NAME_____ **SECTION**_____

PARTNER(S)_____ **DATE**_____

SEPARATIONS I: BASIC TECHNIQUES

This activity is designed to introduce you to a variety of techniques useful for separating mixtures and the reasons why a particular technique is used for a given mixture. By the end of the lab, you will be responsible for determining the most appropriate techniques for mixtures with particular characteristics.

PRE-LAB QUERIES

1. You are presented with a container of grey powder. Discuss how you can tell if it is a mixture or a pure substance.

2. Describe how you would accomplish the following separations:

   a. salt and pepper

   b. egg white from unbroken egg yolk

   c. colored beads by color

3. Classify the following as homogeneous or heterogeneous mixtures.

A B C

_____ _____ _____

INTRODUCTION

One characteristic that distinguishes a mixture from a pure substance is the ability to separate the mixture into its components by simple physical means. Whether a mixture is homogeneous or heterogeneous, its components will have **properties that can be used to affect this separation**. Some of the properties that can aid in the isolation of components are: **particle size; color; density; solubility in water; ability to sublime; and magnetism**. You will take advantage of these properties during the procedures below.

PROCEDURE

You will be rotating from station to station in the laboratory to perform each of the separations that follow. **For each mixture used you are to record the following information in the data section before you begin that mixture**:

- ➢ detailed physical description of the original mixture; include whether it is homogeneous (same throughout) or heterogeneous;
- ➢ approach you might take to separate the mixture based on your visual inspection.

When you are finished the separation you must record:

- ➢ description of separated components

The stations are numbered 1 through 8. It does not matter in what order you do the stations but you should leave Stations 7 and 8 until you have completed Stations 1-6. The procedure number (below) and the mixture number match the station number.

1a. Obtain one small scoop of Mixture 1 (fine sand, SiO_2, and table salt, NaCl) and place it in a medium (25mm x 200mm) test tube. What does Mixture 1 look like? After completing the visual inspection, add approximately 5 mL of distilled water to the mixture. Agitate the contents to insure complete mixing.

What does this new mixture with the water mixture look like?

Has anything happened to the original mixture? Explain.

After allowing any material to settle, carefully pour off the water collecting it in a small evaporating dish. Keep the solid component in the test tube. What do you think is the identity of the solid left in the test tube?

This technique that separates a liquid from an insoluble solid by carefully pouring off the liquid is called **decanting** or **decantation**.

Now heat the water solution in the dish to dryness on a hot plate.

What is the purpose of the heating?

What is the identity of the solid remaining in the dish?

Why do you think the solid did not evaporate away?

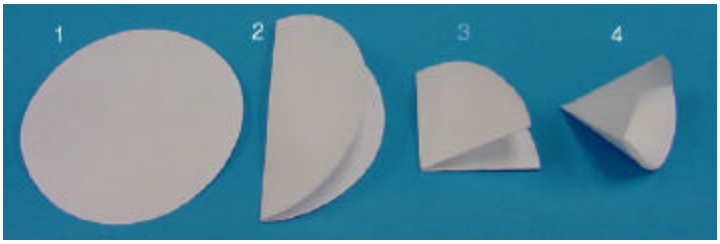
Record the characteristics of the isolated components in the data section. You have just done a separation through **evaporation** of one component.

PLACE ISOLATED MATERIALS IN THE PROPER WASTE CONTAINERS.

1b. Obtain one scoop of Mixture 1 (fine sand and table salt) and place it in a medium test tube. Add water as before and mix.

Set up a filtration apparatus as shown here.

Below is an illustration on how to fold the filter paper for use in the funnel.



Pour the entire contents of the tube into the funnel.

Collect the liquid passing through the funnel in a small evaporating dish.

Rinse the material in the funnel with a few milliliters of distilled water from your wash bottle and

collect the additional liquid in the same evaporating dish.

Why do you rinse the filter paper while it is in the funnel?
This separation process is called **gravity filtration.** The liquid in the evaporating dish is called the **filtrate**. *What is the composition of the filtrate? Is it a pure substance or a mixture?*

Place the dish on a hot plate and evaporate off the water. Describe the isolated mixture components as before. Dispose of waste in the proper containers.

Why might you choose to use gravity filtration rather than decantation?

2. Obtain one small scoop of Mixture 2 (black sand and iron filings, Fe) and place it in a massing boat. Record the description and proposed technique for separation.

Obtain a small magnet in a plastic bag. **Do not remove the magnet from the plastic bag!** Pass the covered magnet over and/or through the mixture until no more change occurs.

What is the identity of the material adhering to the magnet?

Record the description of the isolated materials.

This technique you just used is referred to as **magnetic separation**.

PLACE THE ISOLATED MATERIALS IN THE APPROPRIATE WASTE CONTAINER.

3. Take one small scoop of Mixture 3 (ammonium chloride, NH_4Cl, and table salt, NaCl) and place it in a medium test tube. Add approximately 5 mL of distilled water and mix well.

What happens?

What does this tell you about the components of this mixture?

DISPOSE OF THE SOLUTION IN THE SINK.

Take another small scoop of Mixture 3 (ammonium chloride and table salt) and place it in a small, DRY 150 mL beaker. Cover the dish with a watch glass.

Place the covered beaker on a hot plate and heat on a high setting.

What happens?

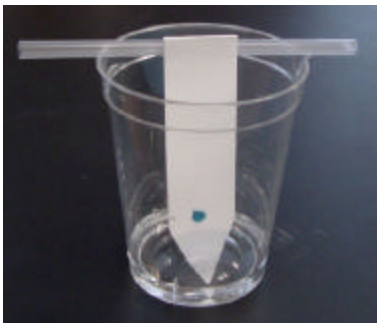
Heat until no material is vaporizing from the BOTTOM of the beaker and you can clearly see two components. Carefully remove the covered beaker with "hot hands" and place it on the counter to cool. When cool, remove the watch glass and describe the two newly separated components.

This separation used a process involved a process called **sublimation**. A substance that converts from a solid directly to a gas at a low temperature is said to sublime.

From your experience, which of the two components of Mixture 3 sublimed?

CLEAN THE BEAKER AND WATCH GLASS WITH WATER RINSING THE MATERIALS INTO THE SINK.

4. Obtain a clear plastic cup, pre-cut straw, and a pre-cut strip of paper. Place about 1 cm of distilled water in the bottom of the cup and balance the straw on the top edge.



Cut one end of the strip in a V shape. Fold the top edge so that the point of the V will be in the water when the paper hangs from the straw. DO NOT PUT THE PAPER IN THE WATER AT THIS TIME.

Place a small spot of Mixture 4 (ink from a marker) on the paper at a point that will be just above the water level when placed in the cup. *It is important that no part of the spot be submerged when you begin.*

Carefully hang the paper from the straw so that the point is now in the water. Allow the

separation to proceed, observing occasionally, until you can identify and describe distinct components in the mixture.

Why is this separation occurring?
When the separation is complete, remove and dry the paper. Dry and replace the cup and straw.

Record the description of the components.

This technique which separates components based on their relative attraction to moving and non-moving phases is called **paper chromatography**.

5. Observe Mixture 5 (mixture of solids). Record a description and a possible separation method for the mixture.

Place about half of the mixture into a large beaker partially filled with tap water.

What happens?

Separate and describe the components. Drain the water from the components using the strainer.

when finished.
This technique makes use of the different densities of the components and water. When one component is less dense than water it will float. This separation technique understandably is called **flotation**.

What must be true about the solubility of all the components of the mixture so the flotation technique will work?

6. Obtain a set of sieves and a medium scoop of Mixture 6 (rough sand, table salt, corn starch). Shake the mixture onto a small area of the sieve made from plastic window screen.

Gently shake the screen catching any material that falls through in a massing boat. Carefully transfer the material remaining on the screen to another massing boat and put it aside.

Shake the mixture that passed through the first screen onto the second screen made from cloth

and gently shake the screen. Collect any material passing through in an additional massing boat. **IT IS IMPORTANT THAT YOU DO NOT RUB THE SCREEN OR ATTEMPT TO FORCE MATERIAL THROUGH. THIS DISTORTS AND DESTROYS THE SIEVE.**
Transfer the material remaining on the screen to another massing boat.

This technique which separates using devices with varying pore sizes is called **sieving.**
Observe the three components and record their descriptions.

Which component got caught in the first sieve? Why?

Which component got caught in the second sieve? Why?

Name another three component mixture that could be separated by sieving.

7. Obtain a small scoop of Mixture 7 (red Kool-Aid powder and corn starch). Place it in a small test tube and add 10 mL of distilled water. Mix the contents well.

What happens?

How might you separate the mixture at this point?

Allow the tube to sit for about 5 minutes. After this time describe the contents of the tube.

Separate the components by decantation.

What is left in the test tube?

What physical property allowed you to separate the original mixture?

Did you achieve an effective or ineffective separation? Explain.

8. *How would you separate a mixture of sand and pepper?*

Place 20 mL of distilled water in a small beaker. Slowly add a small scoop of Mixture 8 (sand/pepper mixture).

What happens?

Did you achieve an effective or ineffective separation? Explain.

What technique would you use to separate the mixture based on your observation?

BE SURE YOU HAVE COMPLETED THE DATA SHEET FOR ALL MIXTURES

DATA

Note: Description must include what the substance or mixture it looks like, not just its chemical composition.

Mixture	Description of Original Mixture (include whether it is homogeneous or heterogeneous)	Description of Component (after separation)
1 Part a		
1 Part b		
2		
3		
4		
5		

Mixture	Description of Original Mixture (include whether it is homogeneous or heterogeneous)	Description of Component (after separation)
6 6		
7		
8		

CONCLUSIONS

For each type of mixture below, supply the technique used in this activity which is most efficient for separating the mixture.

MIXTURE	TECHNIQUE
two water insoluble compounds with different densities	
one water soluble compound and one water insoluble compound	
magnetic element and non-magnetic compound	
solid compound that vaporizes at low temperature and solid non-evaporating compound	
two water soluble, colored components	
two components that have different particle sizes	

ADDITIONAL QUESTIONS

1. Making coffee or tea requires hot water to remove soluble components from the grounds or leaves. This is a separation process called **extraction,** removing a soluble component from solid material. What other separation technique is used to prepare the coffee or tea to drink? Explain.

2. Name and explain and the techniques used in each of the following processes:

   a. removing pasta from boiling water

   b. purifying air that is used in a car engine

   c. pouring excess water from a container of ice

3. Prince George's County operates a materials recovery facility for sorting commingled (mixed) recyclables such as glass, steel cans, aluminum cans, and plastics. Suggest methods to separate a mixture of this composition.

4. You have separated an insoluble white substance from a soluble blue substance by filtration. The filter paper retains a blue color. Explain what possible error might occur and how you can eliminate it