Grade 5 Science

Week of December 7 – December 11

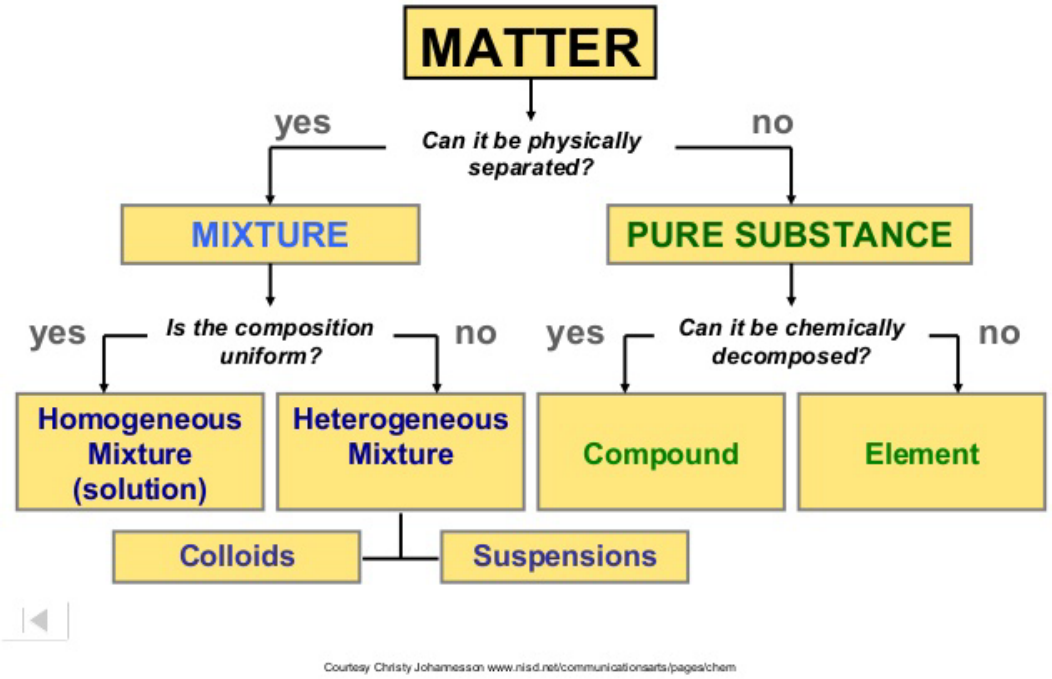
Unit 2: Chemistry

Mixtures and Solutions

Welcome to Chemistry

Chemistry is the study of matter. Matter is anything that has mass and takes up space.

The image below shows the classification of matter. In Grade 5, we will focus on homogeneous mixtures called solutions.



Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

In past grades you have learned about some of the following big ideas:

- Everyday materials that you interact with are made up of matter.
- Matter has useful properties. For example, solids keep their shape and liquids and gases flow.
- Materials can be changed physically and chemically.
- Matter is made of particles called atoms.
- Matter has mass and takes up space.
- Matter has different phases (solids, liquids, and gases).
- Matter can change phase.

Mixtures

In this unit, we will review **mixtures** and then compare them with **solutions**.

Consider the following video as an introduction to some of the topics we'll be learning about: https://youtu.be/TlxajGi8bAI

Mixtures are everywhere you look. Most things in nature are **mixtures**. If you look around you will notice the rocks, lakes, and even the air we breathe are **mixtures**. There are an infinite number of **mixtures**. Anything you can combine together is then called a **mixture** once combined. Think of all of the different foods you eat. Think of how many different types of cake there are, an infinite amount. Each cake has a different **mixture** of ingredients that were combined together to form a cake.

Image adapted from Betty Crocker

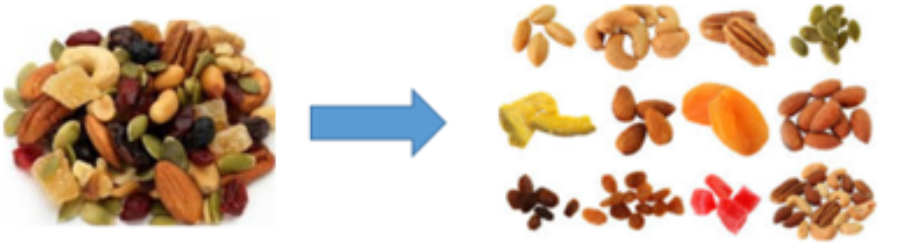
Cake Ingredients

Final product, cake.

Mixtures involve the physical properties of substances, not the chemical ones. What this means is that the individual substances are near each other, as they are mixed together, but the properties of each substance does not change.

Example:

Trail mix is a popular mixtures of different ingredients.



Trail mix is a mixture of different substances.

When the ingredients are separated, their physical properties have not changed.

Image Adapted from backpackingtips.com

Heterogeneous Mixtures

In a **heterogeneous mixture** the substances are not evenly distributed (ex. chocolate chip cookies, pizza, and rocks).

Example 1: Let's consider a pizza:

- You can separate the parts (ex. take the tomatoes off if you don't like tomatoes). Therefore, you know that the pizza is a **mixture**.
- Since the tomatoes (or olives or onions or....) are not evenly distributed, we know that it's a **heterogeneous mixture**.

Homogeneous Mixtures

A **homogeneous mixture** or **solution** is a **mixture** where one of the substances completely dissolves in the other. Solutions are typically **transparent** (you can see through them and they do not scatter light).

A **mixture** is a combination of two or more substances. The **solute** is the substance that will be dissolved (sugar for example or the Kool-Aid crystals). The **solvent** is the substance that will do the dissolving (water for example). For **homogeneous mixtures** or **solutions**, the solute is evenly distributed throughout the solvent. This means that you cannot distinguish between the solute and the solvent and you cannot physically separate them.

Solutions

A **solution** is a mixture of two or more substances in a single phase. At least two substances must have been mixed in order to have a solution. The substance with the smallest amount and the one that was dissolved or dispersed is called the **solute**. The substance with the larger amount is called the **solvent**.

Water is the most common solvent. The gases, liquids, or solids that were dissolved in the water are the solutes. We call these solutions, with water as the solvent, aqueous solutions. The term aqueous comes from the Latin word "aqua" meaning water.

In the graphic below, the blue bottle contains a solution (homogeneous mixture) of water, KOH, glucose, dissolved oxygen gas, and methylene blue (an indicator). In this example, water is the solvent with the KOH, glucose, oxygen, and the methylene blue being the solutes.

The video defines solutions and heterogeneous mixtures and gives an example of each one: https://youtu.be/JoiAzaNSNsc

Concentration

Concentration is the **amount of a substance in a given space**.

Let's use a glass of saltwater solution as our example. In a saltwater solution, water is the **solvent** and salt is the **solute**. If you add one spoonful of salt to the water then there is a small amount of salt in the glass of water and the solution has a low salt concentration. As you add more spoonfuls of salt to the glass of water the concentration of salt increases.

Eventually, you will not be able to add more salt and still have it dissolve in the water. We call a solution with a maximum solute concentration a **saturated solution**.

Types of Solutions

Although solutions with water as the solvent are very common there are many other possibilities. If gases are mixed uniformly into a liquid or if two or more gases are mixed uniformly together then these are also solutions. Alloys are solutions where two or more solids are mixed uniformly together to form a solid solution. Alloys are found in common items like coins and gold jewelry.

The video introduces you to examples of these other types of solutions: https://youtu.be/gpHwcyPNyI0

Solutions differ from mechanical mixtures in that they are homogeneous rather than heterogeneous. That is, each small part is exactly the same as any other.

Solutions consist of two parts, the solvent and the solute. The solvent is a chemical, such as water or alcohol, which does the dissolving. The solute is the chemical, such as salt or iodine, which dissolves in the solvent. Normally, there is much more solvent than solute. In ocean water, for instance, water is the solvent and the various salts are the solutes.

Most people think of a solution as a solid solute dissolved in a liquid solvent (salt in water). Admittedly, this is the most common form of solution, but there are many other types, such as a gas in a liquid, a liquid in a liquid, or even a solid in a solid. The following table gives the various possibilities and examples of each. Examine it closely.

Solvent	Solute	Example	Solvent	Solute(s)
Gas	Gas	Air	$N_{2\,(g)}$	$O_{2\,(g)}$, $CO_{2\,(g)}$, $H_2O_{(g)}$
Liquid	Gas	Carbonated beverages	$H_2O_{(l)}$	$CO_{2\,(g)}$
Liquid	Liquid	Wine	$H_2O_{(l)}$	$C_2H_5OH_{(l)}$
Liquid	Solid	Ocean water	$H_2O_{(l)}$	$NaCl_{(s)}$, $MgF_{2\,(s)}$
Solid	Liquid	Gold amalgam	$Au_{(s)}$	$Hg_{(l)}$
Solid	Solid	Brass alloy	$Cu_{(s)}$	$Zn_{(s)}$

As you can see, the solution category encompassed many possible combinations of which solid solute in a liquid solvent is only one. Matter "as thin as air" and "as strong as steel" qualify. Note that alloys are simply solutions of metals and amalgams are solutions of mercury. In some cases, it is difficult to decide which is the solvent and which is the solute; for example, a 50-50 solution of alcohol and water.

Electrical Conductivity

Electrical Conductivity of Solutions: https://youtu.be/ABAqtFPfVos

Properties of Solutions - pH

This video introduces the concept of pH in solutions using common examples you will know. It also shows how pH can be measured and why this might be important: https://youtu.be/7WRXOT7OAig

Freezing Points

This video introduces the concept that adding solute to a solution will lower the freezing point as compared to the pure solvent: https://youtu.be/lKwHR16Azpg

Solution Test 1 – Light

A light beam behaves differently in a solution than in a heterogeneous mixture:
https://youtu.be/QjlylBuPBxg

Solution Test 2 – Uniform

Solutions are uniform throughout while heterogeneous mixtures are not uniform throughout:
https://youtu.be/3bHeadCpIf8

Solution Test 3 – Filtering

This video shows how solutions and heterogeneous mixtures behave differently when they are poured through a filter. It imagines molecules to help explain what happens in each case:
https://youtu.be/7py2FN2P5Aw

Chemistry ~ Learning Guide Name: _____

Instructions:

Using a pencil, complete the following notes as you work through the related lessons. Show ALL work as is explained in the lessons. You are required to have this package completed BEFORE you write your unit test. Do your best and ask questions if you don't understand anything!

Mixtures

1. What are the differences between a heterogeneous mixture and a homogeneous mixture?

2. What is another name for a homogeneous mixture?

3. List five examples of heterogeneous mixtures in your home.

4. List five examples of solutions found in your home.

Solutions

1. What is the name we give to solutions with water as the solvent? _____
2. Watch the Types of Solutions video and use it to fill out the table below.

Solution Type	Solute	Solute phase	Solvent	Solvent phase
Orange Drink				
Food Colouring				
Carbonated Water				
Air				
Brass				

3. Give an example of a solution with a liquid solute and a solid solvent.

4. Identify the solvent and solute in the solutions below by underlining the solvent and circling the solute.
    a. Vinegar – water and 5% acetic acid by volume.
    b. Salt water – 1L of water and 10 g of NaCl.
    c. 18 carat Gold – 75% Gold and 25% Copper metals.
    d. Instant coffee – coffee crystals in water.
    e. Carbonated water – CO_2 gas in water.
    f. Brass – 40% Zinc and 60% Copper metals.

5. Many solutions have more than one solute. Use the ingredient information in your favourite soda pop to list the solutes.

6. Are alloys homogeneous mixtures or heterogeneous mixture?

7. Name two examples of an alloy that is not brass.

8. For the two alloys listed, what are the benefits of these alloys over the pure metals found in them?

9. Name three way you can change the concentration of a solution. The Phet simulation can help with this question. Try it out!

10. Watch the Electrical Conductivity of Solutions video and use it to fill out the table below.

Solution Type	Level of Electrical Conductivity
Distilled Water as a control	
Tap Water	
Salt Solution	
Vinegar Solution	
Sugar Solution	

11. Explain in your own words why a salt solution will conduct electricity but a sugar solution will not conduct electricity.

12. Watch the pH of Solutions video and use it to fill out the table below.

pH	Example	Acidic, Basic, or Neutral
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

13. Name three foods that have low pH values that prevent the growth of harmful bacteria.

14. Watch the Freezing Points of Solutions video and use it to find five practical applications for lowering the freezing point of a solution. List these five applications in the space below.

15. Name the three tests to determine if a mixture is a solution and explain how each test works.

16. Watch the Solution Test 1, 2 and 3 videos and fill out the table below.
    How can we tell whether a mixture is a solution or heterogeneous mixture?

Solutions (Homogeneous Mixtures)	Heterogeneous Mixtures