

Environmental Science 108

Laboratory Manual

3rd Edition

by

Anthony Carpi, Ph.D. and Morris S. Zedeck, Ph.D.



Student's Name _____ Section # _____

Environmental Science 108

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3rd Edition

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On-line course and lab information can be found:
<http://web.jjay.cuny.edu/~acarpi/>

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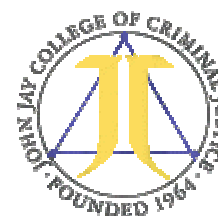
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Acknowledgements

The authors wish to acknowledge the assistance of Riva Pocha, Tina Altro and Christy Reynolds in the preparation of this manual.



Laboratory Safety Rules



Objective: To provide an environmentally safe and academically beneficial atmosphere in the laboratory by promoting safety and awareness.

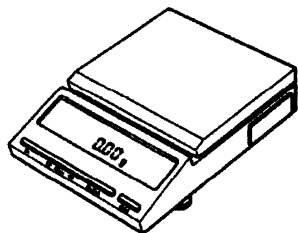
1. **Wear approved eye protection in the laboratory at all times.** This means eye protection that will protect against both impact and splashes; contact lenses do not meet these requirements.
2. **Notify the instructor at once in case of fire or accident.**
3. **Note the location and operation of the safety equipment in the lab.** Note the location and operation of the fire extinguisher, fire blanket, safety shower and eye-wash station so that you can use them properly.
4. **Wash your eyes for 15-20 minutes if a chemical gets in them.** Use flowing water from a sink or eye-wash station while keeping eyes open. Do not shorten time period.
5. **Act immediately to extinguish any fire to person or property.** Fires spread rapidly. Remove affected clothing while drenching under safety shower. Do not allow modesty to cause disfigurement. Wet towels are very effective for smothering small, isolated fires on benches, for larger fires use the fire extinguisher.
6. **Act immediately to neutralize chemical spills.** Remove all unnatural affected clothing while drenching under the safety showers. For isolated spills on benches, use the neutralizing agents located in the hoods.
7. **Avoid inhalation of fumes of any kind.** The inhalation of fumes can be harmful and must be avoided.
8. **Keep the working area and glassware clean when not in use.** Many chemicals react violently with other chemicals. Do not add anything to dirty glassware. Do not leave dirty glassware in the laboratory.
9. **Confine long hair in the laboratory.** Flames, chemicals and equipment all present hazards to loose hair.
10. **Protect against creating a biological hazard.** Many biological substances are capable of producing a hazard if improperly used. Wash your hands thoroughly after handling anything in the laboratory.
11. **Never taste anything in the laboratory.** Do not eat or drink in the lab or using lab glassware.
12. **Never perform an unauthorized experiment or procedure.** Do not deviate from the procedure assigned by your instructor. Improper handling of chemicals can result in violent reactions.
13. **Never use mouth suction when filling pipettes.** Always use a suction bulb.
14. **Never force glass tubing into rubber stoppers.** Lubricate tubing and protect your hands with a towel when inserting tubing into stoppers. If it does not insert easily, call your instructor.
15. **Never perform a procedure you are uncertain about.** Ask your instructor for clarification.
16. **Never work in the laboratory alone.**
17. **Never smoke in the laboratory.**
18. **You must go to St. Luke's-Roosevelt Hospital for medical treatment.** All injuries must be treated. Your instructor will arrange transportation if needed.

It is the official policy of the Science Department that: **“A laboratory instructor may safeguard student safety by barring students from the laboratory who fail to observe required safety rules when so directed by the instructor, and may have such students removed from the laboratory.”**

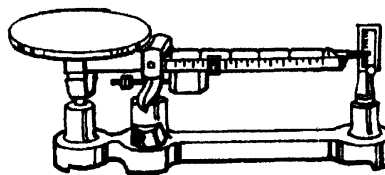
Laboratory Equipment and Glassware



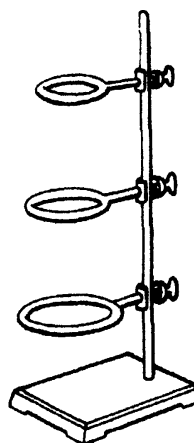
Safety goggles



Top loading balance



Platform balance



Ring stand (with rings)



Reagent bottle

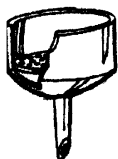
Mortar



Pestle



Watch glass



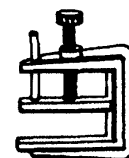
BÜCHNER funnel



Funnel



Pinchcock clamp



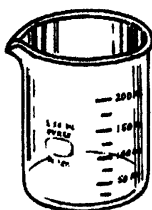
Screw clamp



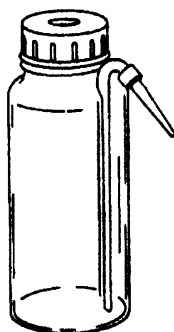
Buret



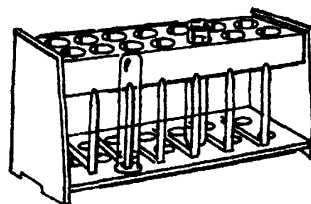
Buret clamp



Beaker



Plastic wash bottle



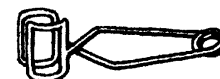
Test tubes and rack



Clamp holder



Extension clamp



Test tube clamp



Forceps



Test tube brush



Crucible tongs

Laboratory Equipment (continued)



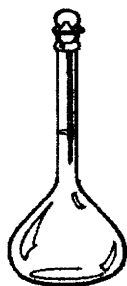
Graduated cylinder



Graduated pipet



Volumetric pipet



Volumetric flask



Erlenmeyer flask



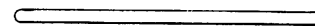
Filter flask



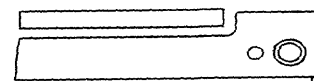
Dropper pipet
(medicine dropper)



Thermometer



Stirring rod



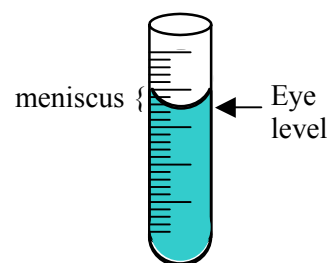
Hot plate

🔒 All students and instructors must wear eyeglasses with plastic lenses or lab safety glasses/goggles meeting the ANSI Z87.1-1989 standard when working with chemicals, an open flame or cleaning glassware. Persons wearing prescription lenses may purchase safety side shields. A penalty of deducted lab points including prohibiting the student from participating in the lab will be implemented (Review laboratory safety rules policy p.ii).

1. Laboratory Equipment & Measurements

The objective of this laboratory is to become familiar with the various types of glassware, pipettes and other equipment that will be used throughout this course of study. Also, the student must understand the terms 'meniscus,' 'parallax' and 'taring,' the difference between 'accuracy' and 'precision,' the use of the metric system (use of same prefixes for volume, mass or length), the use of scientific notation and the concept of significant figures.

When you are measuring liquid in a glass container, you will see that it does not form a straight line across the container but rather forms a **meniscus** (from a Greek word meaning "crescent moon") or curve at the top of the surface. When you are reading the amount of liquid, you should put your eye at the same level as the meniscus and read the volume at the bottom of the meniscus.



Procedures

1. Using a 10 ml pipette, pipette 5 ml of water into a 50 ml graduated cylinder. Do this for a total of 4 times (a total of 20 ml). Read the volume in the graduated cylinder and compare it to the expected 20 ml result.

NEVER PIPETTE ANYTHING BY MOUTH!

2. a) Using a 50 ml graduated cylinder, fill it up to the 50 ml mark and pour the contents into a dry 100 ml volumetric flask. Do this twice. b) Using a 100 ml graduated cylinder, fill it to the 100 ml mark and pour the contents into a dry 100 ml volumetric flask. Note your results and explain any differences.
3. Using a ruler, measure the side of a cube in inches. Convert this number to centimeters. Convert the centimeter result to millimeters and to meters.
4. Using a triple beam balance, weigh some object (cube, piece of paper) and convert your result in grams to milligrams and to kilograms.

5. Weigh an empty 100ml beaker. Pour in exactly 50 ml of water. (Which piece of glassware would you use to be most accurate?) Weigh the beaker with the water. Subtract the weight of the beaker and determine the weight of the water. Does it equal 50 grams? [The density of water at 25°C (approximate room temperature) is 0.997 g/ml. How would you use this information in analyzing your answer?] Repeat the above procedure using 10 mL of 200 proof ethyl alcohol, the density of which is 0.79 g/ml at 25°C.
6. Convert 50 ml to microliter (μl), deciliter and to liter.
7. Weigh six similar size stoppers, one at a time and compare the results.

Record your observations on the Report Sheet in the back of this manual.

2. Drug Analysis - Thin Layer Chromatography

Thin layer chromatography is one of the methods available to the chemist for the separation and tentative identification of components present in mixtures. A compound will travel at a rate fixed by its relative solubility in a moving solvent and the stationary phase. The stationary phase in thin layer chromatography is the silica gel or other solid material. The moving phase is a solvent system that will dissolve some of the components of the mixture more readily than others.

A solution of the mixture to be analyzed is spotted on a thin layer plate and then the lower edge of the plate is placed into the solvent system. The solvent moves up the plate carrying with it any components that are dissolved in it. The distance the components are carried up the plate depends on how soluble each component is in the solvent and how much interaction or attraction the component has for the stationary phase. The more soluble the component is in the solvent, the farther the component travels. The more interactions the component has with the silica gel on the thin layer plate, the less distance it will travel.

The location of each component must be determined by making them visible, if they are not already visible. This may require a visualizer, which can be a chemical or an instrument.

The distance that the component has traveled is normally recorded by computing an 'R_f' value (Relative flow value). This value is calculated by applying the following formula:

$$R_f = \frac{\text{distance traveled by the component}}{\text{distance traveled by the solvent}}$$

This R_f is characteristic of the substance in the solvent system used and helps identify the unknown substance. The size of the spot provides a rough quantitative measure of the amount of the substance present.

When you work with a particular group of compounds, 'known samples' should be run with the unknown to avoid any uncertainties caused by variations in the system, as well as for comparison purposes at the time of identification.

Procedure

1. Obtain a thin layer plate from the Instructor. Contamination and damage to the surface of the plate may be avoided by holding the plate at the edges.
2. Using a pencil ONLY, draw a baseline, approximately 1.5 cm from the bottom of the plate. Mark seven equidistant spots on this baseline, and label them 1, 2, 3, 4, 5, Unknown, and Mixture. Put your initials on the plate, in pencil, in order to be able to distinguish your plate from those of your classmates.
3. Obtain six clean dry test tubes and label them using a China marker, as follows:

Test tube #1: Caffeine (a stimulant)

Test tube #2: Ibuprofen (an analgesic)

Test tube #3: Phenacetin (an analgesic)

Test tube #4: Quinine (an antimalarial)

Test tube #5: Salicylic acid (an analgesic)

Test tube #6: UNKNOWN sample

*Steps 3-6 can be eliminated if your instructor provides you with prepared solutions of standards, 10 mg/ml in ethyl acetate.

4. To each of the tubes labeled above add a spatula-tip full of the appropriate drug, in its powdered form (located on the Instructor's desk). Be sure to avoid contamination from one tube to the next.

Tube #6: This is an unknown sample that you have to identify using the technique of thin layer chromatography. The Instructor will provide you with this sample. It should be treated exactly the same as the standard (known) drugs.

5. In the hood, add approximately 3 ml of concentrated ammonium hydroxide to each tube, and mix gently (Caution: do not inhale the ammonium hydroxide fumes). Then add 1 ml of the ethyl acetate solvent to each tube and mix thoroughly. Let the tubes stand for a few minutes in order to allow the ammonium hydroxide and the ethyl acetate to separate (use a centrifuge if necessary).
6. Using a clean dropper for each tube, transfer a portion of the upper (ethyl acetate) layer to a clean, labeled tube. Be careful NOT to transfer any of the ammonium hydroxide layer.
7. Using a new capillary tube for each sample, spot each of the samples on the appropriate mark on the chromatography plate. Some samples may have to be spotted more than once. Let the spots dry. To the mark labeled 'Mixture' on the plate, spot one drop of

each of the five standard drugs. To the mark labeled 'Unknown' on the plate, spot the unknown sample from tube #6 a few times.

8. Place the plate in the prepared 'solvent chamber' located in the hood. The solvent is a mixture of ethyl acetate: methanol: ammonium hydroxide (85:10:5). When the solvent has moved 3/4 of the way up the plate, remove the plate. Let it dry in the hood.
9. Examine your plate under short wavelength ultraviolet light in order to visualize your results. Be sure to check the origin for any drugs that do not readily move in the solvent. Diagram your observations on the Report Sheet, and identify your Unknown.

3. Drug Analysis - Color Tests

Color tests (also known as Spot Tests) are used as preliminary screening tools in drug analysis. These tests are based on the principle that many substances give distinct colors when brought into contact with various chemical reagents. The colors produced with a particular reagent may be specific for that compound, and thereby will facilitate a tentative identification of the sample.

Since a wide range of colors are produced by different reagents, with tremendous variation in hue, when interpreting the results of a color test, the final decision should be made by comparing the unknown sample with a reference substance tested under the same conditions.

The color tests were designed to be quick, efficient tests that could be conducted in a matter of minutes using as little as 1 mg of solid drug.

There are a number of color tests that are used today, however, in our experiment we will restrict ourselves to three commonly used tests.

Liebermann's reagent: 1 gram potassium nitrite in 10 ml concentrated sulfuric acid. (Prepare in the hood.) Produces intense colors with phenols.

Sulfuric acid reagent: Concentrated sulfuric acid. Produces many different colors with a variety of compounds.

Ferric chloride reagent: 5% ferric chloride in water. Produces many different colors with a variety of compounds.

Procedure

1. Obtain the following equipment and materials:



















A clean, dry porcelain spot plate (if it is not clean, wash and dry it thoroughly before use).

Several clean toothpicks for mixing.

The five drug samples: Caffeine, ibuprofen, phenacetin, quinine, salicylic acid.

The three test reagents: Liebermann, sulfuric acid, ferric chloride.

2. Label the spot plate as shown:

	Caffeine	Ibuprofen	Phenacetin	Quinine	Salicylic Acid	Unknown
Liebermann						
Sulfuric Acid						
Ferric Chloride						

3. Keep the Report Sheet out. After performing each test you will report the color changes that occur IMMEDIATELY, and then any further color change AFTER 1 MINUTE.

Liebermann test:

Place 1 drop of Liebermann's reagent into each of the 6 Liebermann labeled wells.

To the caffeine well add a few crystals of caffeine; mix with a toothpick. Report color changes.

To the ibuprofen well add a few crystals of ibuprofen and mix. Report color changes.

To the phenacetin well add a few crystals of phenacetin and mix. Report color changes.

To the quinine well add a few crystals of quinine and mix. Report color changes.

To the salicylic acid well add a few crystals of salicylic acid and mix. Report color changes.

To the unknown well add a few crystals of the unknown and mix. Report color changes.

Repeat the above procedure for the sulfuric acid wells and for the ferric chloride wells.

4. Drug Analysis – Crystal Tests

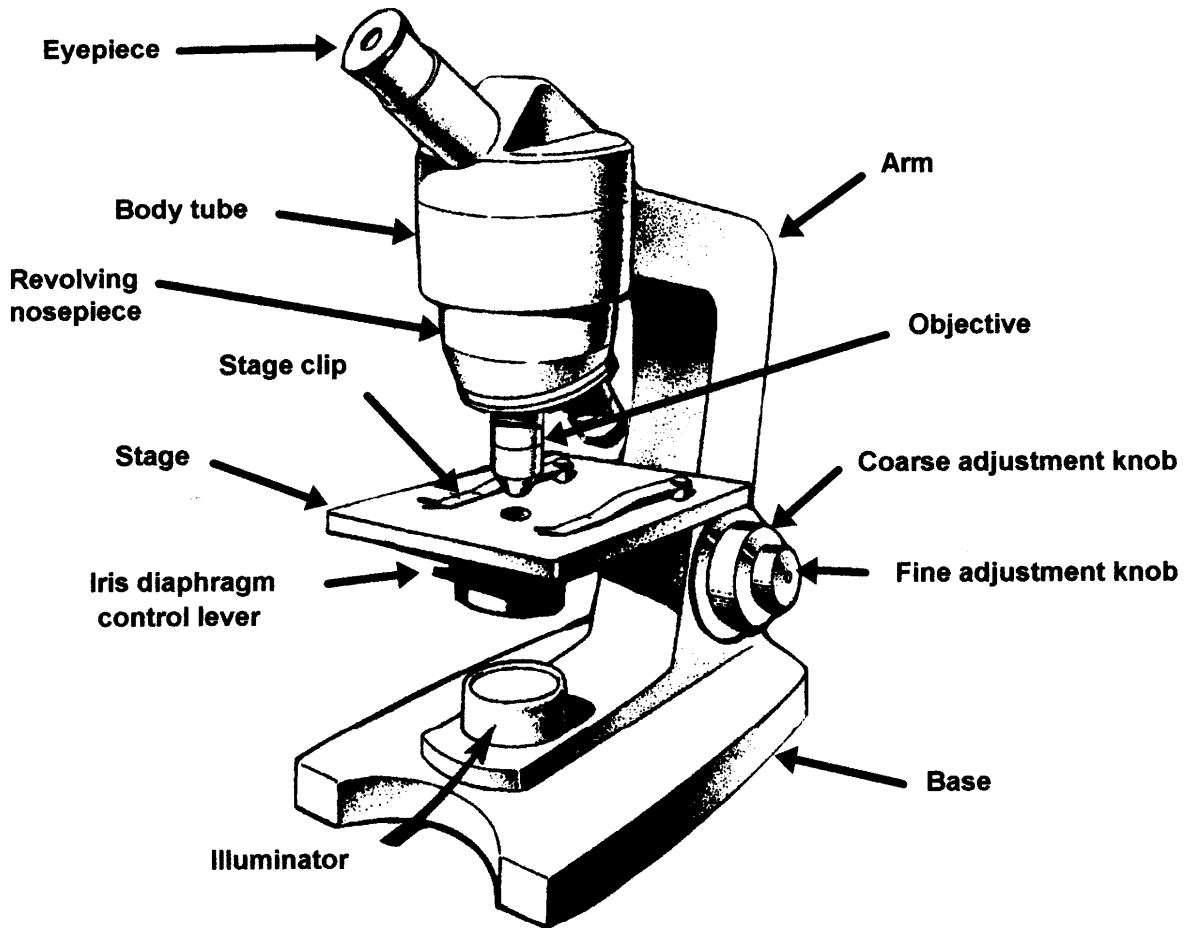
Introduction to Microscopy

The compound microscope is designed to magnify thin, semitransparent objects up to approximately 1000 times (1000x). There are two types of lenses in a compound microscope, the **ocular** lens (in the eyepiece, see diagram) and the **objective** (close to the object being magnified, see diagram). Both contribute to the **total magnification**, which is calculated by multiplying the power of the ocular by the power of the objective. (For example: using a 10x ocular and a 43x objective, the total magnification is 430x, which means that the object seen under the microscope will appear 430 times larger than it actually is.)

Get a microscope from the front of the room. Carry the microscope to your table, by gripping the arm of the microscope firmly with one hand, while supporting the base of the microscope with the other hand. Carefully unwrap the cord from the base and plug it into the nearest outlet.

Familiarize yourself with the parts of the microscope with the help of the diagram on the next page. If your microscope differs from the one in the diagram, see the Instructor for help.

IMPORTANT: If on examination of the microscope, you find parts of the microscope are damaged or missing, inform the Instructor IMMEDIATELY.



The Compound Microscope

Parts of a Compound Microscope:

1. Base: bottom part of the microscope that supports the rest of the instrument.
2. Arm: the curved metal piece that connects the stage, the base and the nosepiece. It support the body tube.
3. Stage: the flat area on which the specimen slide rests. Your microscope may have a mechanical stage that moves both vertically and horizontally by means of adjustment knobs.
4. Stage Clips: the metal clips on the stage, that are used to hold the specimen slide firmly in place.
5. Illuminator: the built-in light used to illuminate the specimen on the stage.

6. Control (On/Off) Knob (for the light source): this is the knob on the side of the light source box. On some microscopes this may be a switch that is located either on the power cord or on the base of the microscope.
7. Iris Diaphragm: variable shutter or disk that controls the amount of light passing from the light source into the specimen.
8. Condenser: small lens located below the stage used to focus the beam of light coming from the iris diaphragm onto the specimen.
9. Body Tube: joins the nosepiece to the ocular lens. It holds the ocular and objective lenses at the proper working distance from each other.
10. Ocular Lens (Eyepiece): lens through which you look into the microscope. Magnification of the ocular is commonly 10X.
11. Nosepiece: the rotating disc on which the objective lenses are mounted.
12. Objective Lenses: the set of lenses closest to the specimen, each of which has a different magnification: 4X (scanning power), 10X or 20X (low power), and 40-43X (high power).
13. Coarse Adjustment Knob: the large knob near the nosepiece used to move the body tube or the stage over large distances in order to obtain a rough focus of the specimen.
14. Fine Adjustment Knob: the small knob near the base used to fine tune the focus of the specimen, by moving the body tube or stage through very small distances.

Terminology: understand the terms field of view, magnification and resolution.

Drug Analysis - Crystal Tests

Microchemical crystal tests are an important tool used in the identification of unknown drug samples. These tests, coupled with the color tests for drugs, are usually performed as preliminary analyses for any unknown sample, followed by more reliable instrumental techniques to identify the sample in question.

The crystal tests are a quick, efficient means of screening numerous drug samples. The tests require about 1 mg of the solid sample for analysis. The reaction is carried out on a microscopic slide

by mixing the unknown sample with specific chemical reagents, to produce characteristic crystalline products that are analyzed under a microscope.

The crystals produced during each reaction are highly characteristic of certain drugs, in terms of their shape, color, size and other optical properties, and hence help in the identification process.

Procedure

1. From the Instructor's desk, obtain the following drug standards:

Quinine

Caffeine

Phenacetin

Ibuprofen

Salicylic acid

Unknown (be sure to choose the same unknown that you used in the previous lab)

Also, obtain the following test reagents that you will need to perform the Crystal tests:

sodium acetate (10% in water), ferric chloride (5% in water), nitric acid (1M HNO₃, CAUTION-HNO₃ IS CORROSIVE), mercuric chloride (5% in water), and barium chloride (10% in water).

2. Obtain 5 clean, dry microscopic slides. On each slide you will conduct one crystal test, and you will characterize the crystals produced by examining them under the compound microscope.

Technique: place 1 drop of the test reagent at one end of the slide, and at the opposite end of the slide place a few grains of the drug to be tested. Using a toothpick, slowly drag a grain of the drug into the test reagent and observe the resultant crystals formed. It may take 10 minutes for the crystals to develop. The crystals will develop on the perimeter of the powdered drug you are testing. If the original drug you are testing is crystalline, look for different crystals at the perimeter.

Conduct the following tests:

Known Compounds	Unknown Tests
Quinine + 1 drop Sodium acetate	Unknown + 1 drop Sodium acetate
Salicylic acid + 1 drop Ferric chloride	Unknown + 1 drop Ferric chloride
Phenacetin + 1 drop Nitric acid	Unknown + 1 drop Nitric acid
Caffeine + 1 drop Mercuric chloride	Unknown + 1 drop Mercuric chloride
Ibuprofen + 1 drop Barium chloride	Unknown + 1 drop Barium chloride

3. For each test, draw the crystals observed, describe their color, shape, size, and state the total magnification at which they were observed. Use the Report Sheet provided.

5. Lead Detection and Toxicity

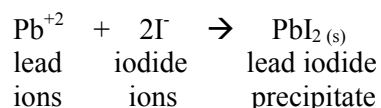
Childhood exposure to lead (Pb) has been called one of the most important environmental risks in the country. Because lead is a versatile metal, it is formulated into many products increasing a person's chances of exposure. Some products, such as common lead-acid batteries used in cars, trucks, boats, motorcycles and the like are sealed and, if appropriately recycled, should not commonly cause poisoning incidents. Other products allow lead to be released into the pathway of human exposure. Lead solder was used to seal seams in the canning industry until it was voluntarily withdrawn, first from baby food containers and then all canning facilities in the early 1980s. The same canning solder is used in other countries, and imported canned food continues to be tainted with lead. Some brightly colored ceramic plates and cups as well as leaded crystal may, in the presence of acidic foods (tomatoes, pineapple, wine etc.), release lead and contaminate the food. Lead-based paint was banned for household use in 1978, but lead is still an ingredient of 'specialty' paints. One common source of exposure to lead is paint dust or chips from older buildings that still contain lead-based paint. Lead was commonly used as a gasoline additive in the 1970s to reduce engine noise and wear. Though leaded gasoline was banned in 1986, lead emitted to the atmosphere from its widespread use in the 1970s is still suspect as causing a number of childhood poisonings. Lead from gasoline emissions has settled on dirt and other surfaces near roadways. Children playing in these areas may be exposed to high levels of lead. In addition, lead was commonly used as soldering material for water pipes. Though this practice has since stopped, many older buildings still contain lead-soldered pipes. Over time, this lead may dissolve in drinking water and cause elevated lead levels in people drinking the water.

Lead poisoning has been known since ancient times. Because a common compound of lead, lead acetate, tastes sweet, it was commonly used to sweeten bitter wine in the Roman Empire. Exposure to high levels of lead has very pronounced and recognizable effects including blackening of the gums, mood swings, abdominal cramping, vomiting, convulsions, coma and even death.

However, in recent years the danger of lead poisoning in children has become clear; even very low levels of exposure to lead are dangerous. At levels below those that cause any outward signs of poisoning, lead may affect brain development and function in children. Thus, children suffering from lead poisoning often suffer from lower IQs, reduced attention span and have more difficulty learning than those not exposed to lead.

One of the ways that lead causes toxicity is by denaturing or changing the shape of proteins. The protein may no longer be able to perform its normal function, e.g. as an enzyme or membrane protein.

This experiment will teach you how to test for lead in samples that are at least 1% lead. Possible samples could be dusts from the roadside, special-purpose lead paints, old paint chips, or an extract from glazed pottery. The reaction used is:



The second part of the experiment will demonstrate the effect of lead on egg proteins and enzymes. The enzyme we will use to demonstrate this effect is the enzyme amylase present in saliva. Amylase breaks down starch into simpler sugars. Starch can react with iodine, which will produce a purple-black color; sugars do not produce this color.

Procedures

Detecting Lead:

1. Place 0.5 ml of 6 M nitric acid (HNO₃) (caution: nitric acid is caustic) in a test tube. Add 1.0 g of the sample (paint chips). Place the test tube in a beaker of boiling water, in a hood, for 15-20 minutes, to dissolve the lead. ***If chips are not available, proceed to step #5 and use a 1% lead acetate solution.**
2. To test for lead in pottery glazes, add 10-20 ml of acetic acid (6 M) to the pottery, and allow the pottery to stand for one hour. Pour the acetic acid solution from the pottery into a test tube. Digest by placing the test tube in a beaker of boiling water in a hood for 5-10 minutes. ***If pottery is not available, proceed to step #5.**

3. Remove the test tubes carefully from the hot water bath. IN THE HOOD, add 7-8 ml of freshly prepared 1% sodium sulfite (Na_2SO_3) to neutralize any excess acid.
*DO NOT inhale the fumes given off in this step they are dangerous.
4. Cool the sample. Centrifuge or let the sample stand until the precipitate has settled.
5. Add a few drops of a 0.1M potassium iodide (KI) solution to your sample. A yellow precipitate indicates at least 1% lead in the sample.
6. Report your observations on the Report Sheet for this experiment.

Effect of Lead on Protein:

1. Take a raw egg and separate the egg white into a beaker. The egg white contains a protein called albumin. Transfer about 10 drops of egg white into a watch glass.
2. Using a dropper, add 1 ml (20 drops) of the 1% lead acetate solution onto the clear egg white.
3. Observe and record the reaction.

Effect of Lead on an Enzyme:

1. Work in groups of 3 for this part of the experiment. Each person collects about 1 ml of saliva in a clean test tube. Combine the saliva by pouring the saliva from each test tube into a 25 ml graduated cylinder. Rinse the test tubes using about 5 ml of pH 7 buffer solution and pour the rinse into the graduated cylinder with the saliva. Then add enough distilled water to bring up the volume to 25 ml. Stir until all is mixed.
2. Label five clean test tubes, #1, #2, #3, #4 and #5. To each of test tubes #2-5 add 5 ml of the saliva solution, prepared in step 1 (do not add saliva to test tube #1).
3. To test tubes #3 and #5 add 1 ml of the 1% lead acetate solution and wait 5 minutes to allow the lead to react with the enzyme.
4. After step 3 is complete, then to test tubes #1, #4 and #5 add 10 ml of 1% starch solution and wait 5 minutes to allow the amylase to react with the starch.
5. To all 5 test tubes add 5 ml of iodine solution and wait 15 seconds. Record your observations. Lab Note: iodine solution = 0.005M I_2/KI (1.3g I_2 + 4g KI bring to 1 L with distilled water).

6. Aluminum Detection

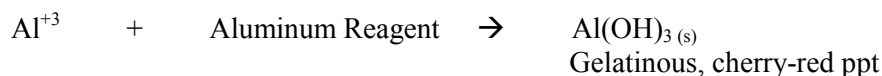
Aluminum (Al) was first isolated in its pure state in 1827. It is the most abundant metal, constituting a large fraction of the Earth's crust.

Aluminum is characterized by its low density and high thermal conductivity, which explains why it is useful in the construction of airplane bodies and cooking utensils, respectively.

Under normal circumstances our exposure to aluminum is minimal, however we do encounter aluminum on a daily basis, since it is an active ingredient in most antiperspirants (as aluminum chlorhydrate) and in antacids (as aluminum hydroxide). Sources of aluminum in the environment are in bodies of water carrying elevated aluminum levels, and from foods prepared in aluminum cooking utensils.

Aluminum has been known to produce toxic effects in man over time. Scientists have observed elevated concentrations of aluminum in the brain of Alzheimer patients, but it has not been linked to the onset of the disease as yet. Aluminum is also known to inhibit the absorption of phosphorus (an element necessary for bone maintenance) causing bone weakness. Excessive aluminum dust causes bronchial asthma.

The objective of this experiment is to test both a deodorant and an antiperspirant for the presence of aluminum. The reaction involves the extraction of aluminum ion (Al^{+3}) from the samples, and the reaction of these ions (Al^{+3} only) with the 'Aluminum Reagent' (Aluminon: ammonium salt of aurintricarboxylic acid) under basic pH conditions.



The Aluminum reagent is specific for aluminum ions in the +3 state only. The gelatinous, cherry-red precipitate remains suspended in a clear solution.

* Important: the pH is extremely critical in order to obtain reliable results.

Procedure

1. Prepare a boiling water bath in a 400 ml or 600 ml beaker.
2. Clean and dry four test tubes. Label these tubes, using a China marker as follows:

Tube #1: Positive Control	Tube #3: Deodorant
Tube #2: Antiperspirant	Tube #4: Blank
3. Using one sheet of clean weighing paper, weigh 0.25 g of antiperspirant and place it in tube #2. Take another sheet of weighing paper, and weigh 0.25 g of deodorant, and place it in tube #3. To the Positive control tube (tube #1) add a pinch of an aluminum salt. Do not add anything to tube #4, the blank.
4. Add 4 ml of distilled water to each tube, followed by 1 ml of 6 M hydrochloric acid (Caution: hydrochloric acid is corrosive, handle with care) to all four tubes. Using a stirring rod, mix the contents of each tube thoroughly, taking care to break up any solid lumps if present. Place all four tubes in the boiling water bath for 5 minutes. This helps to extract all the aluminum ions from the antiperspirant or deodorant, if present.
5. After 5 minutes, carefully remove the tubes from the water bath and allow them to cool to room temperature (a cold water bath may be use to speed up this process; however, care should be taken to prevent any water from getting inside the tubes).
6. If there is solid present in any of the tubes, the contents of that tube need to be filtered (using Whatman #1 filter paper), and ONLY the liquid filtrate collected in a clean test tube. This filtrate will be used for further testing.
7. Add 2 drops of Aluminum reagent to each of the four tubes, and mix thoroughly. Report any color changes observed at this point.
8. In the hood, add 6 M ammonium hydroxide (NH_4OH), dropwise, to each tube, until a basic pH is reached. This can be tested for using red litmus paper, which will turn blue at basic pH. (Caution: Ammonium hydroxide fumes are irritating to the eyes and respiratory tract.) Mix the contents of the tube after each addition of ammonium hydroxide.
9. When basic pH has been reached in all four tubes, if aluminum was present in the sample, a gelatinous, cherry-red precipitate of aluminum hydroxide will be seen suspended in a clear solution. Compare tubes 2 and 3 with control and the blank, in order to interpret your observations correctly. Complete the Report Sheet.

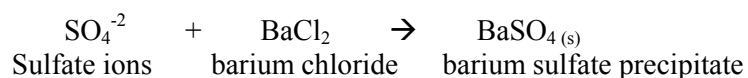
7. Sulfur Dioxide Detection in Foods

Sulfur dioxide, SO_2 , exists as a non-flammable gas with a strong suffocating odor, at room temperature. At temperatures below 10°C , sulfur dioxide is a colorless liquid, which can be irritating to the eyes and respiratory tract.

Notwithstanding these properties, sulfur dioxide is used as a major preservative (fungicide) in the dried fruit industry, as a bleaching agent in textile manufacture, and as a disinfectant in breweries. Fruits are usually dried and treated with sulfur dioxide in order to prevent fungal growth. The addition of sulfur dioxide also helps the preservation of the vitamin C content of the fruit.

The objective of this experiment is to learn how to detect the preservative sulfur dioxide that has been added to the fruit and, if possible, to estimate the amount of sulfur dioxide added to the dried fruit. Different samples that may be used for this experiment include dried figs, apricots and pears. The nutrition labels on the food products should be checked, prior to use, in order to ensure that sulfur dioxide was actually the preservative of choice.

The reaction to quantitate the sulfur dioxide from the dried fruit sample is:



Procedures

Detection of Sulfur Dioxide:

1. Weigh out 3-4 small apricots (or an equivalent amount of another dried fruit) and soak them in a beaker of water, overnight, if possible. This will 'leach out' all the sulfur dioxide into the water. The amount of water added should be measured and should be enough to just cover the fruit.
2. Place a small piece of glass wool in a glass funnel. Filter the solution containing the sulfur dioxide (present as the sulfite ion, SO_3^{-2}). Squeeze the fruit to collect as much liquid as possible. Collect the liquid filtrate in a 10ml graduated cylinder, and record the amount collected.
3. To 3 ml of filtrate, add 30 drops hydrogen peroxide (3% H_2O_2) to the solution, in order to oxidize all the leached sulfur dioxide into the sulfate ion form, (SO_4^{-2}).
4. Add 30 drops barium chloride solution (1M BaCl_2) dropwise, until no more precipitation is observed. A white precipitate indicates sulfur dioxide was present in the original dried fruit sample. Shake the cylinder to mix the ingredients. DO NOT DISCARD the precipitate, you will need it for the second part of this experiment.

Quantitation of Sulfur Dioxide in Dried Fruit:

1. Weigh a clean, dry **Whatman #3** filter paper and record the weight on the Report Sheet. Place this filter paper into a small Buchner funnel, add water to the funnel to moisten completely the filter paper. Pour in slowly the solution obtained in step 4. Discard the liquid filtrate, and keep only the white precipitate collected on the filter paper.
2. Gently rinse the precipitate with distilled water, using a wash bottle. Completely dry the precipitate and the filter paper using a warm hotplate.
3. Re-weigh the filter paper and precipitate, and record the weight.
4. Calculate the weight of the precipitate, and from that, calculate the percentage of sulfur dioxide of the dried fruit sample.

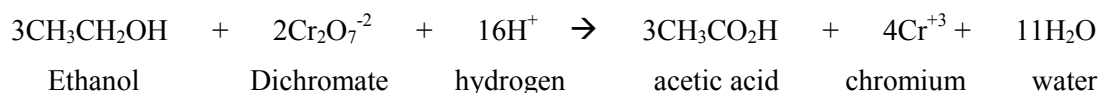
8. Alcohol Detection

There are many organic chemicals called alcohols. Ethyl alcohol, or ethanol for short ($\text{CH}_3\text{CH}_2\text{OH}$), is common drinking alcohol and is derived by yeast fermentation of sugars from various sources. All alcoholic beverages have the same active ingredient, however, the source of the sugar in the beverage contributes a different flavor to different drinks. For example, beer is made by the fermentation of the sugars in malt and barley. Wine is made by the fermentation of grape sugar, vodka is made by the distillation of potato or grain sugars, etc.

Alcohol is a central nervous system depressant. It suppresses function of the nerves of the brain and spinal cord. Alcohol will tend to have a calming effect on people, but it also reduces inhibitions and impairs coordination and many mental functions. While exposure to small levels of alcohol on a daily basis has been implicated in lowering risk of heart attack, exposure to high levels of alcohol can be damaging. Over the long term, high level exposure to alcohol causes liver damage. Fetal exposure to alcohol, such as a mother drinking during pregnancy, can cause Fetal Alcohol Syndrome, a condition that can cause a child to be born with low birth weight, physically deformed or mentally-impaired.

Because of its nature as a central nervous system depressant, the combination of alcohol and any activity that requires coordination (such as operating a car) is potentially dangerous. Thus, all States have laws against drunk-driving. While most alcohol is metabolized in the liver, alcohol is a volatile compound and thus approximately 4% of ingested alcohol is excreted in the breath. This is the basis of all common 'breathalyzer' tests. By determining the amount of alcohol exhaled, one can estimate the amount of alcohol inside of the person's body.

In this experiment you will be testing the alcohol content of a 'model' person's breath. The dichromate reagent solution used undergoes the following reaction when exposed to ethyl alcohol:



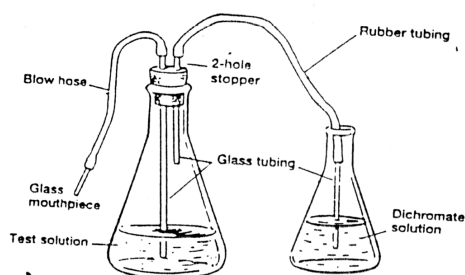
In the process of this reaction, the solution will change from yellow to a dark green color. The rate of color change of the solution will give an estimation of the alcohol content of the sample analyzed.

The reaction of alcohol with the dichromate solution is exothermic, meaning that it will give off heat.

Caution: Potassium dichromate ($K_2Cr_2O_7$) is a strong oxidizing agent and is hazardous.

Procedure

1. Obtain a large beaker and pour 300 ml of distilled water into the beaker. Add 30 g of potassium dichromate ($K_2Cr_2O_7$) and 30 ml of concentrated sulfuric acid (Caution: Sulfuric acid is caustic, perform this step in the hood, very carefully). Mix by swirling the contents of the beaker gently. Label this the dichromate solution.
2. Arrange a 500 ml Erlenmeyer flask with stopper and hoses as shown in the diagram below. A plastic drinking straw should be used instead of glass tubing for the mouthpiece.



3. Prepare a Control Sample by adding 0.1 ml of ethanol to 50 ml of dichromate solution. Label the flask, and set it aside.
4. Place 50 ml of the dichromate solution in a 150 ml Erlenmeyer flask. Place the glass end of the test hose in the dichromate solution.
5. Prepare test solution #1 by mixing 15 ml of ethyl alcohol with 85 ml of distilled water. Place 100 ml of the test solution in the 500 ml flask. The glass tube from the blow hose should be down in the solution.
6. One lab partner measures 60 seconds (1 minute) on a watch as the other partner blows through the mouthpiece with long, even breaths. **(Caution: DO NOT suck the solution into your mouth. Remove the mouthpiece to inhale).**

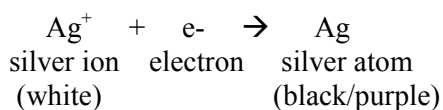
7. After the one minute, set the dichromate/alcohol solution flask beside the Control Sample. Start timing until the dichromate/alcohol solution is the same color as the Control Sample. Record the time elapsed on the Report Sheet for this experiment.
8. Prepare test solution #2 by mixing 30 ml of ethyl alcohol and 70 ml of distilled water in a 500 ml Erlenmeyer flask. Repeat steps 4 through 7, and record the time taken for the dichromate/alcohol solution to reach the same color as the Control Sample.
9. Prepare test solution #3 by mixing 45 ml of ethyl alcohol and 55 ml of distilled water in a 500 ml Erlenmeyer flask. Repeat steps 4 through 7, and record the time taken for the dichromate/alcohol solution to reach the same color as the Control sample.
10. Clean all the glassware used. **Do not discard** any excess dichromate solution. First add ethyl alcohol to the excess. **Pour the dichromate solutions into a labeled waste jar.**
11. Calculate the relative time change ($R\Delta T$) for each solution using the following formula:

$$R\Delta T = \frac{\text{Time in minutes for color change of solution \#1}}{\text{Time in minutes for color change of each solution}}$$

9. Testing Sunscreens

Light is a form of energy that can cause chemical reactions to occur. For example, light allows photosynthesis to take place in plants – a process in which complex organic chemicals are made from carbon dioxide and water. Light can also cause reactions in human skin. Some of these reactions are helpful; for example, the ultraviolet component of sunlight enables the body to produce Vitamin D. On the other hand, excessive exposure to ultraviolet light can damage proteins and DNA inside cells leading to skin cancer. Your body has a natural defense against damaging sunlight. Your skin will produce extra concentrations of the pigment melanin upon exposure to sunlight. Increased melanin increases the darkness of your skin and helps to filter out damaging ultraviolet radiation before it can harm skin cells. We have also developed artificial ways to filter out harmful ultraviolet radiation; these are called sunscreens. Sunscreens are chemicals that absorb the energy of the ultraviolet rays. Sunscreens are rated with a SPF number or Skin Protection Factor. Thus, the cells of a person wearing a sunscreen with an SPF of 2 would require 2 hours to receive the same amount of ultraviolet energy as an unprotected person would receive in one hour; a person wearing a sunscreen with an SPF of 10 could be in the sun for 10 hours before receiving the same amount of ultraviolet energy as an unprotected person.

In this experiment, you will use a light sensitive reaction to test various sunscreens and sunglasses. This reaction is similar to that used in common photographic film. In photographs, chemicals exposed to light will turn darker colors. You will be using a chemical that was used in the earliest type of photographic film, silver. In this reaction, silver ions (from a silver nitrate solution) are reduced by sunlight to form silver atoms:



This reaction is helpful in photography because silver ions appear white and silver atoms appear black/purple. Thus, after exposure to sunlight, your silver coated paper should change to a dark color.

Procedure

1. Place three drops of 0.1 M hydrochloric acid (HCl) in the center of a piece of filter paper. Add three drops of 0.1 M silver nitrate (AgNO₃) in the same place. Observe the formation of a white solid. Caution: hydrochloric acid is corrosive, handle carefully.
2. Place a key, or other object so that only part of the white solid is covered by the key. Place the filter paper and object under ultraviolet light for five minutes. The white solid should turn dark only where light could react with the silver ions. (This is the same reaction that occurs when photographic film is exposed!)
3. Repeat step 1 with 2 additional pieces of paper.
4. Using a marker pen, divide the bottom part of a petri dish into 4 quarters. Thinly coat 3 of the 4 quarters of the inside of the petri dish with a different sunscreen leaving one quarter uncoated. Mark the SPF number of the coating on the outside bottom for each sunscreen.
5. Cover one piece of treated filter paper from step 3 with the petri dish from step 4. Be sure that each treated quadrant of the petri dish overlaps some part of the filter paper. Note which part of the paper is under each quarter of the petri dish.
6. Cover ½ of the second piece of filter paper from step 3 with a pair of sunglasses
7. Place both set-ups under the ultraviolet light for 5 minutes. Then remove the sunglasses and the petri dish, and complete the Report Sheet.

10. Solids in Smoke

Cigarette smoking is the number one cause of lung cancer in the United States today. It is estimated that smoking alone accounts for almost 30% of all cancer deaths in the United States, almost 150,000 people per year. In addition to lung cancer, smoking causes heart disease, mouth cancer, emphysema, and fetal low birth weight.

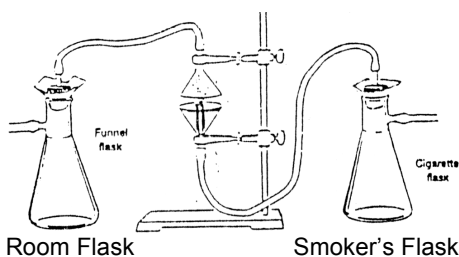
Cigarette smoke is generated by burning tobacco leaves. The smoke produced by this combustion contains many chemicals including nicotine, carbon monoxide, polyaromatic hydrocarbons and small solid particles to name but a few. The focus of this lab will be on the small particles released by cigarette smoke. These particles are tiny in size (a few millionths of an inch in diameter), however, they can become lodged in the alveoli of the lung, causing irritation, damaging tissue and contributing to the formation of lung cancer.

Smokers are exposed to cigarette smoke when they inhale from the end of the cigarette. However, not all of the smoke goes into the smoker's lungs. A large part is distributed into the air either from the cigarette or when the smoker exhales. This '2nd hand smoke' has recently been implicated as a cause of lung cancer among non-smokers and is the reason why many States have limited, or banned altogether, smoking in public places. In this laboratory you will determine the amount of particulate matter collected from the smoker's end of the cigarette and the amount of 2nd hand smoke released into a room from a cigarette.

Procedures

Part I: Determining Solids in Cigarette Smoke:

1. Each pair of students obtains 2 of each of the following: a 250 ml filter flask, a piece of filter paper, a 1-hole rubber stopper, some glass tubing, a glass funnel, and a piece of rubber tubing. Assemble the equipment as shown in the diagram below and attach the filter flask to a water aspirator.



2. Remove the filter papers from the apparatus and weigh each to the nearest 0.001 g. Replace the filter papers in the apparatus.
3. One pair of students should insert a non-filtered cigarette into the funnel as shown in the diagram.
4. Clamp the cigarette funnel pointing up and clamp a second funnel to collect the room smoke (second hand smoke) about half inch above the cigarette funnel. The funnels are to be far enough apart to allow air in but close enough together to catch all the smoke.
5. Turn on both water aspirators and light the cigarette. Adjust the aspirator so that the cigarette burns slowly, over a period of 3-5 minutes. (Caution: DO NOT burn yourself.)
6. When the cigarette has burned down to the last centimeter, turn off the aspirators and put out the cigarette. Remove the filter papers from both filter flasks and weigh each paper.
7. Record all weights on the Report Sheet.
8. Subtract the initial weight of the filter paper from the final weight to obtain the weight of the solids collected. Calculate the number of grams of solids collected per cigarette for both smoker's and second hand smoke.
9. Divide the solids collected from the second hand smoke funnel by the solids collected for the smoker's funnel and multiply by 100 to get the percent solids in room smoke compared to solids in smoker's smoke.

Part II: Effectiveness of a Cigarette Filter:

1. Repeat part I using a filtered cigarette and compare your results.

11. Water Quality

This laboratory exercise is devoted to measuring the levels of various chemicals in water, understanding the source of the chemicals and their potential toxic effects. In particular, you will measure the levels of free and total chlorine, total hardness, nitrate and nitrite nitrogen, total copper, total alkalinity, pH and total iron. Bring in a sample of water from your home faucet or, if desired, from another source (local lake, office mineral water supply, etc). You will be given a kit, which can determine the parameters mentioned above.

After all of the measurements have been made, the data can be grouped and compared as follows: borough of collection, residential water, mineral water, other sources (lake, etc). Also, a comparison by age of building can prove interesting. In each case, the levels found will be compared with the permissible levels.

Procedure:

1. Bring to the laboratory approximately 100ml (3-4 ounces) of a sample of water from home or office or other location in a clean glass or plastic jar. Fill the jar you bring to class to the top and close the jar tightly.
2. You will be provided with small test tubes. In each tube, pour or pipette approximately 5 ml of the water sample.
3. For each tube, use a different test strip[†]. Immerse the end of the test strip into the water sample, swirl the test strip for the specified amount of time and compare the color result with that on the standard color chart provided. Note your result for each of the test strips as ppm on the Report Sheet.

[†] Carolina Shirt Pocket Water Test Kit, Carolina Biological Supply Co., Burlington, NC

12. Clarification of Water

Clean drinking water is a major concern for much of the world. While 75% of the Earth's surface is covered by water, only ~3% of this is freshwater. And since much of this freshwater is locked up in the polar ice caps, only ~1% remains for all of the world's needs. One of the primary concerns in purifying water is to remove particles suspended in the water. One of the primary methods for removing solids from water is to add a chemical that will help the solids precipitate and settle out of solution. These chemicals, generally referred to as flocculants, increase the speed at which particles naturally settle from water. The settled particles can then be removed from the water. One example of a flocculant is aluminum hydroxide. Aluminum hydroxide provides a surface for suspended particles to bind to in water. Once many particles bind to the aluminum hydroxide, the increased weight will drag the particle to the bottom and out of solution.

Another method for purifying water is to filter it using some filtering material such as activated charcoal. While activated charcoal is an effective water filter, it is difficult to use on large volumes of water because the filter material often clogs and causes problems at large water treatment facilities. However, activated charcoal is very effective for small filtering needs and home water filters are often composed primarily of an activated charcoal filter.

In this lab you will be using a flocculant and activated charcoal to filter water samples.

Procedure

Preparing the Flocculant (perform these steps in a hood)

1. Cut two strips, 1 cm x 3 cm, from an aluminum can (watch out for sharp edges!).
2. Place the strips in an evaporating dish in the hood. Add 15 ml of 6 M sodium hydroxide (corrosive to the skin), and make sure the strips are completely covered.
3. Warm the dish with a hot plate in the fume hood. Do not let the solution come to a boil. Stir gently to prevent foaming. Continue the heating until most of the fizzing stops, about 5 minutes. Cool the solution.
4. In the hood, add 20 ml of 3 M sulfuric acid (corrosive to the skin) and stir well to dissolve as much aluminum hydroxide ($\text{Al}(\text{OH})_3$) as possible.

5. Filter the aluminum sulfate solution by suction filtration using the Buchner funnel suction apparatus. First, wet the filter paper slightly with distilled water so that the filter covers completely the inside of the funnel.

Clarifying Water with a Flocculant

6. Add 10 ml of the filtrate (from step #5) to 10 ml of dirty water in a 50 ml beaker. In a second 50 ml beaker, add 10 ml of the filtrate to 10 ml of dyed water (prepared by adding 10 drops of fabric dye to 100 ml of water). To each beaker, add solid sodium bicarbonate slowly with mixing until the solution is basic to litmus paper (i.e. red litmus paper turns blue). Stir well and pour some solution from each beaker into 2 small Spectronic 20 tubes marked # 1 and 2. Let these tubes sit for 10 minutes.
7. Using two other Spectronic 20 tubes, fill one with dirty water and the other with dyed water – mark these # 3 and 4 (these tubes will serve as your control samples). Let these sit with the first tubes.
8. After 10 minutes, compare the tubes visually and again in the spectrophotometer set at 500 nm. (Be sure to zero the spectrophotometer first using a tube filled with tap water.) Record the absorbance of each. (The lower the absorbance value, the clearer the sample.)

Clarifying Water with Activated Charcoal

9. Prepare two more Spectronic 20 tubes. To one, add some dirty water and to the other add some dyed water. Add 0.5 g of activated charcoal to each and shake briskly. Centrifuge both tubes and compare them visually and with the spectrophotometer to your control samples (from step #7).

Student's Name: _____

1. Laboratory Equipment and Measurements**Lab Report**

1. Volume in the graduated cylinder _____. How does this compare to the expected result (20 ml)? If it differs, why?

2. Do the results of the two experiments equal exactly 100 ml? Explain any differences.

3. Length of object _____ in. In cm _____. In mm _____. In meters _____.

4. Weight of object _____ g. In mg _____. In kg _____.

5. Weight of beaker _____ g. Weight of beaker + water _____. Weight of water _____.

5a. Calculate the density of the water (weight in g/ volume in ml) _____.

5b. Weight of alcohol _____. Calculated density of alcohol (g/ml) _____.

6. 50 ml = _____ μ l = _____ dl = _____ l.

7. Weight of stoppers in g: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____.

7a. Are the results the same? Why or why not?

Student's Name: _____

2. Drug Analysis - Thin Layer Chromatography**Lab Report**

Draw a diagram of the TLC plate after you have seen your results. Be sure to label all the spots correctly.

Questions:

1. Based on your observations, identify the drug present in the Unknown sample.
2. Compare the spots observed in the 'Mixture' to the spots observed for each individual standard drug. Do all the spots separated in the 'Mixture' match with the standards? Explain your answer.

Student's Name: _____

3. Drug Analysis - Color Tests

Lab Report

Observations:

DRUG	REAGENT	COLOR CHANGE OBSERVED	
		Immediately	After 1 minute
	Liebermann's reagent		
Caffeine			
Ibuprofen			
Phenacetin			
Quinine			
Salicylic acid			
Unknown			
	Sulfuric acid		
Caffeine			
Ibuprofen			
Phenacetin			
Quinine			
Salicylic acid			
Unknown			
	Ferric chloride		
Caffeine			
Ibuprofen			
Phenacetin			
Quinine			
Salicylic acid			
Unknown			

Student's Name: _____

4. Drug Analysis - Crystal Tests**Lab Report**

Describe and draw the crystals obtained with each of the five crystal tests. Indicate the total magnification used.

1. Quinine + Sodium acetate

2. Salicylic acid + Ferric chloride

3. Phenacetin + Nitric acid

4. Caffeine + Mercuric chloride

5. Ibuprofen + Barium chloride

6. Which pair does your unknown match?

Student's Name: _____

5. Lead Detection and Toxicity**Lab Report****Detecting Lead:**

Sample: _____

Lead Test Observations: _____

Lead Test Positive? YES / NO

Effect of Lead on a Protein:

1. Describe the effect of lead on egg white.

2. One emergency treatment for ingesting lead is to swallow egg white or milk. Why?

Effect of Lead on an Enzyme:

1. Describe the color change, or lack of, in each test tube.
 1. Starch + Iodine:
 2. Saliva + Iodine:
 3. Saliva + Lead + Iodine:
 4. Saliva + Starch + Iodine:
 5. Saliva + Lead + Starch + Iodine:
2. Did the amylase in saliva break down the starch in test tube #5? Why or why not?

3. What was the purpose of test tubes #1, 2, 3 in this experiment?

Student's Name: _____

6. Aluminum Detection

Lab Report

Antiperspirant brand: _____

Deodorant brand: _____

TEST TUBE	COLOR CHANGE (after addition of Aluminum rgt.)	COLOR CHANGE (after addition of NH ₄ OH)
#1: Positive Control	_____	_____
#2: Antiperspirant	_____	_____
#3: Deodorant	_____	_____
#4: Blank	_____	_____

Questions:

1. Does the Antiperspirant contain aluminum? Why?
2. Does the Deodorant contain aluminum? Why?
3. What is the purpose of test tubes #1 and #4?
4. What is the difference between an Antiperspirant and a Deodorant?

Student's Name: _____

7. Sulfur Dioxide Detection in Foods**Lab Report****Detection of Sulfur Dioxide:**

Sample: _____

Ws = Weight of original sample: _____g

Volume of water added to the original sample: _____ml

Describe your observations when barium chloride is added to the filtrate obtained in step 2.

Did the dried fruit sample contain Sulfur dioxide as preservative? YES / NO

Quantitation of Sulfur Dioxide: W_1 = Weight of clean dry filter paper: _____g W_2 = Weight of dried filter paper and precipitate: _____g W_3 = Weight of precipitate = $W_2 - W_1$ = _____gRemember that your precipitate is actually BaSO_4 , so you must use the following calculation to determine the percent SO_2 in your sample.Percent SO_2 in the dried fruit sample:

$$\text{Weight of ppt. } (W_3) \text{ g.} \times \frac{64 \text{ g } (\text{SO}_2)}{233 \text{ g } (\text{BaSO}_4)} = \text{_____g of } \text{SO}_2$$

$$\text{_____g of } \text{SO}_2 \times \frac{\text{Volume water added to fruit sample}}{3 \text{ ml of filtrate used for analysis}} = \text{_____ total g } \text{SO}_2 \text{ in fruit}$$

$$\frac{\text{_____ total g of } \text{SO}_2}{\text{g of original sample } (W_s)} \times 100 = \text{_____} \% \text{ } \text{SO}_2$$

Report: _____% of sulfur dioxide in the dried fruit sample.

Student's Name: _____

8. Alcohol Detection**Lab Report**

TEST SOLUTION	TIME TO REACH COLOR OF CONTROL SAMPLE	R Δ T
#1: 15 ml Alcohol + 85 ml Water	_____min	T ₁ /T ₁ =_____
#2: 30 ml Alcohol + 70 ml Water	_____min	T ₁ /T ₂ =_____
#3: 45 ml Alcohol + 55 ml Water	_____min	T ₁ /T ₃ =_____

Questions:

1. What is the color of the Control Sample and why did the color of the dichromate solution change?
2. Test solutions #2 and #3 had higher alcohol concentrations than test solution #1. Would you expect dichromate/alcohol solutions #2 and #3 to change color faster or slower than solution #1? Why? How much faster or slower? Were your R Δ T results consistent with your expectations? If not, why not?
3. What happens to the temperature of the dichromate solution after the alcohol is blown into it? Why?
4. Why was proper disposal of the dichromate solutions important?

Student's Name: _____

9. Testing Sunscreens**Lab Report****Silver:**

1. Did all of the white solid turn black after exposure to ultraviolet light in Step 2? Why or why not?
2. Films are made with AgBr (silver bromide) as a gel. What is the chemical reaction that occurs when light hits the film?

Sunscreen Testing:

Brand Name _____ _____ _____
SPF Value _____ _____ _____

1. Which sunscreen protected best, that is which absorbed the most ultraviolet rays?
2. Which protected the least?
3. What color was the unprotected quarter of the white paper? Why?
4. Did the sunglasses block the ultraviolet rays?

Student's Name: _____

11. Water Quality**Lab Report**

Water Source (tap, bottle, stream) _____

Source Location: City/Borough - _____ Zip Code - _____

PARAMETER	EXPERIMENTAL VALUE	REFERENCE VALUE
FREE CHLORINE		0.2 to 4.0 ppm.
TOTAL CHLORINE		Less than 4.0 ppm.
THE PH		6.5 to 8.5
TOTAL ALKALINITY		40 to 240 ppm.
TOTAL HARDNESS		50 to 125 ppm.
NITRATE NITROGEN		Less than 10 ppm
NITRITE NITROGEN		Less than 1.0 ppm.
TOTAL COPPER		Less than 1.3 ppm.
TOTAL IRON		Less than 0.3 ppm.

Questions:

1. Pick any two of the above nine tests and explain the possible sources of the chemicals that were measured.

2. Are there any differences in the results based upon the sources of the water samples? (Compare your results with those of your classmates.)

3. Are any of the measurements above the permissible (reference) levels?

4. If your answer to no. 3 is yes, what should be done?

Student's Name: _____

12. Clarification of Water**Lab Report****I. Use of Flocculant**

DIRTY WATER

DYED WATER

Absorbance Value (Control)

DIRTY WATER

DYED WATER

Absorbance (w/ Flocculant)

II. Use of Charcoal

DIRTY WATER

DYED WATER

Absorbance (w/ charcoal)

Questions:

1. What were the bubbles that formed when aluminum reacted with sodium hydroxide?
2. Which method (flocculant or charcoal) worked better on the dirty water?
3. Which method (flocculant or charcoal) worked better on the dyed water?
4. Is the clarified water you prepared safe to drink? Why or why not?