Melda

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Presents

Crazy Chemists

OnTrack™ Science Edition 3.1

This is the class guide that you will be using while tacking the Crazy Chemists Introductory Course – "An Inside Look At Chemistry"

written by

E. Christophe Darsow

Name____

Melda Scientific is a company dedicated to perusing excellence in scientific education. This is the class packet that you will be using while you take the Crazy Chemists Introductory Course. Over the next two days you will have the opportunity to learn a large amount about chemistry and have fun at the same time.

This class packet is divided into sections and days. This was an improvement over Melda Scientific's OnTrack science curriculum 1.1 which was hard to follow and needed numerous grammatical improvements. This class packet, Melda Scientific's OnTrack science 3.0 is much improved in that the explanations are better and the laboratory experiments are more easily understood. There are also great resources in the back of this packet that can be used in school or any place science references are needed. This book can be purchased from Melda Scientific for $2.00. The material in this book may all be used by written permission only from Melda Scientific's president. Thank you for choosing Melda Scientific.

About the Facility:

Melda Scientific's laboratory has 5 separate stations, one for each student and a teachers station. Each station has its own cupboard with lab supplies. Each station also has its own sink, 8 power outlets, and a gas jet for Bunsen Burners. Each station is equipped with the following supplies…

Pencil	1 – 30 ml glass vial	Chemicals in small bags
Bunsen Burner	Erlenmeyer Flask	Graduated Cylinder
Measuring Spoons	Tripod Stand	1 – Balloon
Wire Mesh with heatproof Gauze	1 – Paint Brush	Syringe
Glass Test Tube	1 – Coffee Filter	Test Tube Holders
3 - 250 ml beakers	4 – Plastic Cups	10 - Straws
Burner Tongs	1 – Funnel	Safety Glasses
1 - Eye Dropper	1 – 3x5 card	Small Tray of 16 pH Strips

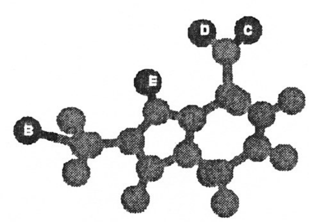
The creators of this laboratory would like to advise all students and participants that this lab is one of a kind and replacements are costly. Please try your hardest to respect the equipment, especially the countertops, they can be damaged easily. Do all chemistry experiments on a counter pad. Remember, if you every have a question or safety concern, your instructor will be happy to assist you in your needs.

Day 1: An Inside Look at the Nuts and Bolts of Chemistry

Section 1: Chemistry Is the of Study of Matter

Everything around is matter, or it is made up of extremely small particles that are called atoms. There are many different kinds particles around us, each one of those particles can be called a substance. Anything that you can see, touch, breathe, or taste is a substance. All through this class guide, you will see the term substance, understand it now and understand it well. A **substance** is that which has mass and occupies space or in other words, anything that you can see, feel or touch, or smell.

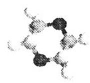
Another term that is also useful to know while pursuing the study of chemistry is a mixture. A **mixture** is a combination of two or more substances. A key characteristic about mixtures is that the substances are not bonded in any way, they are simply touching each other, like any two old shoes touch each other, no bonding occurs.



In chemistry we speak of mixtures frequently, but even more frequently we speak of a special kind of mixture called a solution. A **solution** is a term for a mixture of two or more substances in which the components are bonded chemically. You cannot discern between one particle and another within a solution. Take a simple example, when you make the drink tang, you add the powder into the water, and stir them together. You are creating a solution. Each one of the small particles of the tang powder is **dissolved** in the water. The water is called the **solvent** and the tang powder is the called the **solute**. Or in other words, whatever is being dissolved is the solute and whatever the solute is dissolved is the solvent. If a solvent has dissolved as much solute as it can hold, the solution is said to be **saturated**. If there is excess solute in the container, and the solvent has dissolved all the particles that it can hold, the solution is said to be **supersaturated.**

Another principal that is important to understand is concentration of solutions. Take for example, you have 1 cup of water and 1 teaspoon of tang powder. When you dissolve the tang powder in the cup of water, you have a solution. Now, you are given 2 teaspoons of tang powder and still 1 cup of water. When you dissolve the tang powder again, into a new cup of water, you have a **higher concentration** of tang. The first solution of tang you made, the one with only one teaspoon of powder was a **lower concentration**. Concentration is a relative term describing the amount of solute compared to the amount of solvent.

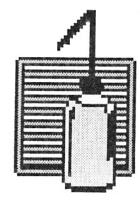
The material covered above is very important to understand and in some cases, this class packet is not equipped with all the text necessary to allow some students to fully understand, please, if you are confused, listen to your instructor and ask questions, he or she will help you to understand the more clearly. Below is lab experiment number 1, it should give you an opportunity to understand the topics above more clearly while you do hands-on experimentation.



Lab Experiment 1: Creating Your Own Solutions

In this lab you will be making solutions that you will use later in this class session when we discuss more in depth chemistry concepts. For now, be sure to set aside the solutions you make for later use.

Materials:
2 - 250 ml beakers
2 – Stirring rods
Sodium Ferrocyanide – In small bag in cupboard
Ferric Ammonium Sulfate – In small bag in cupboard



Procedure:
1. Measure 150 ml of water into one of the beakers.
2. Measure 25 ml of water into the second beaker.
3. Measure 1/8 teaspoons of Sodium Ferrocyanide into the beaker with 25 ml of water in it.
4. Measure 1/8 teaspoons of Ferric Ammonium Sulfate into the beaker with 150 ml of water in it.
5. Stir each one of the beakers so all the solid material is completely dissolved. Be sure to use two separate mixing sticks so you do not contaminate one beaker with the substance in the other.
6. Set each beaker aside. Be sure that the beakers are not on the edge of the counter to reduce the chance of them getting knocked over.

Discussion:

We just made two solutions. We can speak of the solutions we made as a Sodium Ferrocyanide solution and a ferric Ammonium Sulfate solution. Water is the most common solvent so when we are speaking of a solution in which the solute is dissolved in water, we do not need to state the solvent that was present.

If we speak on the lines of concentration, compare the amount of chemical that we put in each beaker, notice that the Ferric Ammonium Sulfate solution is less concentrated than that Sodium Ferrocyanide solution.

Section 2: The Separation of Mixtures and Solutions

We have talked about basic mixtures and how a special form of a mixture is called a solution. Now we will explore different methods that are used to separate mixtures. Here is a summary of each of the 4 different separation methods that we will explore in this class.

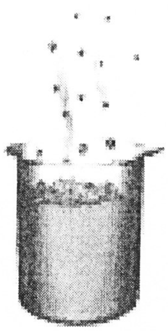
- **Filtration** – Filtration is probably the most widely used of all separation methods. This method can be used on a large scale as well as on a smaller scale within the laboratory or kitchen. This method is usually applied when a mixture is made up of substances of varying sizes, such as sand a gravel. The entire mixture can be poured through a filter, and only the large stones will remain in the filter. Filters can differ in size, some have very small openings, so small that you need a microscope to see the openings, and some are large enough that you could stick your finger into an opening.

- **Magnetic Attraction** – This method is useful only if one of the materials you wish to separate is magnetic and the other is not. An example is saw dust and metal screws. If you dropped a box of screws into a pile of sawdust, an efficient way to remove the screws would be to use a magnet.
- **Shaking** - This is not a very widely used method outside of science demonstrations. If for example, you have a jar of rice and some small pebbles are contained inside the rice, you could retrieve the pebbles by placing a lid on the jar and shaking, the pebbles would rise to the top of rice. This happens because the rice is more dense than the pebbles, so when the jar is shaken, the material with the least density, naturally moves above the material with greater density.
- **Water Addition** – Water addition is used when one of the materials you want to separate either floats or sinks in water. If you are again trying to separate the screws from a pile of sawdust, you could place the entire mixture in a bucket filled with water and the sawdust would float and the screws would sink, you could then remove the sawdust from the stop of the water and use the filtration method to retrieve the screws, or you could just use you hand and reach below the sawdust and remove the screws.

Section 3: Chemical Reactions

When are solutions actually used? The most common place is when dealing with chemical reactions. A **chemical reaction** is when two or more substances or **reactants** are combined to form 1 or more new substances or **products**.

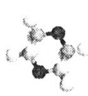
Have you every mixed baking soda and vinegar? If you have, to inform you, that is what we call a chemical reaction. The two reactants that were mixed are the Baking Soda and Vinegar. The chemical reaction changed the Baking soda and Vinegar into: carbon dioxide, water, and a substance called a salt. Chemical reactions are literally all around us, and even inside us.



Chemical reactions can be separated into two separate groups. Exothermic and Endothermic chemical reactions. **Exothermic** chemical reactions are all reactions that give up heat while taking place. Examples of this type of reaction are burning and rusting. In contrast, **endothermic** chemical reactions are all reactions that take in heat while taking place. An example of this type of chemical reaction is the reaction between Ammonium Chloride and water, or the substances found in instant cold packs.

Chemical reactions are used all the time to help us make our lives easier. We use chemical reactions frequently for cleaning and removing tarnish and hard water stains on various surfaces. They are used in industry constantly for making many products we use everyday such as plastic, gasoline, and computer chips.

Have you ever done the experiment where you put iron nails in both salt water and regular water for the purpose of testing which nail would rusted the faster? There is a good explanation for why the nail in saltwater rusted sooner. The salt acted as a catalyst. A **catalyst** is a substance that speeds up a chemical reaction without being used up in the process.



Lab Experiment 2: Performing A Chemical Reaction

In this lab experiment you will be using the solutions you made in lab number 1. The chemical reaction you will be performing is simple, but illustrates essential chemistry principals.

Materials:
The Solutions you made in lab 1
Procedure:

1. Pour the contents of the beaker with 25 ml of water in it into the beaker with ~~100~~ 150 ml of water.
2. Watch the chemical reaction take place.

Discussion:

When you poured the Sodium Ferrocyanide solution into the Ferric Ammonium Sulfate solution, the molecules of each substance re-arranged themselves to make a new substances. One of the substances created in the chemical reaction happened to take on the color blue. Remember that more than one new substance was created and more than one exchange of molecules occurred, it just happens that we only saw the effects of one of them.

Lab Experiment 3: The Precipitate Reaction of Silver Nitrate

This chemical reaction is very widely used because of its stunning presentation.

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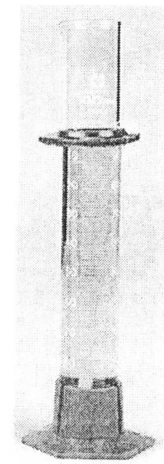
WARNING

The chemicals you are dealing with are very toxic. They will stain anything it comes in contact with. Be very careful that anything the liquid or solid touches it brought to the attention of your instructor Immediately.



Materials:

1 – 30 ml glass vial
1 - 50 ml beaker
1 – 12 ml syringe
2 – stirring rods
Silver Nitrate Powder – From Instructor
Sodium Chloride – In small bag in cupboard
40 ml of Distilled Water – Beaker or glass at station

Procedure:

1. Fill the glass vial ¾ full with distilled water.
2. Add 1/8 teaspoon of silver nitrate to the distilled water in the glass vial.
3. While holding onto the vial firmly, stir the silver nitrate crystals until they are completely dissolved.
4. Fill the 50 ml beaker with about 20 ml of water (regular tap water).
5. Add ½ teaspoon of Sodium Chloride to the water and stir for about 1 minute. (If all the salt dissolved, add more until it no longer dissolves, meaning, there is un-dissolved salt at the bottom of the beaker.)
6. Using the syringe, suck up 5 ml of salt solution. Note: Do not put the syringe tip all the way to the bottom of the beaker, this will cause the Sodium Chloride Crystals to be sucked into the syringe and cause unexpected results.
7. While holding the syringe vertically above the vial, depress the plunger and watch the stream of Sodium Chloride solution soar into the water, leaving a white precipitate behind. NOTE: Do not let the tip of the syringe tough the fluid in the vial, this will contaminate it, and cause delays.

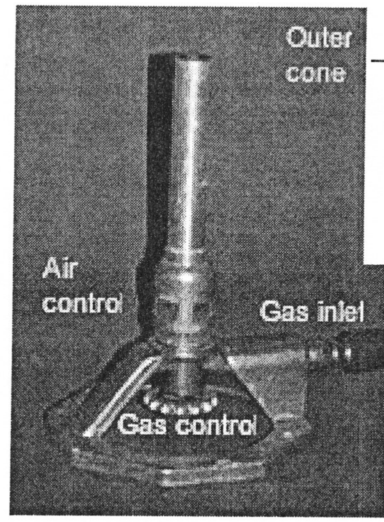
Discussion:

There is a new chemical created when we mix a solution of Sodium Chloride and a Solution of Silver Nitrate called Silver Chloride. In this chemical reaction, the product (Silver Chloride) was not only white but it was a solid. We call this solid a **precipitate.** Thus this chemical reaction can be called a precipitate reaction.

Section 4: Bunsen Burner Safety

A Bunsen Burner is a easy and quick way to heat something in a laboratory. It was invented by Robert Bunsen, a German Chemist in the 1800's. The burner's that you will be using burns natural gas. The burner will heat things fast and with an even heat. On the type of burners you are going to use you can adjust the height and the temperature of the flame. Use the following Melda Scientific approved safety rules while preparing, lighting, and extinguishing your Bunsen burner.

These are safety rules that are to be followed at all times when dealing with Bunsen burners. Failure to follow these rules my endanger the safety or life of other students and the condition of the laboratory supplies.



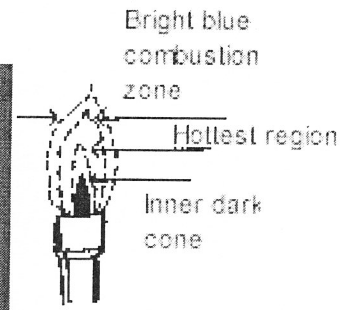


Figure 2-19. Bunsen burner and proper flame.

- Everyone must be wearing safety glasses or goggles at <u>all</u> times when dealing with the Bunsen burners. No exceptions. If for any reason you must take the glasses or goggles off, tell the instructor and he or she will show you out of the room to do so.
- Nobody is to turns on the gas jets unless everyone has on eye protection and the instructor is personally watching you and has given the OK to light the burners.
- Tie back any loose hair, baggy clothes, loose watches, etc.
- Make sure the Bunsen burner is <u>not</u> under the upper cabinets thus posing a risk of fire.
- Make sure the Bunsen burner is a safe distance from other burners and a safe distance away from the edge of the countertop, and other pieces of equipment.
- Prepare all the supplies you need before lighting the Bunsen burner so you need to do as little moving around as possible while the burner is lit.
- Only people that have been taught and certified in the proper way to use a Bunsen burner is allowed to light, operate or extinguish them.

Lighting a Bunsen Burner

1. Make sure you have all the necessary parts before starting : Connecting line (4 ft), Bunsen Burner, something to heat, tripod, or other stabilizing equipment, match or spark lighter, protective hot plate to place hot materials when heating is complete.
2. Check the connecting line for holes, or crusty patches. Also check the Bunsen Burner for dents, cracks, or jagged edges that may cause the flame to burn in a different direction than expected.
3. Make sure nothing is within 2 ft of the burner that may catch fire and burn. (That includes people not using the burner.)
4. Check to make sure the Bunsen burner's valve is in the OFF position.
5. Connect the tube (gas line) to the gas jet on the wall. DO NOT OPEN VALVE.
6. Connect the other end of the tubing to the Bunsen burner. Make sure both connections are tight around the fixtures.
7. Once the instructor gives the OK, turn the gas jet to the OPEN position. NOTE there should be no gas coming out of the burner, the gas is only filling the supply tube .
8. Turn the Flame control knob on the Bunsen burner to half way OPEN. Be ready to light the burner. NOTE : light the match first, then turn on the gas. This will let the least amount of unburned gas into the air as possible.

9. Hold the match directly over the Bunsen burner and wait for the burner to light. Once lit, remove the Match and put in cup of water. (If the burner is not lighting check to make sure that there is gas coming out of the burner. If you hear gas, you might have the valve open too far and the flame blows itself out. To prevent this, turn the valve in to release less gas. If you have trouble on your second try, ask your instructor of assistance.)
10. Adjust the flame to the appropriate height and temperature for your specific heating need.

Extinguishing Bunsen Burners

1. Remove the item being heated with the proper pieces of equipment and place on a hot pad.
2. Turn the flame control dial on the Burner to OFF.
3. Turn the gas jet on the wall to the OFF position.
4. Do not disconnect any tubing until you are sure the burner is cool.
5. Place all the equipment that you used in the proper place after it has cooled.

I ____________________________ am committed to following and respecting all the above rules and regulations pertaining to Bunsen burner safety procedures. I am also confident that I am ready to use the Burner to carry out worthwhile science experimentation in a mature and adult fashion.
Signature of Student_____________________________________ TE __________

Lab Experiment 4: Making White Glue

This experiment is very useful because it demonstrates the principles that we have talked about all throughout this session. Although the glue itself is not extremely fascinating, it is the process that counts.

Materials:

1- Bunsen Burner	1 - Tripod	Wire Mesh for tripod
Tubing	1 - 50 ml Graduated Cylinder	
1 - Match	10 ml of Vinegar – Test Tube #1	
65 ml of Milk – In beaker	0.6 g of baking soda	
4 - Stirring Rods	1 - Funnel	
Paper towel or Filter Paper	1 - 250 ml Erlenmeyer Flask	
1 – 250 ml beaker	1 – 3 x 5 card	

Procedure:

1. Measure the 65 ml of Milk into one of the 250 ml beakers.
2. Add the vinegar and stir.
3. Gently heat the vinegar and milk solution until it is just too hot to touch. (A clump of curd should be forming on the bottom of the beaker, if not, tell your instructor.) Stir occasionally.
4. Once the milk and vinegar is warm, use beaker tongs to pour out as much of the whey (the fluid) as possible into the Erlenmeyer flask.
5. Place the filter paper in the funnel and pour the clump of curds into the funnel and let the remaining fluid drip into the Erlenmeyer flask.
6. Pour the clump of curds back into the beaker that you heated it with.
7. Add the Baking soda and water, stir for 1 minute.
8. Rip the 3 x 5 card into two pieces and glue them together using your glue!

Discussion:

Milk contains a protein called casein. Casein is a white, tasteless, odorless protein precipitated from milk by rennin. It is the basis of cheese and is used to make plastics, adhesives, paints, and foods. (Dictionary.com) Casein can easily be separated from milk by adding an acid such as vinegar. The acid causes the casein to come out of solution and coagulate or clump together. This clumped casein can now be neutralized and made into a white glue that dries into a transparent solid.

In this process of coagulating the casein, you are really separating the curds from the whey. The curds will remain in the filter paper and be used for making glue. The whey, which is mostly water and sugar, will drip through the filter paper. This process is very similar to the making of cottage cheese.

The reason that we are using nonfat milk is that the fat molecules in regular milk would also precipitate with the casein. These fat molecules would interfere with the glue structure, making the glue weaker and less desirable as an adhesive.

Section 5: Indicators

An **indicator** is a chemical that reacts uniquely to a substance depending on its composition. Some of the most widely used indicators are the ones that react specially to acids or bases. The special reaction is usually a color change but it can vary from indicator to indicator. We will talk more about acids and bases in day two.

Lab Experiment 5: Phenolphthalein Indicator Reaction

This lab is going to introduce you to the topic that we will be covering tomorrow: Acids and Bases. Follow the instructions below to perform a semi-chemical reaction.

Materials:

Phenolphthalein Solution – In Test tube #2
2 - Plastic Cups
1 - Straw
1 – Sheet of Paper
1 – Paint Brushes
1 - Eyedropper

Procedure:

1. Fill the plastic Mixing Cup with about 20 ml of water.
2. Add about 10 drops of Phenolphthalein solution to the water and stir.
3. Use the paintbrush to draw a picture or write words on the paper.
4. Fill the other plastic cup with water.
5. Rinse off the other paint brush and carefully paint around the design you made using the clear water, making it harder to see the drawing by the texture of the paper.
6. Set the paper aside to dry, later on in the session when we will uncover the image.

Discussion:

All we did was paint on a thin coating of the indicator Phenolphthalein. The regular water was put on to make it harder for the other people in the room to see the design before it is uncovered.

Part 2:

Supplies:

Sodium Carbonate in a spray Bottle
The sheet of paper you used earlier to dray in the clear Phenolphthalein Solution

Procedure:

1. Place the sheet of paper flat in a sink.
2. Lightly spray the sheet of paper with base solution until the image appears.

Discussion:

Here, we used the Sodium Carbonate to activate the Base indicator, Phenolphthalein, making the words or pictures visible.

Lab Experiment 6: Reaction Between Corn Starch and Iodine

This lab will give you an opportunity to use another indicator, like Phenolphthalein, to make a color change. This indicator is called Iodine. Iodine will turn a dark purple when it is exposed to a strong starch. In this lab we will use household corn starch to act as the starch.

Supplies:

1 – 250 ml Glass Beaker
1 - Straw
Tincture Iodine – In test tube #3
Corn Starch from instructor

Procedure:

1. Measure 200 ml of water into the 250 ml beaker
2. Measure 1 teaspoon of corn starch into the water and stir until completely dissolved.
3. Pour the contents of the container with the iodine tincture into the beaker with the corn starch.

Discussion:

This was what chemists call an indicator reaction. The Iodine indicated that there was a starch present by turning purple. This method can be used in detecting starch in any substance, not just pure starch, like we had in the lab.

Lab Experiment 7: Reaction Between Iodine and Sodium Thiosulfate

This is a chemical reaction like other ones we do, but on a smaller scale. You will be using test tubes instead of beakers, this will give you experience with liquids in smaller quantities.

Materials:

Test Tube #4
Iodine – In test tube #3
Test Tube #5
Graduated Cylinder
Stirring Rod
2 long-tipped pipettes

Procedure:

1. Using a graduated cylinder and a wash bottle, measure 18 ml of water into a test tube.
2. Add 5 drops of iodine into the test tube with water in it.
3. Stir until all the water is evenly colored.
4. All 1 drop of Sodium Thiosulfate in test tube #_______ into the iodine. Stir.
5. If the solution is not clear, add another and stir. Bravo! Clear again.

Discussion:

The sodium Thiosulfate reacted with the iodine to make a clear solution. Wow, was that cool or what!

Lab Experiment 8: Performing an Exothermic Reaction

You will be using chemicals to make a substance that produces large amounts of heat once initiated. Follow the steps word for word, slight changes could cause unexpected results. The Chemical labeled P.N was abbreviated for safety purposes. Melda Scientific strongly discourages the use of this reaction because of its flammability. Only advanced students are going to do this lab in Melda's Classes/

Materials:

Sulfur – From instructor
*****
Charcoal – From Instructor
Straw
Measuring Spoons
Disposable Ketchup Bin
Square sheet of wick

Procedure:

1. Carefully measure ½ teaspoon of Potassium Nitrate into the ketchup Tray
2. Measure ¼ teaspoon of Charcoal and Sulfur into the ketchup tray.
3. Stir well, grinding all of the chemicals together.
4. Roll the square of wick to a tight cylinder.
5. Go outside and pour the powder onto a wooden board, make it into as much as a pile as you can. Place the wick in the center of the pile of powder.
6. Light the wick, stand back at least 4 feet.

Discussion:

This chemical reaction is like all the other ones, except it emits hear. Each one of the chemicals that we added had its own purpose, and without it, the reaction would not have taken place. The **ratio of composition** is a term used to describe how much of one substance there is in terms of the other. In this reaction's case, the ratio of composition was 2:1:1 Meaning for every one part of charcoal, there needed to be one equal amount of sulfur and twice as much ***. as Charcoal and Sulfur.

Day 2: Acids, Bases, Gasses, and Pressure

Section 1: Acids, Bases, and Neutral Substances

Every substance on earth can be classified into one of the following groups...

Acid ***Neutral*** ***Base***

and each one of these three groups have special characteristics or properties.....
Acids : Usually have a sour taste and they react with metals, they contain Hydrogen atoms.

Neutral Substances : Substances that do not contain any Hydrogen ions are always neutral. Water is the most common of all the neutral substances we encounter.
Bases : They usually have a bitter taste and feel slippery to the touch. Bases always contain Hydroxide ions.

Besides physical characteristics, we have another method which is used very commonly because of its precision and reliability. This method is called pH. **pH** stands for Percent Hydrogen. Most substances that contain those Hydronium or Hydroxide ions have a measurable pH. Look below at what chemists call the pH scale : pH is measured on a 0-14 scale, 0 being very strong acids that we rarely or never encounter, 7 being neutral, or not being acidic or basic (water), and 14 being very strong bases.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Strong Acids | **Acids** | Neutral | **Bases** | **Strong Bases**

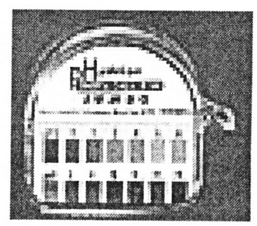
Experiment 9: Testing for Acids, Bases, and Neutral Substances

In this lab, you will have 15 different substances, some of them are household substances and some of them are laboratory substances. You will record the pH and the classification for each of the 15 different substances.

Supplies:
Bin of 16 pH strips

Procedure:

1. Locate the ketchup tray with 16 pH strips in it.
2. Stand up and go to each one of the cups with a liquid in it.
3. Dip half of the strip into the liquid and place it up to the side of the pH strip bottle and record in the chart below the pH of that liquid. If there is no name on the table, guess and you instructor will reveal the substance at the end of the lab.
4. Completely fill out the table below by looking at the recorded pH value and make a check mark as to whether it is an acid, base, or neutral.
5. Once the table is filed out return to your seat and compare your answers with the ones recorded by your instructor.
6. Observe the table for substances that you recognize and think if you have noticed any characteristics compliant with the standard characteristics of acids or bases.



#	Substance	Acid	Base	Neutral	Neither	pH Value
1	Water					
2	Milk					

13	Alcohol					
14	Iodine					
15	Glycerin					

Discussion:

This method of testing is one that is used constantly in chemistry and industry. You now can see that some substances that you use everyday are acidic, some are basic, and some are neutral. This lab's purpose was to introduce you into what we will talk about next, the reaction between acids and bases.

Lab Experiment 10: Making Red Cabbage Indicator

You will be making your own indicator of every the everyday vegetable, red cabbage. Refer to the Bunsen Burner safety procedure for information on the use of Bunsen Burners.

Materials:

Bunsen Burner
Tripod Stand
Glass Stirring Rod
1-250 ml beaker
Testing Substances
Beaker Tongs
250 ml Erlenmeyer Flack
Connecting Tubing
Wire Mesh
Red Cabbage
PH paper strips.
4 small cups for testing pH
Funnel w/ filter paper

Procedure:

1. Measure 150 ml of water into the 250 ml beaker.
2. Cut enough red cabbage into the beaker so all of the leaves are submersed just below the water level.
3. Boil the mixture for about 5 minutes, or until the water turns a dark purple color.
4. Decant the liquid into the Erlenmeyer flask, use a strainer if necessary.
5. Let the solution cool for a few minutes while you set up the supplies needed for testing substances for their pH with your new red cabbage indicator.
6. Label each one of the 4 ketchup trays with the numbers 1-4 with a permanent marker.
7. Fill each ketchup tray with enough of the solution you wish to test so that the cup is about ½ full.
8. Use the pH paper to test the pH of the 4 substances. Record your results on a the table below.
9. Add about 10 drops of cabbage indicator into each bin, watch the color change.
10. Record the color in the table below, look for patters between the pH and the color.
11. See if you can tell which color of the cabbage indicator indicates which pH.

Data Table:

Bin #	Substance	pH	Red Cabbage Color
1			
2			
3			
4			

Discussion:

Red cabbage contains a pigments called anthocyanins. They are in a group of chemicals called flavonoids. These special chemicals use a technique of latching onto bases readily than acids. The more base there is, or the stronger the base, the more molecules the cabbage indicator can latch onto, making the color darker. The boiling was to allow the pores of the cells of red cabbage to open up, releasing the pigments into the water.

Section 2: The Reaction Between Acids and Bases

The classic baking soda and vinegar reaction is one that has a special name, it is called a neutralization reaction. A **neutralization** reaction is one that specifically involves acids and bases when they are mixed together. When a strong enough acid is mixed with a strong enough base, a gas called Carbon Dioxide is formed. Alongside with Carbon Dioxide, water and a substance called a salt is also formed.

The reaction is called a neutralization reaction because the acid and the base react to form a neutral substance, water. In a way, you could say that the acid and the base cancel each other out. Here are a few labs that will give you a chance to experiment with acid-base reactions.

Experiment 11: Performing Acid-Base Reactions

In this lab we will perform an acid–base, or neutralization reaction. We will actually get to see the gas build up inside a balloon, due to a chemical reaction between a liquid and a solid!

Supplies:

1 - Erlenmeyer flask
1 - Balloon
1 – Measuring spoon set
Dilute Hydrochloric Acid - In labeled bottle in cupboard
Sodium Bicarbonate - In bag in cupboard
Sodium Carbonate – In bag in cupboard

Procedure:

1. Measure 40 ml of dilute Hydrochloric acid into the Erlenmeyer flask.
2. Carefully measure ½ teaspoon of Sodium Bicarbonate into the balloon
3. Carefully measure 1 teaspoon of Sodium Carbonate into the balloon
4. Shake the powders inside the balloon to the bulb end (the end without the opening).
5. Stretch the balloon over the mouth of the Erlenmeyer flask
6. Make sure that the seal is tight by pulling up on the balloon and making sure it does not un-seal itself.
7. Also make sure that the balloon bulb is hanging on the side of the Erlenmeyer flask so the powder does not fall into the acid before you are ready.
8. Tip the balloon to the vertical position so the contents of the balloon falls into the Erlenmeyer flask, creating a chemical reaction and inflating the balloon with Carbon Dioxide gas.

Discussion:

All we did was make an acid base reaction as usual but we collected the gas that was formed. This reaction will be varied in the next lab.

Experiment 12: A Long Lasting Acid-Base Reaction

This will be essentially the same as before but with an added substance, soap. See what happens.

Supplies:

Sink
Sodium Carbonate – In bag in cupboard
Sodium Bicarbonate – In bag in cupboard
1 – 250 ml Beaker
1 – Plastic Cup
Soap – about ¼ teaspoon – Test tube #6
Dilute Hydrochloric Acid

Procedure:

1. Measure 30 ml of Dilute Hydrochloric acid into the 250 ml beaker and place it in the sink.
2. In the plastic cup, measure 1 teaspoons Sodium Carbonate and Sodium Bicarbonate.
3. Add ¼ teaspoon of soap into the acid.
4. Pour the contents of the plastic cup into the glass beaker in the sink, watch!

Discussion:

The soap was used to make the surface tension of the bubbles formed by the Carbon Dioxide gas stronger, thus making the bubbles last longer.

Experiment 13: Phenolphthalein Indicator Reaction

This is a great lab for demonstrating the principle of an indicator.

Materials:

1 – 250 ml Beaker
Sodium Carbonate (Washing Soda)
Hydrochloric Acid
Phenolphthalein Solution – Test tube #2
Specimen Eye Dropper (The Long eye dropper, not the one with the black bulb.)
Eye Dropper (The glass dropper with black bulb.)
Measuring Spoons
1 - Straw
Safety Glasses

Procedure:

1. Measure 100 ml of water into the 250 ml beaker.
2. Add 4 drops of Phenolphthalein solution into the 100 ml of water.
3. Using the ¼ teaspoon measuring spoon, fill it with about 1/8 teaspoon of Sodium Carbonate.
4. While stirring vigorously with one hand, use the other to tap in Sodium Carbonate into the water with Phenolphthalein in it. Continue to tap and stir until the solution until becomes a rich pink color.
5. Uncap the bottle of Hydrochloric acid. Begin stirring the solution in the beaker again, and use the Glass Eye dropper to drop in enough acid so that the solution turns clear once again.
6. Try adding more Sodium Carbonate to the solution, do you see how you can go back and fourth between pink and clear?

Discussion:

As was discussed before, An indicator is a chemical that reacts uniquely to a substance depending on its composition. The indicator used in this lab was Phenolphthalein. It is a base indicator. The solution was made basic, or with a pH of higher than seven, this caused the indicator to turn pink. In contrast, when the acid was added, it neutralized the base, making the solution as a whole neutral, and the Phenolphthalein indicator no longer had anything to indicate, so it turned clear again. This can happen as many times as practically possible because the Phenolphthalein indicator is never used up in an acid-base reaction, it is always there, we just may not be able to see it.

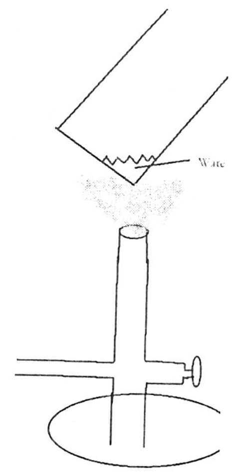
Experiment 14: The Effects of Rapid Cooling on the Integrity of an Aluminum Can

This lab will require you to use a Bunsen Burner to boil water in a an aluminum can, please refer to Bunsen burner safety, lighting, and extinguishing procedures on page 6.

Melda Scientific

WARNING

You will be using a Bunsen burner to heat an aluminum can that will collapse at a high pressure and speed. Always wear safety glasses and use your head so nobody gets injured!



Supplies:

1 – Pop can
1 – Tongs
1 – Sink or Bucket filled with Ice Water
1 – Bunsen Burner
1 – Matches
1 – Bunsen Burner Tubing
1 – Safety Glasses
1 – 50 ml Graduated Cylinder

Procedure:

1. Put on the safety glasses and tie back any dangling necklaces or hair.
2. Set up the Bunsen burner and get the connections checked by the instructor.
3. Measure 10 ml of water into the pop can using the 50 ml graduated cylinder.
4. Prepare a bucket or sink with cold ice water. Set the Bunsen Burner up near the sink or bucket for a better chance of success of the experiment.
5. Light the Bunsen burner.
6. Using the tongs heat the water inside the can until it boils. (Heat the water as shown in diagram 2.1.)
7. Once the water is boiling, continue to allow the water inside the can to boil for about 30 seconds more.
8. Notify the students around you that you are going to flip the can now.
9. As quickly as possible, invert(flip vertically) the can so the top of the can is submerged in the cold ice water. The can should collapse with and somewhat loud crunching noise.
10. If the can did not compress follow steps 6-10 until it compresses.
11. Turn the Bunsen burner off and allow the supplies to cool.
12. Return all equipment to the cabinet with your station number.

Discussion:

This experiment is completely based on **air pressure.** When you added the water to the aluminum can, the water took up the least amount of space while in a liquid state. When you boiled the water, the water changed states and became a gas. One of the qualities of a gas is that the tiny particles that make up that gas take up more space than the exact same number of particles as a liquid. When the can is flipped, the top touches cold water and the steam inside cools down back into a liquid form very quickly, because of this, there is a so called "vacuum" inside the pop can because there is less air inside than outside the pop can. Because there is a vacuum inside, the air pressure is lower inside and the higher pressure on the outside pushes so hard on the can that it collapses.

Section 3: Dry Ice

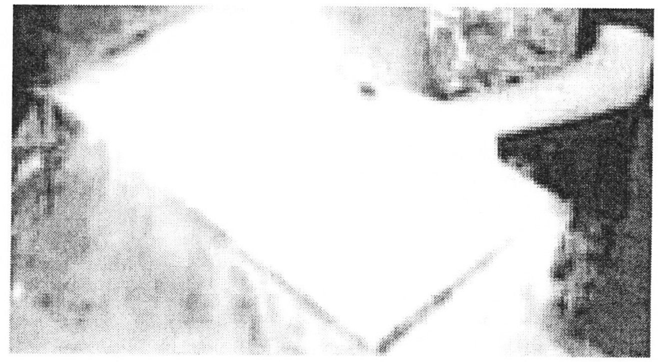
Experiment 15: Carbon Dioxide at Extremely Cold Temperatures

In this experiment we will be conducting experiments on a substance best known as dry ice. **Dry Ice** is solid Carbon Dioxide cooled down to -78.5 degrees C or -109.3 degrees F! It is called dry ice because it is so cold that when humans touch it, it feels like it is really hot, in fact it can "burn" you if you touch it long enough.

In this lab we will conduct a few different experiments to find out more about the properties of dry ice.

Supplies:

1 – Container with dry ice
3 – Plastic cups
1 – Cup of Soap
1 – 50 ml Graduated Cylinder
1 – Erlenmeyer Flask
1 – Balloon
1 – Hand Cloth
1 – Drop of food coloring



Procedure 1: Classic Wizardry Effects

1. Fill 1 plastic cup 2/3 full with warm (not hot) water.
2. Using the hand cloth, pick up an medium sized piece of dry ice and place it in the water.
3. Wait about 10 seconds for the fog to form, have fun, blow, inhale, wave your hands, its perfectly safe!

Procedure 2 : Make a Messy tube of Bubbles

1. Fill the 50 ml graduated cylinder with about 20 ml of warm water.
2. Using a hand cloth, pick up an medium sized piece of dry ice and place it in the water.
3. If you would like, add a small amount of soap and watch the gas and bubbles mix as they rise up the graduated cylinder.

Procedure 3 : Blow up a Balloon With Carbon Dioxide

1. Fill the Erlenmeyer flask with 75 ml of warm water.
2. Using the hand cloth, pick up an medium sized piece of dry ice and place it in the water.
2. Quickly stretch the balloon over the neck of the Erlenmeyer flask and watch the balloon blow up.

Procedure 4: I Thought Food Coloring Would Dye Anything?

1. Fill 1 plastic cup 2/3 full with warm (not hot) water.
2. Drop a few drops of food coloring into the water and without touching the water with your hands, swirl the cup to evenly distribute the food coloring
3. Using the hand cloth, pick up an medium sized piece of dry ice and place it in the water.
4. Watch as the color of the water has no effect on the color of the fog.

Discussion:

Dry ice is simply carbon dioxide at such a low temperature that it freezes. A property of carbon dioxide that is very interesting is that while in the solid state, it can go directly from a solid to a gas, without passing through the liquid state! That's weird! This process is called **subliming.**

Lab Experiment 16: The Comparison of Oxygen and Carbon Dioxide

This lab will be comparing the effects Oxygen and Carbon Dioxide have on glowing wood splints.

Materials:
Hydrochloric Acid
Sodium Bicarbonate
Oxygen
2 - Wooden Splints
Matches
2 – 250 ml beakers
Ice Cream Pail filled with water
Connecting Tubing
Petri Dish (Use as beaker covers)

Procedure:

1. Fill an ice cream pail 5/6 full with water.
2. Add about 20 ml of Hydrochloric Acid to one of the two beakers.
3. Separate the petri dish onto two halves and place one half by the beaker with Hydrochloric acid in it.
4. Add about 1 teaspoon of Sodium Bicarbonate to the acid.
5. Quickly cover the beaker while it is bubbling, with one half of the petri dish.
6. Light one of the splints.
7. Tap out the splint. (Flick the non-burning edge of the splint with your finger so there is no flame, just a glowing tip.
8. Remove the petri dish from the beaker and hold the glowing splint about half way into the beaker. Observe what happens and quickly remove the splint and replace the cover.
9. Trim the tip of the last splint to the end of the burnt section, making a new splint.
10. This time light the splint, but do not tap it out, leave it flaming.
11. Remove the petri dish from the beaker and hold the flaming splint about half way into the beaker. Observe what happens and quickly remove the splint and replace the cover.
12. Use the water displacement method to fill the other clean beaker with pure oxygen.
13. Light the second splint.
14. Tap out the splint. (Flick the non-burning edge of the splint with your finger so there is no flame, just a glowing tip.
15. Remove the petri dish from the top of the beaker and hold the glowing splint about half way into the beaker. Observe what happens and quickly remove the splint and replace the cover.
16. Trim the tip of the last splint to the end of the burnt section, making a new splint.
17. Remove the petri dish from the beaker and hold the flaming splint about half way into the beaker. Observe what happens and quickly remove the splint and replace the cover.

Discussion:

This is a great experiment for demonstrating the essential role that Oxygen plays in burning. Oxygen itself is not flammable. Though it is essential for burning. Oxygen is consumed and converted into water when something burns. We saw the splint burst into flames when placed into the pure oxygen because there was 80% more oxygen inside the beaker than out of it. The particles in the wood splint more rapidly combined with oxygen to form new substances because there was a higher concentration of oxygen inside the beaker. That made a bright flame, because it was hotter and consumed more wood spilt per second. The beaker filled with Carbon Dioxide behaved just the opposite, there was a lack of Oxygen inside the beaker, and the splint could not combine with enough oxygen to keep the reaction temperature high enough to continue burning.

Appendix A : Conversion Tables

English to Metric Conversion

To Convert:	Multiply by:	To Obtain:
Inches	25.4	Millimeters
Inches	2.54	Centimeters
Feet	0.3048	Meters
Ounces, Weight	28.35	Grams
Ounces, Fluid	29.573	Milliliters
Pounds	453.6	Grams
Pounds	0.4536	Kilograms
Cubic Inches	16.3871	Cubic Centimeters
Quarts	0.946352946	Liters
Fahrenheit Degrees	Subtract 32 and Divide by 1.8	Celsius Degrees

Metric to English Conversion

To Convert:	Multiply by:	To Obtain:
Millimeters	0.03937	Inches
Centimeters	0.3937	Inches
Meters	3.281	Feet
Grams	0.0235274	Ounces
Grams	0.002205	Pounds
Kilograms	2.2046	Pounds
Cubic Centimeters	0.0610237	Cubic Inches
Milliliters	0.0338	Ounces, Fluid
Liters	1.057	Quarts
Celsius Degrees	1.8 (And add 32)	Fahrenheit

Appendix B : Glossary

Word	Day	Section	Definition
Acids	2	1	A substance that yields hydrogen ions when dissolved in water. An acid is any substance with a pH of less than 7.0 on the pH scale. (Dictionary.com)
Air Pressure	2	2	The force that is exhorted by the weight of air molecules. There is a constant air pressure on us at all times but we do not notice because it is pushing on us in all directions.
Bases	2	1	Any of a class of compounds whose aqueous solutions are characterized by a bitter taste, a slippery feel, the ability to turn litmus blue, and the ability to react with acids to form salts. A substance that yields hydroxyl ions when dissolved in water. A base is any substance with a pH of greater than 7.0 on the pH scale.

Casein	1	3	A white, tasteless, odorless protein precipitated from milk by rennin. It is the basis of cheese and is used to make plastics, adhesives, paints, and foods. (Dictionary.com)
Catalyst	1	3	A substance, usually used in small amounts relative to the reactants, that modifies and increases the rate of a reaction without being consumed in the process. (Dictionary.com)
Chemical Reaction	1	3	A process in which one or more substances are changed into others. Molecules and Atoms are exchanged. (Dictionary.com)
Concentration	1	1	The amount of a specified substance in a unit amount of another substance. (Dictionary.com)
Dissolve	1	1	When small particles are in a solution, they are considered to be dissolved.
Dry Ice	2	3	Solid carbon dioxide that sublimates at -78.5°C (-110°F) and is used primarily as a coolant. (Dictionary.com)
Endothermic	1	3	A chemical reaction in which heat is absorbed during the reaction process.
Exothermic	1	3	A chemical reaction in which heat is expelled. (When ionic compounds are involved, the reaction is usually exothermic)
High Concentration	1	1	A high ratio of solute to solvent.
Indicator	1	3	Any of various substances, such as litmus or phenolphthalein, that indicate the presence, absence, or concentration of another substance or the degree of reaction between two or more substances by means of a characteristic change, especially in color. (Dictionary.com)
Low Concentration	1	1	A low ratio of solute to solvent.
Mixture	1	1	A mixture is a combination of two or more substances. A key characteristic about mixtures is that the substances are not bonded in any way, they are simply touching each other, like any two old shoes touch each other, no bonding errors.
Neutralization	2	2	A reaction between an acid and a base that yields a salt and water. (Dictionary.com) Also known as an Acid-Base Reaction.
pH	2	1	A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The pH scale commonly in use ranges from 0 to 14. (Dictionary.com)
Products	1	3	The substances involved in a chemical reaction after the reaction took place.
Reactants	1	3	The substances that are present in a chemical reaction before the reaction actually takes place.
Saturated	1	1	When a solution has dissolved as much solid as it can hold, the solution is said to be saturated.
Solute	1	1	The substance dissolved in the solvent is the solute.
Solution	1	1	A solution is a term for a mixture of two or more substances that are chemically bonded. You cannot discern between the different particles within a solution.
Solvent	1	1	Whatever substance the small particles are dissolved in is the solvent. Water is the most common of all solvents
Subliming	2	2	When a substance can pass directly from a solid to a gaseous state, without passing through the liquid state!

Substance	1	1	A substance is that which has mass and occupies space or in other words, anything that you can see, feel or touch..
Super Saturated	1	1	When there is more solute in a solution than the solvent can hold, the solution is said to be supersaturated.

Appendix C : Various Chemistry References

Densities of Some Common Substances

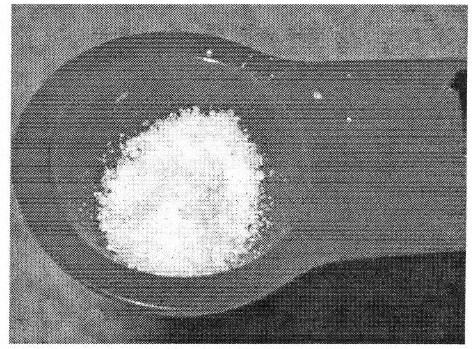
Substance Densities in g/cm^3		Substance Densities in g/cm^3	
Hydrogen	0.00009	Aluminum	2.7
Oxygen	0.0013	Iron	7.9
Water	1.0	Copper	8.9
Sugar	1.6	Lead	11.3
Table Salt	2.2	Mercury	13.6
Quartz	2.6	Gold	19.3

Composition of Dry Air

Substance	Percent	Boiling Point
Nitrogen	78.1	-195.78
Oxygen	20.9	-182.98
Argon	0.934	-185.87
Carbon Dioxide	0.033	-78.477
Neon	0.0018	-246.1
Helium	0.00053	-268.94
Krypton	0.00012	-153.4
Xenon	0.00009	-108.1
Hydrogen	0.00005	-252.77
Methane	0.00002	-161.5
Nitrous Oxide	0.00005	-88.48
Ozone	Trace	-111.3

Experiment 17: Cobalt Chloride Reactions

This lab will show you that one compound, Cobalt chloride reacts differently with Ammonia and Sodium Ferrocyanide.



Materials:
2 – 250 ml beakers
1 – 30 ml glass vial with arrow measure
2 – Glass stirring rods
Cobalt Chloride
Sodium Ferrocyanide
Aqua Ammonia

Procedure:

1. Measure 100 ml of water into one of the 2 - 250 ml glass beakers.
2. Add 1/8 teaspoon (See Image) of Cobalt chloride to that beaker and stir with a stir rod until completely dissolved.
3. Measure 50 ml of water into the unused of the glass beakers.
4. Measure 1/8 teaspoon of Sodium Ferrocyanide into the beaker and stir until completely dissolved.
5. Fill the 30 ml glass vial up to the arrow with Cobalt Chloride solution.
6. Being very careful not to inhale any fumes from the aqua Ammonia, drop about 5 drops of it into the 30 ml vial and stir gently. Watch as the reaction occurs.
7. Pour the contents of the beaker containing the Sodium Ferrocyanide into the beaker that has the rest of the Cobalt Chloride solution in it. Watch as the reaction occurs.

Section 1: Indicators

As you further peruse you study of chemistry you will find that a class of substances called indicators are used often when learning about the properties of certain chemicals. An **indicator** is a substance that signals when a certain substance is present. Indicators can signal the presence of many different types of substances such as: acids, bases, sugars, starches, and vitamins. In this class you will deal with the following indictors that are summarized in the below table. The Rest Color column gives the color of the indicator when on the shelf, or when not indicating.

Indicator Name	Rest Color	Indicates	When and How
Phenolphthalein	Clear	The presence of a base	If The pH of the tested solution is over 10, the indicator turns a rich pink color.
Bromthymol Blue	Blue	The presence of an acid or a base.	If there is an acid (less than 6.0) Bromthymol blue turns yellow. The more basic (greater than 7.6) the solution, the darker blue the indicator will turn.
Red Cabbage	Pink	The presence of an acid or a base.	Red Cabbage indicator turns varying shades of red and purple when in an acid and varying shades of blue and green in the presence of a base.
Iodine	Brown	The presence of a starch	Iodine will turn a dark purple or almost black in the presence of a starch.

An indicator is very special because it does not get consumed (used up) while indicating. You can change Bromthymol blue from blue to yellow as many times as you possible could want and the indicator would still be useable. Indicators are not reactants, or in other words, they are not chemically modified even if you put the indicator in with reactants that do get modified. Below is a lab that will give you an opportunity to make an indicator called red cabbage indicator. You will then get to brush up on your pH skills that you learned earlier by using the 4 indicators listed above, plus pH paper to identify 15 different substances.

Lab Experiment 18: Making Red Cabbage Indicator

You will be making your own indicator of every the everyday vegetable, red cabbage. Refer to the Bunsen Burner safety procedure for information on the use of Bunsen Burners.

Materials:

Bunsen Burner
Tripod Stand
Glass Stirring Rod
1-250 ml beaker
1 – Glass stirring rod
Beaker Tongs
250 ml Erlenmeyer Flack

Connecting Tubing
Wire Mesh
Red Cabbage
Knife
Funnel
Filter Paper

Procedure:

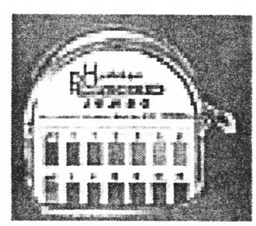
1. Measure 150 ml of water into the 250 ml beaker.
2. Fill the beaker with enough red cabbage so all of the leaves are submersed just below the water level.
3. Boil the mixture for about 5 minutes, or until the water turns a dark purple color.
4. While the solution is boiling, prepare the funnel, filter paper and Erlenmeyer flask.
5. Using beaker tongs, pour the liquid in the beaker into the funnel and allow the liquid to flow into the Erlenmeyer flask.
6. Let the solution cool.

Discussion:

Red cabbage contains a pigments called **anthocyanins**. They are in a group of chemicals called **flavonoids.** These special chemicals use a technique of latching onto bases readily than acids. The more base there is, or the stronger the base, the more molecules the cabbage indicator can latch onto, making the color darker. The boiling was to allow the pores of the cells of the red cabbage to open up, releasing the pigments into the water.

Experiment 19: Testing for Acids, Bases, and Neutral Substances

In this lab, you will have 15 different substances, some of them are household substances and some of them are laboratory substances. You will need to use the listed indicator to record the respective information.



Supplies:

Student record sheet.

Procedure:

1. Use the indicators provided at each substance testing station and the indicator usage table to fill in the table on the student record sheet.

Indicator	Indicates	To Test	To Check
Phenolphthalein	Bases	Add 1-2 drops of the indicator to the solution being tested	If pink appears, the substance is a base. If it remains clear check unknown.
Bromthymol Blue	pH	Add 2-3 drops of indicator to the solution being tested	If the indicator remains blue, it could be a base or neutral or unknown. If the turns yellow, it is an acid.
Red Cabbage	pH	Add 4-5 drops of indicator to the solution being tested	If the indicator turns red or purple, it is an acid or unknown. If it turns blue, green or yellow the substance is a base.
Iodine	Starches	Add 1 drop of indicator to the solution being tested	If the indicator remains brown it is unknown. If it turns black or purple, the substance is a starch.
pH Paper	pH	Dip paper in solution being tested for 5 seconds	Match the color of the paper up with a color on the dispenser that matches best, record the number below the matched color.

#	Substance	Indicator	Result from indicator	Final Result
1	Water	PH		
2	Milk	PH		
3	Sugar	PH		
4	Soap Water	RC		
5	Salt	RC		
6	Strong Acid	RC		
7	Ammonia	Phenolphthale		
8	Washing Soda	PH		
9	Sodium Bicarbonate	RC		
10	Corn Starch	Iodine		
11	Acid	PH		
12	Vinegar	Bromthymol		
13	Bread	Iodine		
14	Alkazeltzer Water	RC		
15	Baking Powder	Bromthymol		

Experiment 20: Phenolphthalein Indicator Reaction

This is a great lab for demonstrating the principle of an indicator.

Materials:

2 – 250 ml Beaker
Sodium Carbonate (Washing Soda)
Hydrochloric Acid
Phenolphthalein Solution – Test tube #2
Specimen Eye Dropper (The Long eye dropper, not the one with the black bulb.)
Eye Dropper (The glass dropper with black bulb.)
Measuring Spoons
1 - Straw
Safety Glasses

Procedure:

1. Measure 100 ml of water into both of the 250 ml beakers.
2. Add 5 drops of Phenolphthalein solution into the 100 ml of water.
3. In the other 250 ml beaker, measure ¼ teaspoon of sodium carbonate into the 100 ml of water and stir.
4. Begin Stirring the beaker with the Phenolphthalein in it and use the other to slowly pour in the sodium carbonate solution. Continue to pour until the solution until becomes a rich pink color.
5. Uncap the bottle of Hydrochloric acid. Begin stirring the beaker with Phenolphthalein again, and use the Glass Eye dropper to drop in enough acid so that the solution turns clear once again.
6. Try adding more Sodium Carbonate to the solution, do you see how you can go back and fourth between pink and clear? Why does that happen?

Discussion:

As was discussed before, An indicator is a chemical that reacts uniquely to a substance depending on its composition. The indicator used in this lab was Phenolphthalein. It is a base indicator. The lab started by making the solution basic, or with a pH of higher than seven, using sodium carbonate. Because the solution was now basic, the phenolphthalein "indicated," or turned pink. In contrast, when the acid was added, it neutralized the base, making the solution as a whole neutral, and because Phenolphthalein only indicates bases, it turned clear because the base was no longer present. This can happen as many times as practically possible because the Phenolphthalein indicator is never used up in an acid-base reaction, it is always there, we just may not be able to see it when it is clear because it is not indicating.

Section 2: The Formation of Acids Using Water

We have talked about acids, bases, indicators, the reaction between acids and bases, but we have not talked about how acids and bases are made and what they are made from. The familiar gas Carbon Dioxide, with a formula of CO_2, is not itself an acid, but when this gas is dissolved is water, H_2O, it bonds with the water molecules and becomes an acid called carbonic acid. This acid is very common and is not harmful to humans, in fact it is in every "carbonated" beverage you have every tasted.

Experiment 21: Carbon Dioxide and Carbonic Acid

This lab will show you that when two substances are mixed together, the carbon dioxide produced by the reaction creates carbonic acid. We can see this because we will add Bromthymol blue to the mixture so when the Carbonic acid is produced, the color of the Bromthymol blue will change from being blue to yellow because Bromthymol blue is a pH indicator.

Materials:

30 ml vial with arrow measuring guide
Measuring spoons
1 - Ziplock© bag
1 – Straw
Calcium Chloride
Sodium Bicarbonate
Bromthymol Blue

Procedure:

1. Using the measuring spoons, measure ¾ teaspoon of Calcium Chloride into the bag. (To measure ¾ tsp you must add 1 spoon using the ½ tsp measure and one spoon using the ¼ measure.)
2. Shake the Calcium chloride into one of the two corners of the bag.
3. Measure 1 teaspoon of Sodium Bicarbonate into the other corner of the bag.

4. Fill the 30 ml vial with water up to the bottom of the paper label.
5. Add 13 drops of Bromthymol Blue into the vial and use the glass stirring rod to mix the Bromthymol Blue and the water together.
6. Add the contents of the 30 ml vial into the bag and quickly seal the bag shut.
7. Use your hands to mix the contents of the bag together. You should see bubbles, the bag blowing up, and the Bromthymol Blue turning yellow, signaling the presence of an acid, and you should be able to feel the liquid in the bag getting cool.

Discussion:

We see that the Calcium Chloride and the Sodium Bicarbonate react to form a few new substances, one of which is Carbon Dioxide. The Carbon Dioxide dissolved in the water and made Carbonic acid. The Bromthymol Blue then changed to show the existence of the acid. There was excess Carbon Dioxide that did not dissolve and form an acid and that was dispelled as a gas into the bag, blowing it up.

Lab Experiment 22: Carbonic Acid Produced by Dry Ice

Students will see that "dry ice" is really frozen Carbon Dioxide.

Materials:

1 – Glass 250 ml beaker
Bromthymol Blue
Piece of Dry Ice

Procedure:

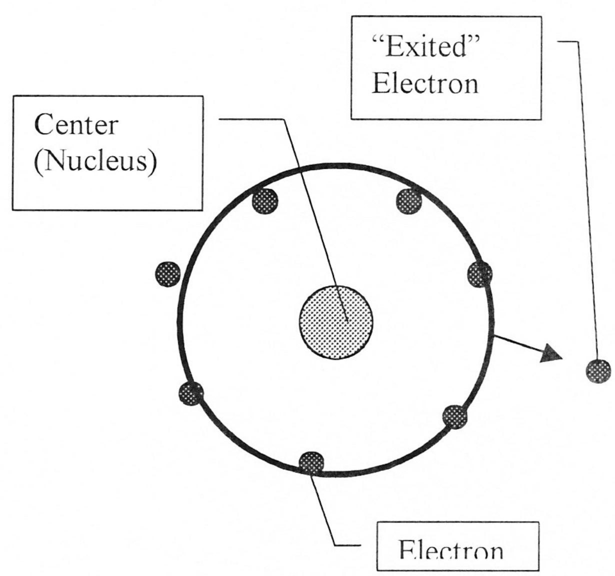
1. Fill the glass beaker up with 200-250 ml of hot water.
2. Drop into the water 12-15 drops of Bromthymol Blue. Swirl the water lightly to mix.
3. Add the piece of dry ice! There is that color change!

Discussion:

As the frozen Carbon Dioxide sublimes, or melted, the Carbon Dioxide gas dissolved in the water, creating carbonic acid and that made the water acidic. As we have learned earlier, Bromthymol blue is a pH indicator and it turns yellow when in an acidic solution.

Section 3: The Exited Electron

All of the tiny little balls, that make up literally *everything* around us are called atoms. These atoms are very special in what they are made of. They are made of 3 even smaller balls or particles. One of those little balls is called an Electron. The Electrons are always circling around the outside of the atom while the other two particles (protons and neutrons) are in the center of the atom. There are anywhere form 1 to 120 electrons in an atom. Scientists have found that if a particular size of atom is heated, these Electrons are stretched out a little bit, meaning that the electrons jump up and out from the track that they usually fly around on. Although they only jump for a very short amount of time when the electrons fall back from their "exited" or stretched out state they give off a small amount of light (a photon). It has also been found that the light given off by each size of atom is a slightly different color than any other



element . Our eyes can see these different colors of light that are emitted by the atoms, and that is how we can successfully conduct flame tests. In the next lab you will be testing a few different elements and observing what color or wavelength of light they emit.

Experiment 23: Conducting Flame Tests

Students will test the flame color of 6 different elements.

Materials:

1 – Wire flame test loop
Safety Glasses

Procedure:

1. Put on the safety glasses and locate the Wire flame test loop.
2. Find a station that has no student at it.
3. Dip the wire flame test loop into the nitric acid so about ¾ of the wire portion is submerged. It is only necessary to hold the lop in the acid for about 1-2 seconds.
4. Tap the wire on the edge of the nitric acid beaker so there is no excess acid on the loop.
5. Flame the wire until the wire is completely dry.
6. Dip the tip of the wire (about 3 mm) into the plain water beaker.
7. Lightly tap the end 3 mm of the wire onto the surface of the pile of powder you are trying to test.
8. Shake off all the remaining powder, only a few crystals should be on the wire.
9. Hold the tip of the wire in the flame ling enough to burn the powder on the tip, observe the color of the flame. Be specific: How bright is the orange or yellow? Are there sparks? What color are the sparks?
10. Dip the wire loop into the Nitric Acid beaker and flame until wire is completely dry.
11. You are now ready to go onto the next element.

#	*Compound*	*Observations*
1	Sodium Chloride	
2	Cobalt Chloride	
3	Potassium Iodate	
4	Potassium Nitrate	
5	Ammonium Chloride	
6	Potassium Ferrocyanide	

Discussion:

Each metal that was put into the flame emits its own color of light, we observed and recorded it.

Lab Experiment 24: Performing an Exothermic Reaction

You will be using chemicals to make a substance that produces large amounts of heat once initiated. Each one of the students in the class will make the initial mixture and then each student will receive a unique compound to add to the base mixture. Students will then observe the difference each additive makes to the combustion of the base mixture. Melda Scientific strongly discourages the use of this reaction because of its flammability. Melda Scientific also is not responsible for any injury caused in attempt to reproduce any reactions done by the students in the class or demonstrated by the teacher.

Materials:

Sulfur – From instructor
Potassium Nitrate - From Instructor
Charcoal – From Instructor
Special Additive
Glass Stirring Rod
Measuring Spoons
Plastic cup
Square sheet of wick

Procedure:

1. Carefully measure ½ teaspoon of potassium nitrate into the plastic cup.
2. Measure ¼ teaspoon of Charcoal into the plastic cup.
3. Wash out the ¼ tsp measuring spoon before preceding.
4. Measure ¼ tsp of Sulfur into the plastic cup
5. Stir well, grinding all of the chemicals together. Especially the chunks of sulfur.
6. Carefully add the labeled amount of additive that you received into the mixture.
7. Mix the new mixture until all of the compounds are uniform.
8. Go into a well ventilated area and pour the contents of your cup into a small pile on a fire board.
9. Roll the square of wick to a tight cylinder.
10. Place the wick in the center of the pile of powder.
11. Light the wick, stand back at least 4 feet.
12. Observe how the mixture burned and compare that with the other students pile with a different additive.

Discussion:

This chemical reaction is like all the other ones, except it emits hear. Each one of the chemicals that was added had its own purpose, and without it, the reaction would not have taken place. The **ratio of composition** is a term used to describe how much of one substance there is in terms of the other. In this reaction's case, the ratio of composition was 2:1:1 Meaning for every one part of charcoal, there needed to be one equal amount of sulfur and twice as much potassium nitrate, as Charcoal and Sulfur.