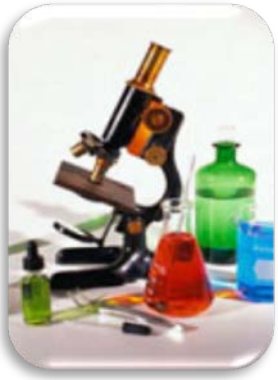
CHEMISTRY EXPERIMENTS YOU CAN DO AT HOME

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA



11 element symbols derived from ancient names.

English name	symbol	ancient name
antimony	Sb	stibium
copper	Cu	cuprum
gold	Au	aurum
iron	Fe	ferrum
lead	Pb	plumbum
mercury	Hg	hydrargyrum
potassium	K	kalium
silver	Ag	argentum
sodium	Na	natrium
tin	Sn	stannum
tungsten	W	wolfram

Doing experiments without the use of a laboratory

Physical science is a branch of natural sciences. To some people, science only happens is a laboratory. This booklet is an attempt to show that Physical Science happens anywhere, in our homes, in our bodies, in the forests and just about anyplace one can think of. Many of the activities we do in our homes like cooking, cleaning our homes, relaxing or dyeing our hair involve chemical reactions. Burning wood or making fire is one of the oldest and most common chemical reactions. When we eat food, many chemical reactions take place. The food is broken down into compounds necessary for our bodies to function. The products are then absorbed and go to various places in our bodies to support

A laboratory is a place where the conditions are idealized for a reaction to happen. While we need the laboratories to make it possible for us to see the reactions, without waiting for them to happen, reactions actually take place every day, everywhere, planned and sometimes not planned. Some reactions happen quickly e.g. burning of wood or very slowly e.g. corrosion; in between there is a whole range of rates of reactions. The world is actually one big laboratory!!!

In a chemical change, new products which sometimes have different chemical and sometimes different physical properties are produced. The experiments in this booklet can be used to demonstrate many concepts, feel free to use them for suggested experiments or for any other purpose. The selected experiments can be done as part of a practical investigation or demonstrations to explain concepts. Household apparatus and reagents were used for these experiments. A few suggestions for the extension of these experiments have been given inside the boxes marked with ✸. Feel free to use them anyway you like!

Safety is another important aspect to consider when working in the laboratory. The Department of Education has issued **Safety Guidelines** to help teachers to organize their laboratories. It is important for teachers to know the nature of chemicals they are using at all times when conducting experiments. This will help teachers to know what they need to know and do in case of emergencies in the laboratories. **Visit: http://www.ilo.org/public/english/protection/safework/cis/products/icsc/dtasht/index.htm** for information on all chemicals.

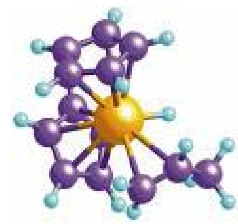
Baking soda and **baking powder** are leavening agents, which mean they are added to baked goods before cooking to produce carbon dioxide and cause them to 'rise'. Baking powder contains baking soda, but the two substances are used under different conditions.

Baking Soda

Baking soda is pure sodium bicarbonate. When baking soda is combined with moisture and an acidic ingredient (e.g., yogurt, chocolate, buttermilk, honey), the resulting chemical reaction produces bubbles of carbon dioxide that expand under oven temperatures, causing baked goods to rise. The reaction begins immediately upon mixing the ingredients, so you need to bake recipes which call for baking soda immediately, or else they will fall flat!

Baking Powder

Baking powder contains sodium bicarbonate, but it includes the acidifying agent already (cream of tartar), and also a drying agent (usually starch). Baking powder is available as single-acting baking powder and as double-acting baking powder. Single-acting powders are activated by moisture, so you must bake recipes which include this product immediately after mixing. Double-acting powders react in two phases and can stand for a while before baking. With double-acting powder, some gas is released at room temperature when the powder is added to dough, but the majority of the gas is released after the temperature of the dough increases in the oven



MEDICAL PRACTICE FROM AFRICA

Born in Africa, Onesimus was a slave of Cotton Mather, a Puritan minister in Boston. When a smallpox epidemic broke out in Boston in 1721, Onesimus informed his master about an inoculation procedure practiced in Africa. The centuries-old practice was practiced throughout Africa and involved the extraction of material from the pustule of an infected person and, using a thorn, scratching it into the skin of the unaffected person. The deliberate introduction of smallpox gives the inoculated person immunity from the disease. In some cases, there is no reaction while a mild non-fatal form of the disease may occur in others.

Although inoculation was considered to be extremely dangerous, Cotton Mather was steadfast in accepting the reliability of the information provided by Onesimus, and convinced Dr. Zabdiel Boylston to experiment with the procedure. Beginning with his son and two slaves, he inoculated over 240 people.

The process of inoculation was politically, medically and religiously opposed in the United States and Europe. In religious circles, it was deemed unnatural and perceived as subverting God's will. Public reaction to the experiment was so adverse that both Mather and Boylston's lives were threatened. Records indicate that the inoculation process itself killed 2 percent of the patients who requested it, while 15 percent of the people who contracted the disease and were not inoculated died from the virus.

Onesimus' recollection of a traditional African medical practice saved numerous lives and sparked the introduction of smallpox inoculation in the United States. *The African Background in Medical Science: Essays on African History, Science and Civilizations*, Charles S. Finch. Karnak House, 1990.

EXPERIMENT 1: REACTION BETWEEN BAKING SODA AND VINEGAR – A chemical Change

These experiments or the questions that follow may be modified so as to teach concepts in boxes

✸ Chemical change •excess and limiting reagents• concentrations• the mole concepts• naming of compounds •writing chemical formulae oxidation states

Chemical reactions occur every day all around us. A chemical reaction is a process where one type of substance is chemically converted to another substance. The fire in your fireplace is another type of chemical reaction.

When two substances react together, they can form new chemicals or products. In this chemical reaction, the vinegar and baking soda react and create carbon dioxide and other products.

Let us check the chemical reaction:

Materials

- A small, strong plastic bottle (250ml bottle)
- A medium-sized round balloon
- Vinegar
- Baking soda
- A funnel

Procedure

1. Pour vinegar into the small bottle until it is about half an inch deep.

2. Using a funnel, pour two teaspoons of baking soda into the neck of a balloon.

3. Stretch the neck of the balloon over the neck of the bottle, being careful not to let the baking soda out of the balloon.

4. Now lift the balloon so that the baking soda runs into the vinegar. Shake the bottle. What happens?

$NaHCO_3$ (s) + $HC_2H_3O_2$ (aq) --> $NaC_2H_3O_2$ (aq) + CO_2 (g) + H_2O(l)

Task

Use the safety charts provided by your teacher to compare any five properties of the products to the properties of reactants:

To the teacher:

This experiment can be used to demonstrate the chemical and physical changes that take place during a chemical reaction. We started with a solid and a liquid but we end up with an aqueous solution and a gas. The products have completely different properties to the reactants. Check the safety cards for these differences.

EXPERIMENT 2: PRODUCTION AND TESTING OF CARBON DIOXIDE

✸ gases expand upon heating• gases contract upon cooling• gases occupy space• CO_2 extinguishes fire

Some common chemicals will produce carbon dioxide. Vinegar and baking soda are household products that can also produce carbon dioxide. Some of the properties of carbon dioxide are easily observed.

Materials	**Substitutions**
sodium hydrogen carbonate (3 g)	baking soda
acetic acid 0.80 M	vinegar
125 mL Erlenmeyer flask	small jar
beral pipet	dropper
wood splints	toothpicks
matches and a candle	

Procedure

1. Measure approximately 3 grams (1/2 teaspoon) of baking soda and place it in the flask.
2. Using the pipette, add a few drops of vinegar to the sodium hydrogen carbonate. Gas bubbles will form.
3. Light a wooden splint or toothpick with the candle.
4. Carefully tip the flask, insert the burning splint into the neck of the flask, and observe the effect the gas (carbon dioxide) has on the flame.
5. Using the candle, re-light the splint and test the gas again.

Questions

1. Write the equation for the reaction occurring in the above experiment.
2. Describe the effect of carbon dioxide on the burning splint.
3. What property of carbon dioxide allowed us not to use a stopper or lid?
4. Since carbon dioxide is often used in fire extinguishers, describe how you could use this experiment to create your own extinguisher.
5. Other chemicals can react to produce carbon dioxide. Can you pick other chemicals that you know that can react to produce carbon dioxide. Teacher's Notes

1. The equation for this reaction is
   $NaHCO_3$ (s) + $HC_2H_3O_2$ (aq) --> $NaC_2H_3O_2$ (aq) + CO_2 (g) + H_2O(l)
2. Carbon dioxide does not support combustion. Oxygen is the substance that is necessary for any burning to take place. The splint should be extinguished.
3. The density of carbon dioxide is 1.56 g/mL while that of air is 1.0 g/mL. Since the carbon dioxide is denser than air, it will remain below the air in the container.

Safety Precautions

1. Proper ventilation is required due to the odours of vinegar.
2. The reaction containers should be wrapped with tape. Pressure will increase if the containers are sealed.

Disposal: The solutions can be poured into the sink and followed with water. Unreacted sodium hydrogen carbonate may be dissolved in water and poured down the sink. Solid residues may be placed in the trash can.

EXPERIMENT 3: DANCING RAISINS

✸ buoyancy • density

Raisins are denser than water and, therefore, sinks when placed in water. When raisins are placed in a solution of baking soda and vinegar, the raisins rises to the surface due to the carbon dioxide gas that adheres to them. When the raisins reach the surface, the gas is released, and the raisins sink again.

Materials	Substitutions
1 1000-mL beaker	1 glass mixing bowl
10 g sodium hydrogen carbonate	3 Tsp baking soda
45 mL 3% acetic acid	4-5 Tbsp vinegar
5-10 raisins	
water	

Procedure

1. Fill a clear container 3/4 full with water. Add the sodium hydrogen carbonate (or baking soda) and stir to dissolve.
2. Add the raisins to the container.
3. Add the acetic acid (vinegar). If the raisins do not begin to "dance" after a few minutes, add more sodium hydrogen carbonate and acetic acid.
4. If possible, substitute raisins with mothballs or spaghetti.

Teacher's Notes

1. Vinegar ($HC_2H_3O_2$) is a 5% solution of acetic acid. It reacts with baking soda , sodium hydrogen carbonate ($NaHCO_3$), to produce a carbon dioxide gas (CO_2) and sodium acetate ($NaC_2H_3O_2$). The reaction can be written as follows:

$$NaHCO_3\ (aq) + HC_2H_3O_2\ (aq) \text{ ------> } CO_2\ (g) + H_2O\ (l) + NaC_2H_3O_2\ (aq)$$

Bubbles of carbon dioxide gas adhere to the surface of the raisins. The result is that the sum of the density of the raisins and the gas is less than that of the water solution. Thus, the raisins rise to the surface. Many of the bubbles are released at the surface, and the density of the raisins becomes again greater than that of the solution. Thus, the raisins sink. **Children's "water-wings" operate on the same principle by adding to the volume of the child without increasing the mass considerably.** *Recall the relationship between mass, volume and density.*

2. The amounts of baking soda and vinegar are approximate and depend on the size of the container used. If a larger container is used, increase the amount of baking soda and vinegar appropriately.

Extensions

1. Mothballs can be used in addition to, or in place of, the raisins. Remember to make provisions for solids be placed in the trash instead of your sinks!!

2. Add a drop of food coloring to your water to enhance "dance" movement.

Disposal
Solutions may be flushed down the sink. Solids should be placed in a solid waste container.

EXPERIMENT 4: STEEL WOOL GENERATING HEAT

✸ exothermic and endothermic reactions• balancing chemical equations• oxidation states•

Put the thermometer in the jar and close the lid. Wait about 5 minutes and write down the temperature. Remove the thermometer from the jar. Soak a piece of steel wool in vinegar for one minute. Squeeze the vinegar out of the steel wool pad. Wrap the steel wool around the bulb of the thermometer. Place the thermometer and steel wool back into the jar and close the lid. Wait 5 minutes. Take the temperature again

The vinegar removes any protective coating from the steel wool, allowing the iron in the steel to rust. **Rusting is a slow combination of iron with oxygen**. When this happens, heat energy is released. The heat released by the rusting of iron causes the mercury in the thermometer to expand and rise.

The chemical reaction for the rusting of iron shows that four atoms of solid iron react with three molecules of oxygen gas to form two units of solid rust.

$4Fe + 3O_2 \rightarrow 2FeO_3$

Experiments demonstrate that iron and oxygen react in these proportions in air at room temperature. Rust is the product, or result, of the reaction. Iron and oxygen are the reactants.

Acids and Bases: How many acids and bases can you identify in your household?

How do you decide whether a substance is an acid or a base?

Remember it is not always advisable to taste or smell substances! Our answer lies with Indicators

Indicators: Indicators are weak acids or bases which happen to change colour when they change from one form to their conjugate form. Each indicator will have its own unique colour for the acid form and another unique colour for its base form. The colour seen depends on which form dominates in concentration at equilibrium. However a third possibility exists in the special case where the concentrations of the acid form and base form are equal or close to equal. In this instance a high concentration of both colour causing species are present and the intermediate colour is observed.

Let the indicator bromthymol blue be represented by the general formula HInd, then its conjugate base is Ind-, and we can write a dissociation equation:

yellow blue

$$\underset{\text{yellow}}{HInd} \rightleftharpoons H^+ + \underset{\text{blue}}{Ind^-}$$

$$K_a = \frac{[H^+][Ind^-]}{[HInd]}$$

This is how all indicators work. Do you see the difference that can be made by the loss or acquisition on one H^+?

Make your own indicator

The goal is to make your own pH indicator paper, and use it to measure the acidity and alkalinity of various solutions from around your house.

Introduction

In this project you'll learn how to make your own pH paper that you can use to find out if a solution is acidic or basic (alkaline). What does it mean for a solution to be acidic or alkaline?

It all has to do with hydrogen ions (abbreviated with the chemical symbol H^+). In water (H_2O), a small number of the molecules dissociate (split up). Some of the water molecules lose hydrogen and become hydroxyl ions (OH^-). The "lost" hydrogen ions join up with water molecules to form hydronium ions (H_3O^+). For simplicity, hydronium ions are referred to as hydrogen ions H^+. In pure water, there are an equal number of hydrogen ions and hydroxyl ions. The solution is neither acidic nor basic.

An acid is a substance that donates hydrogen ions. Because of this, when an acid is dissolved in water, the balance between hydrogen ions and hydroxyl ions is shifted. Now there are more hydrogen ions than hydroxyl ions in the solution. This kind of solution is acidic.

A base is a substance that accepts hydrogen ions. When a base is dissolved in water, the balance between hydrogen ions and hydroxyl ions shifts the opposite way. Because the base "soaks up" hydrogen ions, the result is a solution with more hydroxyl ions than hydrogen ions. This kind of solution is alkaline.

Acidity and alkalinity are measured with a logarithmic scale called pH. Here's why: A strongly acidic solution can have one hundred million million (100,000,000,000,000) times more hydrogen ions than a strongly basic solution! The flip side, of course, is that a strongly basic solution can have 100,000,000,000,000 times more hydroxide ions than a strongly acidic solution. Moreover, the hydrogen ion and hydroxide ion concentrations in everyday solutions can vary over that entire range. In order to deal with these large numbers more easily, scientists use a logarithmic scale, the pH scale. Each one-unit change in the pH scale corresponds to a ten-fold change in hydrogen ion concentration. The pH scale ranges from 0 to 14. It's a lot easier to use a logarithmic scale instead of always having to write down all those zeros! By the way, notice how one hundred million million is a one with fourteen zeros after it? It's not coincidence, its logarithms!

To be more precise, pH is the negative logarithm of the hydrogen ion concentration:

$$pH = \log 1/[H]^+ = -\log [H^+] .$$

The square brackets around the H^+ automatically mean "concentration" to a chemist. What the equation means is just what we said before: for each 1-unit change in pH, the hydrogen ion concentration changes ten-fold. Pure water has a neutral pH of 7. pH values lower than 7 are acidic, and pH values higher than 7 are alkaline (basic).

The table below has examples of substances with different pH values (Decelles, 2002; Environment Canada, 2002; EPA, date unknown).

Table 1. The pH Scale: Some Examples

pH Value	H^+ Concentration Relative to Pure Water	Example
0	10 000 000	battery acid
1	1 000 000	sulfuric acid
2	100 000	lemon juice, vinegar
3	10 000	orange juice, soda
4	1 000	tomato juice, acid rain
5	100	black coffee, bananas
6	10	urine, milk
7	1	pure water
8	0.1	sea water, eggs
9	0.01	baking soda
10	0.001	Great Salt Lake, milk of magnesia
11	0.000 1	ammonia solution
12	0.000 01	soapy water
13	0.000 001	bleach, oven cleaner
14	0.000 000 1	liquid drain cleaner

In this project you will make your own pH paper from a colored indicator that you will extract from red cabbage by cooking it in water. Once you have the indicator solution, you can soak some coffee filter paper in it, and then allow the paper to dry. When the paper is dry, you can cut it into strips, and you'll have pH paper that will change color. It will turn greenish when exposed to bases, and reddish when exposed to acids. How green or how red? That's your job! Use different solutions that you have around the house to find out how the color change corresponds to changes in pH.

Terms, Concepts and Questions to Start Background Research

To do this project, you should do research that enables you to understand the following terms and concepts:

- Acids, Bases, Logarithms, pH, pH indicators

Questions

- What value of pH is neutral?
- What range of pH values is acidic?
- What range of pH values is basic?
- What color is red cabbage pH paper when dipped in acidic solutions?
- What color is red cabbage pH paper when dipped in basic solutions?

EXPERIMENT 5: MAKING YOUR OWN INDICATOR

✸ Indicators, acid base reactions, chemical equilibrium, Le Chatelliers Principle

Materials and Equipment

To do this experiment you will need the following materials and equipment:

- Red cabbage leaves
- 1-liter cooking pot
- Water
- 1-liter bowl
- Strainer
- White coffee filters, filter paper or soft white toilet
  - Alternatively, you can use chromatography paper.
- Acidic and basic solutions to test, for example:
  - Lemon juice, vinegar, orange juice, soda ;Tomato juice, acid rain ;Black coffee, bananas, milk, saliva, water, eggs, baking soda solution, milk of magnesia , ammonia solution , soapy water. Sour milk, ting (sour porridge made by fermenting maize meal)

Procedure

The **red cabbage** (*Brassica oleracea* var. *capitata* f. *rubra*) is a sort of cabbage, also known as **Red Kraut** or **Blue Kraut** after preparation. Its leaves are coloured dark red/purple. However, the plant changes its colour according to the pH value of the soil, due to a pigment called anthocyanin(flavin). On acidic soils, the leaves grow more reddish while an alkaline soil will produce rather greenish-yellow coloured cabbages. This explains the fact that the very same plant is known by different colours in various regions. Furthermore, the juice of red cabbage can be used as a home-made pH indicator, turning red in acid and blue in basic solutions. It can be found in Northern Europe, throughout the Americas, and in China.

On cooking, red cabbage will normally turn blue. To retain the red colour it is necessary to add vinegar or acidic fruit to the pot.

Red cabbage needs well fertilized soil and sufficient humidity to grow. It is a seasonal plant which is seeded in spring and harvested in late autumn. Red cabbage is a better keeper than its "white" relatives and does not need to be converted to sauerkraut to last the winter. Wiki

1. **Preparation of indicator**
   a. Slice a head of cabbage at approximately 3 cm intervals, or peel the leaves from the head and tear them into pieces.
   b. Place the leaves in the cooking pot and cover with water.
   c. Cook on medium heat for half an hour (low boil is good).
   d. Allow the cooked cabbage to cool, and then pour off the liquid into a bowl. You can pour through a strainer to catch the cabbage pieces, or hold them back with a large, flat ladle with holes.
   e. The solution is a deep blue, but will change color when the pH changes. Put equal amounts of this solution into the combo plate holes or tests tubes; label the combo plate holes or test tubes to indicate the solution you are going to test. Drop the solution to be tested in the relevant holes or test tubes and watch the colour change. Note the colour changes for acids and bases.
   f. You can experiment with using the liquid as a pH indicator.)
2. Here's how to make pH paper using the red cabbage solution and filter paper:
   a. Cut the filter paper or toilet paper into strips of about 3cm breath by 10cm length.
   b. Soak the strips of filter papers or any soft toilet paper in the red cabbage solution for about 30 minutes.
   c. Drain the excess solution from the strips of paper, and set them out in a single layer on some paper towels to dry overnight. To speed up the drying process, you can put them on a cookie sheet and put them in your oven at low temperature.
   d. The strips are now ready to test the pH of various solutions. They start out blue, but will turn green in basic solutions and red in acidic solutions.
3. Use the strips to test the acidity/alkalinity of various solutions around your house. For example:
   a. Lemon juice, vinegar ;Orange juice, soda ;Tomato juice, acid rain ;Black coffee, bananas; Milk, saliva; Pure water; Sea water, eggs Baking soda solution; Milk of magnesia; Ammonia solution; Soapy water

Note: if you test the pH of saliva, do not put the pH paper in your mouth! Instead, spit some saliva into a clean container and dip the paper into the saliva.

4. After testing, put the pH strips in order of increasing pH of the solution tested.
   a. You can use the table in the Introduction as a guide.
   b. The Variations section has some additional suggestions for independent confirmations of the pH readings.
5. Do you see a gradual change in color as the pH of the tested solutions varies? Can you match specific colors to certain pH levels? Over what range of pH does the color continue to change? How accurately do you think you can determine the pH of a solution with your test papers? Within 1, 2, or 3 pH units?

EXPERIMENT 6: USING VINEGAR TO PEEL AN EGG

Reactions of acids ● balancing chemical equations ● Chemical change

Procedure

1. Place the egg in a transparent wide mouthed jar, cylinder or tall glass and cover the egg with vinegar. (Brown eggs are more desirable since the contrast is more noticeable, but you may still use white eggs)
2. Look closely at the egg. What do you see? Do you see any bubbles forming on the shell? Leave the egg in the vinegar for 24 hours.
3. Change the vinegar on the second day. Carefully pour the old vinegar down the drain and cover the egg with fresh vinegar. Place the glass with the vinegar and egg in a safe place for a week, that's right, 7 days! Don't disturb the egg but pay close attention to the bubbles forming on the surface of the shell (or what's left).
4. One week later pour off the vinegar and carefully rinse the egg with water. The egg looks translucent because the outside shell is gone! The only thing that remains is the delicate membrane of the egg. You've successfully made an egg without a shell.

Explanation

5. The bubbles you see around the eggshell are carbon dioxide gas. Vinegar is a dilute acid called acetic acid - CH_3COOH - and white vinegar from the grocery store is usually about 5% solution. Egg shells are made up of calcium carbonate. The vinegar reacts with the calcium carbonate by breaking the chemical into its calcium and carbonate parts (in simplest terms). Some of the vinegar will also sneak through the egg's membrane (permeate the membrane) and cause the egg to get a little bigger. That's why the egg is even more delicate if you handle it. If you shake the egg, you can see the yolk sloshing around in the egg white. If the membrane breaks, the egg's insides will spill out into the vinegar. Allowing the peeled egg to react with the carbon dioxide in the air will cause the egg to harden again.

Experiment 7: Using baking soda and vinegar to fill balloons

Gases - gas laws, states of matter (by freezing or heating air inside the balloon)

When two substances react together, they can form new chemicals or products. In this chemical reaction, the vinegar and baking soda react and produce carbon dioxide. It is these bubbles of gas that inflate the balloon.

Materials

- A small, strong plastic bottle (20oz. soda bottle)
- A medium-sized round balloon
- Vinegar
- Baking soda
- A funnel

Procedure

1. Pour vinegar into the small bottle until it is about half an inch deep.

2. Using a funnel, pour two teaspoons of baking soda into the neck of a balloon.

3. Stretch the neck of the balloon over the neck of the bottle, being careful not to let the baking soda out of the balloon.

4. Now lift the balloon so that the baking soda runs into the vinegar. Shake the bottle. What happens?

Experiment 8: Miscible or immiscible

✸ Bonds, intramolecular and intermolecular forces, density, mixtures, solutions

Oil and Water

You will need the following materials:

• ¼ cup (60 ml) water
• ¼ cup (60 ml) vegetable oil
• small bottle with lid, for example an empty peanut butter bottle
• food coloring or sweet aid

Procedure

1. Pour the water into the small bottle.
2. Add a couple of drops of food coloring or sweet aid and mix.
3. Add the oil. What do you see?
4. Close the glass bottle and shake the bottle so that the two liquids are thoroughly mixed. Set the glass down and watch what happens.

Observations

5. Do oil and water mix? Why?

Questions

6. The oil layer is on top of the water. Why? Because of the difference in density of the two liquids.
7. What is density? The density of a substance is the ratio of its mass (weight) to its volume.
8. What is the unit for density
9. Which of the two liquids is denser? The oil is less dense than the water and so is on top.

Explain density in terms of the packaging of atoms/molecules in a solid, liquid and air.

Experiment 9: Redox reactions

✸ Oxidation states, chemical change, chemical reactions,

Cleaning your old coins

Use old 5c coins, and vinegar to clean them up!:

Materials

- 5-10 dull coins
- 1/4 cup white vinegar (dilute acetic acid)
- 1 teaspoon salt (NaCl)
- 1 shallow, clear glass or plastic bowl (not metal)
- water
- measuring spoons
- paper towels

Procedure

1. Pour the salt and vinegar into the bowl.
2. Stir until the salt dissolves.
3. Dip a penny halfway into the liquid and hold it there for 10-20 seconds. Remove the penny from the liquid. What do you see?
4. Dump the rest of the coins into the liquid. The cleaning action will be visible for several seconds. Leave the coins in the liquid for 5 minutes.

Coins get dull over time because the copper in the coins slowly reacts with air to form copper oxide. Pure copper metal is bright and shiny, but the oxide is dull and greenish. When you place the coins in the salt and vinegar solution, the acetic acid from the vinegar dissolves the copper oxide, leaving behind shiny clean coins. The copper from the copper oxide stays in the liquid. You could use other acids instead of vinegar, like lemon juice.

ADD YOUR FAVORITE SCIENTIST TO THIS LIST!!

Famous Scientists

Patricia Bath - (USA) In 1988, Patricia Bath invented the Cataract Laser Probe, a device that painlessly removes cataracts. Prior to this invention, cataracts were surgically removed. Patricia Bath founded the American Institute for the Prevention of Blindness.http://inventors.about.com/od/bstartinventors/a/zxfPatricia_Bath_img.htm

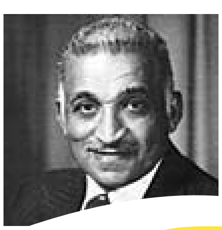
Marie Daly - (USA, 1921–2003) In 1947, Marie Daly became the first African American woman to earn a Ph.D. in chemistry. The majority of her career was spent as a college professor. In addition to her research, she developed programs to attract and aid minority students in medical and graduate school.

Mae Jemison - (USA, born 1956) Mae Jemison is a retired medical doctor and American astronaut. In 1992, she became the first black woman in space. She holds a degree in chemical engineering from Stanford and a degree in medicine from Cornell. She remains very active in science and technology.

http://starchild.gsfc.nasa.gov/docs/StarChild/whos_who_level2/jemison.html

Percy Julian - (USA, 1899-1975) Percy Julian developed the anti-glaucoma drug physostigmine. Dr. Julian was born in Montgomery, Alabama, but educational opportunities for African Americans were limited in the South at that time, so he received his undergraduate degree from DePauw University in Greencastle, Indiana

http://upload.wikimedia.org/wikipedia/en/d/d6/Percy_Lavon_Julian.jpg

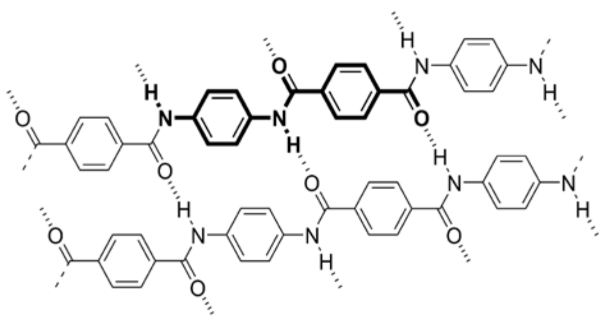


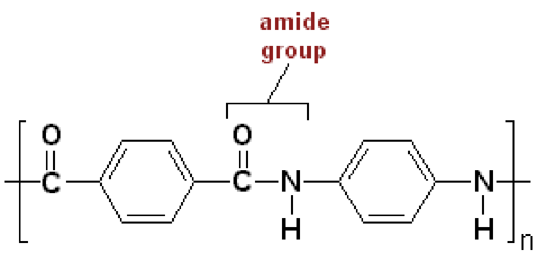
Samuel Massie Jr. - (USA, died May 9, 2005) In 1966, Massie became the first black professor at the U.S. Naval Academy, making him the first black to teach full-time at any US military academy. Massie received a master's degree in chemistry from Fisk University and a doctorate in organic chemistry from Iowa State University. Massie was a professor of chemistry at the Naval Academy, became the chairman of the department of chemistry and co-founded the Black Studies program.
http://www.encyclopediaofarkansas.net/media/gallery/photo/Samuel_Massie_t.jpg

WOMEN IN CHEMISTRY

Kevlar - Stephanie Kwolek

Stephanie Kwolek's research with high performance chemical compounds for the DuPont Company led to the development of a synthetic material called Kevlar which is five times stronger than the same weight of steel. Kevlar, patented by Kwolek in 1966, does not rust nor corrode and is extremely lightweight. Many police officers owe their lives to Stephanie Kwolek, for Kevlar is the material used in bullet proof vests. Other applications of the compound include underwater cables, brake linings, space vehicles, boats, parachutes, skis, and building materials.





This is the monomer for Kevlar

Jacqueline Barton - (USA, born 1952) Jacqueline Barton probes DNA with electrons. She uses custom-made molecules to locate genes and study their arrangement. She has shown that some damaged DNA molecules do not conduct electricity.

Ruth Benerito - (USA, born 1916) Ruth Benerito invented wash-and-wear cotton fabric. Chemical treatment of the cotton surface not only reduced wrinkles, but could be used to make it flame resistant and stain resistant.

Ruth Erica Benesch - (1925-2000) Ruth Benesch and her husband Reinhold made a discovery that helped explain how hemoglobin releases oxygen in the body. They learned that carbon dioxide functions as an indicator molecule, causing hemoglobin to release oxygen where carbon dioxide concentrations are high.

Joan Berkowitz - (USA, born 1931) Joan Berkowitz is a chemist and environmental consultant. She uses her command of chemistry to help solve problems with pollution and industrial waste.

Carolyn Bertozzi - (USA, born 1966) Carolyn Bertozzi has helped design artificial bones that are less likely to cause reactions or lead to rejection than their predecessors. She has helped create contact lenses that are better-tolerated by the cornea of the eye.

Hazel Bishop - (USA, 1906–1998) Hazel Bishop is the inventor of smear-proof lipstick. In 1971, Hazel Bishop became the first female member of the Chemists' Club in New York.

INVENTORS OF NOTE

Garrett Morgan - (USA) Garrett Morgan is responsible for several inventions. Garret Morgan was born in Paris, Kentucky in 1877. His first invention was a hair straightening solution. October 13, 1914 he patented a Breathing Device which was the first gas mask. The patent described a hood attached to a long tube that had an opening for air and a second tube with a valve that allowed air to be exhaled. On November 20, 1923, Morgan patented the first traffic signal (sometimes called traffic lights or robots in South Africa) the U.S. He later patented the traffic signal in England and Canada. He is renowned for a heroic rescue in which he used his hood to save workers trapped in a tunnel system filled with fumes. He is credited as the first African-American in Cleveland to own an automobile-Wiki

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George Washington Carver (George Washington Carver, 1864?-1943, American agricultural chemist, graduated from Iowa State College (now Iowa State Univ.; B.Sc., 1894; M.A. 1896). was an American inventor, scientist, and educator.

Picture of George Washington Carver taken by Frances Benjamin Johnston, in 1906.

George Washington Carver was born into slavery in Diamond Grove. Missouri in 1864, on the plantation of Moses and Susan Carver. His father was killed in an accident and his mother, sister and George were kidnapped by night riders (Klu Klux Klan). The infant George was returned, almost dead from Whooping Cough, after Moses Carver offered a reward. George never heard from or saw his mother or sister afterwards.

Carver worked day and night to make various products from peanuts & sweet potato. During his lifetime he developed 325 products from peanuts, 108 products from sweet potatoes, 75 applications of pecans, 118 industrial products from agricultural products and over 500 dyes from the plants, which was incredible. His experiments soon gave him recognition as a "peanut man."

He did not profit from his discoveries; he gave them to mankind. He would say. "God gave them to me. How can I sell them to someone else?" He strongly believed that the inventor no longer remains an inventor if he starts seeking commercial gratification. He also donated his life savings to the Carver Foundation at Tuskegee in 1940. Carver died on Jan 5th, 1943. On July 14, 1943 U.S. President Franklin Delano Roosevelt honored him with a 'National Monument' dedicated to his accomplishments. "It is not the style of clothes one wears, neither the kind of automobile one drives, nor the amount of money one has in the bank, that counts. These mean nothing. It is simply service that measures success." Carver said so and followed it throughout his life.

http://prism.troy.edu/~rfrierson/class/faculty/carverproject/gwcinventions.htm

All experiments adapted from the following sites:

http://library.thinkquest.org/3347/vinegar+bsoda4.html

http://www.edinformatics.com/math_science/science_of_cooking/naked_egg_experiment.htm

http://www.stevespanglerscience.com/experiment/naked-egg-experiment

http://www.wikihow.com/Clean-Coins

http://www.newton.dep.anl.gov/askasci/chem00/chem00303.htm

http://www.doityourself.com/stry/vinegarbakingsoda

http://nzic.org.nz/ChemProcesses/food/6D.pdf

http://www.apple-cider-vinegar-benefits.com/baking-soda-and-vinegar.html

http://www.sciencefairadventure.com/

http://chemistry.about.com/od/acidsbase1/a/red-cabbage-ph-indicator.htm

http://www.madsci.org/experiments/archive/859332497.Ch.html

http://en.wikipedia.org/wiki/Red_Cabbage

http://chemistry.about.com/cs/foodchemistry/f/blbaking.htm

http://www.thenakedscientists.com/forum/index.php?topic=6240

http://www.edinformatics.com/math_science/science_of_cooking/naked_egg_experiment.htm

http://www.stevespanglerscience.com/experiment/naked-egg-experiment

If you have developed an experiment that you would like to share with South African Schools, please email it to:
masemula.m@dbe.gov.za

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