity?
   - -Experiment- The conductor scavenger hunt

4. Batteries
   - -How do they work?
   - -Experiment- The lemon battery

5. Circuits
   - -Experiment-Wiring
   - -Switches
   - -Parallel circuits
   - -Serie circuits

Experiment- Creating static electricity

-This experiment must be done on a dry day

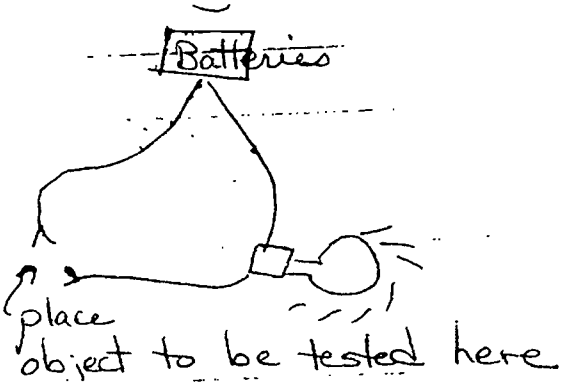
-Get a package of balloons. Blow up 2 balloons. Tie one balloon to a pole. Rub both balloons on your head and notice that they repel each other. Rub one balloon on the palm of your hand. Hopefully, this will remove the charge and the balloons will attract each other.

-You can also let the students rub the balloons and stick them to the wall.

Experiment- The Conductor Scavenger Hunt

Need: Batteries, cables to connect circuit and light bulb

-I have students connect circuit and find things that will and won't conduct electricity. The students seem to enjoy this experiment.



Experiment- The Lemon Battery

-See the next page

-I could not get this to work with a light bulb. However a Sun Alert From Radio Shack works great. Also bigger probes to stick in the fruit make this work better. Juicy fruit works better so squash the lemon or orange before using. I also do with lemon juice (2 cups) connected in series and this works better than the lemon.

Experiment- Wiring

-I have the students wire in series and parallel and notice the difference. I also let them play with switches, variable resistors and resistors.

-I show how an F capacitor charges and discharges.

Concept #14 - Fire Fighting

1. The fire triangle
   - -Fuel
   - -Heat
   - -Oxygen
   - -Remove only one and the fire goes out

2. Discussion
   - -What component of the fire triangle is removed when:
   - -You turn off a gas jet
   - -Put water on charcoal
   - -Roll on the ground
   - -Fire hose
   - -Sand on a fire

3. Types of fire extinguishers
   - -Type A-Paper, wood, fabric
   - -Type B-Oil/solvents
   - -Type C-Electrical fires
   - -Type D-Burning metal

4. Contents of fire extinguishers
   - -Water
   - -Carbon dioxide
   - -Dry chemicals

There is a handout on how a fire extinguisher works

APPENDIX

OTHER TOPICS

1. More simple machines - The wheel and axle
2. Another simple machine - Gears
3. Job safety
4. What topic are you interested in?

SCIENCE REVIEW QUESTIONS 1

1. Where would you float higher - in the ocean or in a freshwater lake?

2. Which is denser - hot water or cold water?

3. Is the air in a hot air ballon heavier than the surrounding air?

4. Think about the hydrometer experiment. Where was the mark for the antifreeze? Is antifreeze denser than water?

5. I have two identical gallon bottles filled with different liquids. Bottle A weighs less than Bottle B. Which liquid is denser?

6. Is ice heavier than cold water?

7. Why must you be careful when entering a manhole?

8. Is aluminum denser than iron?

9. Does density change with temperature?

10. What is inertia?

11. Which egg had more inertia - the raw egg or the hardboiled egg?

12. We hit two balls with the same force. Which ball will roll farther - the light ball or the heavy ball?

13. Why do we have friction?

14. Name a situation when we would want friction.

15. Name a situation when we do not want friction.

16. How does oil reduce friction?

17. I have two wagons. Wagon A has a high center or gravity. Wagon B has a low center of gravity. Which wagon is more stable?

18. Name an application of an incline plane.

19. Name an application of a wedge.

20. Name an application of a lever.

21. Which class of lever would let you lift the heaviest object?

22. Where would you weigh the most - on the moon, on earth, on Jupiter, or on a spaceship in outerspace?

23. Where would you weigh the least - on the moon, on earth, on Jupiter, or on a spaceship in outerspace?

SCIENCE REVIEW - SHEET 2

1. You are given a liquid to mix with water. The density of the liquid is 0.75 g/cc (density of water is 1.0 g/cc).

A. Will the liquid float or sink in the water?
B. If the liquid is mixed together with the water, will the mixture's density be : less than the density of water: more than the density of water; or be the same as water?
C. Do you think it would be safe to go swimming in this mixture (assuming the mixture is not harmful)?

2. You are helping a friend fix a car in his garage on a cold winter day. The car's engine must run whille you make the repairs. Your friend suggests that closing the garage door would keep out the wind and make the garage warmer. What do you think about your friend's suggestion?

3. I have a feather and a ten pound lead weight. If I drop both objects at the same time, which will hit the ground first in:
   a. This classroom?
   b. A vacuum?

4. Why do simple machines allow us to lift heavy objects easily?

5. Is friction affected by an object's weight?

6. What are the 2 types of pulleys?

7. Of the 2 types of single pulleys, which pulley used the least force to lift a weight?

8. Did the size of the fixed pulley change the amount of force needed to lift a weight?

9. What is an application of the pulley?

10. What are the 3 components of the fire triangle?

11. What is removed when you spray a chemical extinguisher on a fire?

12. What is the best type of fire extinguisher to use on a paper fire?

13. What should you do if a pan of grease catches fire on your stove?

14. Why shouldn't you spray water on an electrical fire?

15. What type of electrical circuit do I have if I unscrew one light bulb and the rest of the light?
   a. Stay on?
   b. Go off?

16. Why are electrical wires covered with plastic?

17. Why are fuses important in electrical boxes?

REVIEW QUESTIONS SHEET 3

1. Name the parts of an atom.

2. What do elements exchange during chemical reactions?

3. Name some materials that make good
   a. Electrical conductors
   b. Insulators

4. What information is on an MSDS sheet?

5. All compounds and elements are made of ----------

6. The force of gravity depends on what 2 things?

7. What are the 5 steps of the scientific method?

8. Name ways to increase friction.

9. Name ways to decrease friction.

10 Plastics are made of long or short molecules?

11. What numbers does the pH scale use?

12. What are the pH numbers for
   a. Acids
   b. Bases
   c. Neutral

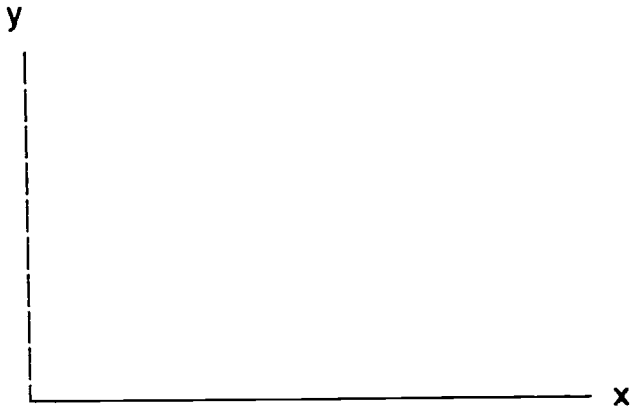
13. Name some materials that are
   a. Acids
   b. Bases
   c. Neutral

SCIENCE REVIEW QUESTIONS 2

1. What is the conversion factor that relates the English (inches) and Metric (centimeters) systems of measuring lengths? Your numerical answer should include the units.

2. How many centimeters are there in one foot?

3. A two dimentional graph consists of an x and a y axis (or coordinate). Which axis is the independent variable conventionally assigned to? Which axis is the dependent variable assigned to?



4. What are the 3 types of subatomic particles that comprise an atom? What are their charges? Where in the atom are they located (i.e. nucleus or orbitals)? Indicate your answers in the chart provided.

Type of Subatomic Particle	Charge	Location

5. Fill in the blanks with the appropriate chemical name or chemical formula:

Au	_____
Na	_____
___	chlorine
Cu	_____
Fe	_____
K	_____
___	oxygen
Hg	_____
___	calcium
Ag	_____
___	ammonia
___	water
CO_2	_____
NaCl	_____

6. Name 2 types of bonds that hold atoms together to form molecules.

7. Which of the two bonds indicated in question 6 is easier to break?

8. What gas is given off when vinegar (acetic acid) and baking soda (sodium bicarbonate) are mixed?

9. Is the gas liberated in question 8 lighter or heavier than air?

10. What is the pH of water?

11. Vinegar is an acidic substance. In which of the following pH ranges would you expect its pH value to fall?

3 to 6
7.1 to 7.9
8 to 10

12. Ammonia is basic and acetic acid (vinegar) is acidic. What pH value would a mixture of equivalent amounts of these two substances have?

13. What 2 types of home-made pH indicators did we construct in class?

SCIENCE QUIZ

1. The World uses Two Measurement Systems, Metric and?

   A. American
   B. French
   C. English
   D. Scientific
   E. Universal

2. A Meter, Pound, Root and Kilogram are Measurement?

   A. Tools
   B. Standards
   C. Phenomena
   D. Controls
   E. None of the Above

3. In outer space, objects have no?

   A. Mass
   B. Color
   C. Size
   D. Weight
   E. Density

4. One of Newton's Motion Laws is?

   A. OHMS
   B. Inertia
   C. Electromagnetic
   D. Quantum
   E. Natural Selection

5. Which force is stronger than Gravity?

   A. Lunar
   B. Tidal
   C. Magnetic
   D. Levers
   E. Projective

6. Only one person improved on Newton's Laws of Motion and Gravity, He was?

   A. Einstein
   B. Kepler
   C. Galileo
   D. Ford
   E. Smith

7. A screw is an example of what simple machine?

   A. Pulley
   B. Wheel
   C. Axle
   D. Lever
   E. Inclined Plane

8. What parts of a complex machine depends on excessive friction?

   A. Belts
   B. Ball Bearing
   C. Fly Wheels
   D. Fuel
   E. Levers

9. A Hydraulic Lift operates on a Principle of Pressure versus?

A. Friction
B. Speed
C. Time
D. Air
E. Area

10. What are the two Electromagnetic Charges?

A. A and B
B. Atoms and Neutrons
C. Positive and Negative
D. Zero and Positive
E. Ying and Yang

11. A lightning bolt is caused by what type of charge?

A. Neutral
B. Static
C. Nuclear
D. Dynamic
E. Zero

12. Electromagnetic Theory Cannot Explain?

A. Magnets
B. Fire
C. Chemistry
D. Ocean Tides
E. Vision

13. An Electric Motor works by using Electricity and?

A. Magnets
B. Light
C. Water
D. A compass
E. Antimatter

14. A Nuclear power plant makes Electricity by?

A. Fusing Atoms
B. Heating Water
C. Cooling Water
D. Bonding Atoms
E. Solar Energy

15. The letters ROYGBIV refer

A. Atoms
B. Planets
C. Colors of the Spectrum
D. Electric Wires
E. Chemistry

16. Everything in the Universe is built from?

A. Water
B. Electricity
C. Gravity
D. Light
E. Atoms

17. Which of the following are part of an Atom?

A. Cells
B. Electrons
D. Plasms
E. Light

C. Viruses

18. What does <u>not</u> conduct Electricity?

A. Graphite
B. Metal
C Plastic
D. Salt Water
E. Mercury

19. A red plastic strip reflects what color?

A. All Colors
B. Red and white
C. Black
D. Red only
E. Green

20. Heat flows from?

A. Hot to Cold
B. Cold to Hot
C. Up to Down
D. Light to Dark
E. East to West

21. Two Temperature Scales are Fahrenheit and?

A. English
B. Calorie
C. Celsius
D. Diablo
E. Chemical

22. Heat is transmitted by Radiation, Conduction, and?

A. Cosmic Rays
B. Tides
C. Gravity
D. Levity
E. Convection

23. If you want to find out the possible hazards of a chemical, you check?

A. MSDS
B A Dictionary
C. An enyclopedia
D. MADD
E. A Baedecker

24. Fire extinguishers are classified by?

A. Color
B. A,B,C, and D
C. Wattage
D. Length
E. Volume

ADDITIONAL EXPERIMENTS

References - Chemistry for Every Kid
Physics for Every Kid

Author - Janice Van Cleve

Topic	pages	# experiments
Buoyancy	57 - 64	4
Balance	81 - 92	6
Simple Machines	107 - 126	10
Inertia	129 - 138	5
Acid Base	189 - 216	10
Changes (starch)	104 - 108	3
Magic Writing	110	1
Gravity	67 - 68	6

Project #1

Design and construct an apparatus to contain a raw egg such that when dropped from a height of 5 feet, the egg will not break.

Project #2

Design and construct a bridge out of the following materials:
balsa wood, thread, tongue depressors, glue
It should span a distance of at least 1 foot and be able to hold a 40lb. weight without breaking.