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REMBRANDT PARK SCHOOL

NATURAL SCIENCES & TECHNOLOGY GRADE 6 TERM 2

MATTER AND MATERIALS (PROCESSING)

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Solutions as Special Mixtures: Solutions

Solutions

A solution is a special mixture of a liquid and a solid. Solutions are ***homogeneous mixtures*** or ***uniform*** in appearance. This means that the solid cannot be seen in the solution. On the other hand, non-uniform mixtures are called ***heterogeneous mixtures***. Heterogeneous mixtures are not the same throughout (hetero = different).

Example: We can make a solution by mixing a solid and liquid, such as sugar and tea. Sugar is a solid and tea is a liquid. When you put the sugar inside your tea the sugar seems to disappear. However, you know the sugar is still there. You can taste it, because sugar is sweet. We say the sugar has **dissolved** in the tea. The sugar particles moved into the spaces between the liquid particles.

- The substance that looks as if it has disappeared is called the ***solute***.
- The substance that we can still see is called the ***solvent***.
- The solvent and solute together are called the ***solution***.

Dissolving a solid

Dissolving is the process of mixing a solid and a liquid so that the solid is no longer visible. If the solid dissolves in the liquid it is said to be ***soluble***. If it does not dissolve it is ***insoluble***.

Difference between melting and dissolving:

Dissolving uses mixing to combine a solid and a liquid. Melting uses heat to convert one solid into a liquid.

Activity 1: Which mixtures are solutions?

1. What name do we give to the substance that looks as if it has disappeared?

   _____

2. What name do we give to the substance that we can still see?

   _____

3. What name do we give to these mixtures?

   _____

4. What name do we give to substances that form solutions when mixed with water?

   _____

5. What name do we give to substances that don't form solutions when mixed with water?

   _____

6. What name do we give solutions which are the same in appearance?

   _____

7. What name do we give to solutions which are not the same in appearance?

   _____

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Soluble and insoluble substances

Substances that dissolve in a liquid to form a solution are known as ***soluble*** substances. Substances which are unable to dissolve in a liquid are known as ***insoluble*** substances. The ability of one substance to dissolve in another is called ***solubility***.

Activity 2: testing mixtures for solubility

Instructions:

1. Test what happens when different substances are mixed with water.
2. Record your findings in the table provided below.

Mixture	State in the mixture	Appearance (***homogeneous mixture or heterogeneous mixture)***	Solution after stirring? (Yes or No)	Soluble or Insoluble in water
Example: Sugar and water	***Solid and liquid***	***Homogenous***	***Yes***	***Soluble***
1. Salt and water				
2. Sand and water				
3. Oil and water				
4. Vinegar and water				
5. Copper sulphate and water				
6. Curry powder and water				
7. Custard powder and water				
8. Mealie meal and water				
9. Flour and water				
10. Samp (uncooked) and water				

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Separating solutions

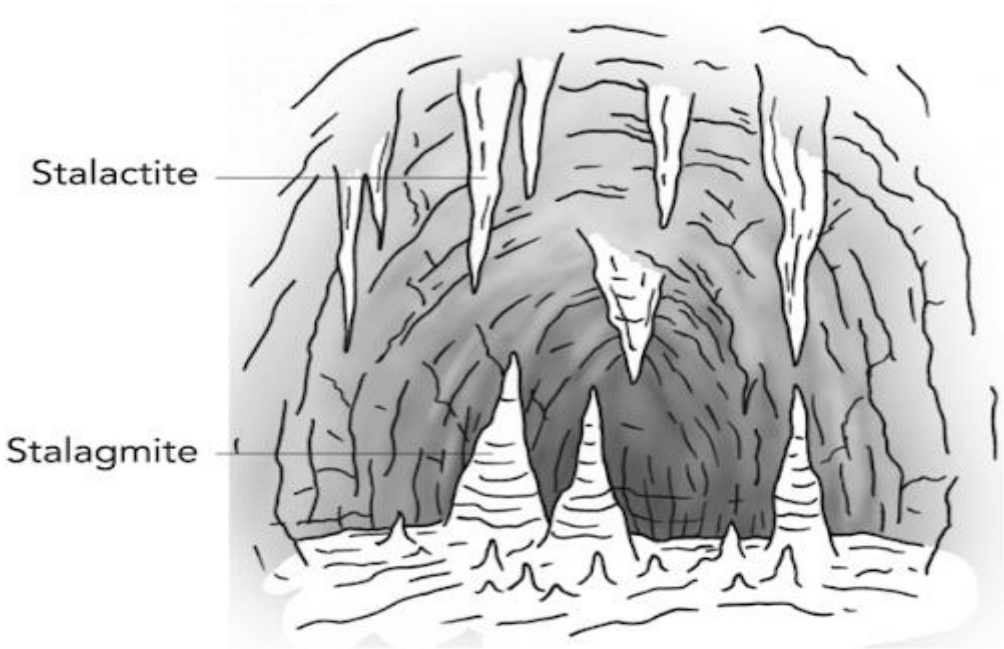
The substances in solutions cannot be separated by sieving, filtering, hand sorting, settling or decanting. The solids in a solution are broken up into very small particles that can pass through the very smallest holes.

Some solutes can be recovered or separated by evaporating the solvent. In this process, the water **evaporates** and salt crystals remain behind. This process is called ***crystallisation*.**
Crystallisation is used on a large scale where salt is recovered from sea water. Sea water is pumped into shallow dams and allowed to evaporate. Windy and sunny weather conditions are necessary to make this happen. Such recovery can be seen at Velddrift on the West Coast.

Some mixtures can be separated by ***filtering***. A special paper, called a filter paper, is folded and put into a funnel. The mixture is then poured through it. If we filter a mixture of a fine substance like curry powder with water, the curry powder will remain behind in the filter paper while the water will pass through the funnel.

An example of crystals in nature

Have you ever visited a cave? Inside, you may have seen crystal formations called stalactites and stalagmites. Stalactites and stalagmites form inside limestone caves. Stalactites hang down like icicles and stalagmites grow from the floor of the cave upwards. Stalactites and stalagmites always occur in pairs. Caves form when water slowly dissolves the limestone underground. The dissolved limestone can crystallise again when the water evaporates. This is also a slow process and it happens when water drips down from the ceiling of the cave over a long period of time. The water drops that land on the floor of the cave also evaporate overtime and when they land on the same spot, a stalagmite will grow on that spot. Over many thousands of years, the stalactite and stalagmite may connect up to become a column.



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Saturated Solutions

When substances dissolve, solute particles become dispersed in the spaces between the solvent particles. When the spaces are full, there is nowhere else for the solute to go. The solute particles that are left out can be seen in the solvent. When no more solute can dissolve in a solution, we say it is a ***saturated*** solution. An ***unsaturated*** solution is one where it is possible to dissolve more solute in the solvent.

Example:

Sometimes when you make yourself tea, you try to put more sugar to get sweeter tea. You may find a layer of undissolved sugar at the bottom of the cup. This sugar did not dissolve completely, although you stirred it for a long time. It did not dissolve because the tea, which is the solvent, could not take any more solute, which is the sugar. That happens when the solution is saturated.

A natural example of a saturated solution:

The Dead Sea is a lake that is on the border of Israel and Jordan. Over thousands of years water has flowed into the lake. Salts are dissolved in the water. The water evaporates and leaves the salt behind. The Dead Sea has become more and more salty. The water in the Dead Sea is saturated. No more salt can dissolve in the water

Summary

Soluble solids (solutes) can dissolve in water (solvent).some solids will not dissolve in water (insoluble solids). The substances in solutions cannot be separated by sieving, filtering, hand sorting, settling and decanting. Some solutes can be separated by evaporating the solvent. When substances dissolve, solute particles become dispersed in the spaces between the solvent particles. There is a difference between melting and dissolving. Melting involves heat and dissolving is the spreading of particles.

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Dissolving: Rates of Dissolving

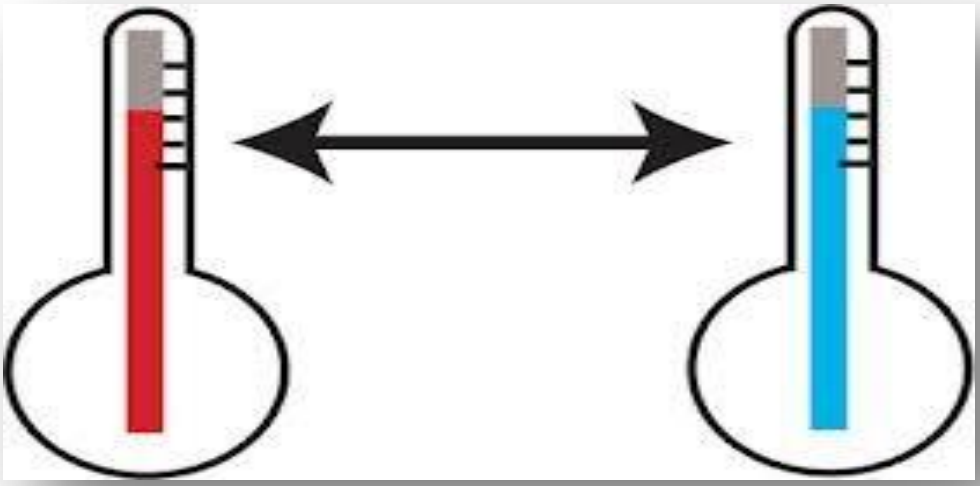
Solutes dissolve in water but there are factors that can make the process faster or slower. The speed at which a solute dissolves is called the ***rate of dissolving***.

There are three factors that affect the rate of dissolving:

1. ***Temperature of mixtures*** - The first one is the temperature of the water. Substances will dissolve faster in warmer water than in colder water. In warm water there are more spaces between the particles of water. This means there is more space for solute particles.
2. ***Stirring versus shaking the mixture*** - Stirring and shaking are both ways of mixing a solute with a solvent. Stirring is better at mixing the solute with the solvent than shaking the solution.
3. ***Grain size of the solute*** - The third factor is the size of the solute. A large grain of solute will take longer to dissolve than a small grain. This is because a grain is made up of particles of the solute. It takes time for the particles in a grain to break apart. The larger the grain, the slower the rate of dissolving will be.

Summary

Factors such as temperature of the mixture, stirring or shaking the mixture and grain size of the solute can affect the rate of dissolving.



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Activity 3: Dissolving sugar in a cup of coffee

Instructions

1. Read the following scenario and answer the questions that follow

The rate of dissolving refers to how quickly a solute dissolves in a solvent. The word "rate" has many meanings. In science, when we use the word "rate" we usually mean how fast or how slow. Kgomotso likes her coffee sweet, with a dash of milk and 3 teaspoons of sugar. For the coffee to taste sweet, the sugar must be dissolved.

Questions:

1. Is the cup of coffee a mixture? Give a reason.

   _____
   _____ (2)

2. Make a list of the components in the coffee mixture.

   _____ (2)

3. Which component is the solvent?

   _____ (1)

4. Is the sugar a solute or a solvent?

   _____ (1)

5. What could Tom do to make sure that the sugar dissolves quickly?

   _____
   _____
   _____ (1)

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Science language activity

1. Match the correct meaning in Column B with the correct word in column A. Write only the correct letter next to the question number in column C.

Column A	*Column B*	*Column C*
1. Solute	a. The ability of one substance to dissolve in another.	1.
2. Solubility	b. The substance that dissolves in a liquid.	2.
3. Solvent	c. A dissolved substance changing into solid crystals again.	3.
4. Rate	d. The liquid in which a substance dissolves.	4.
5. Crystallisation	e. The time it takes to happen.	5.

(5)

Revision activity

1. For each of the substances below, say whether it is soluble or insoluble in water.
   a) Salt: _____
   b) Flour: _____
   c) Rice: _____

(3)

2. What is the difference between melting and dissolving?

_____
_____
_____
_____ (2)

3. Explain how you would separate each mixture
   a) Mixture of salt and water

   _____
   _____ (1)

   b) Mixture of four and water

   _____
   _____ (1)

   c) Mixture of water and rice

   _____
   _____ (1)

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Key concepts

- A solution is a special kind of mixture. Like all mixtures it consists of two (or more) substances mixed together.
- A solution is made up of a solvent (such as water) in which one or more solutes have been dissolved.
- In a solution, the solute looks as if it disappears into the solvent. This is because the particles of the solute and the solvent become closely mixed.
- There are many kinds of solutions, but the most well-known ones are mixtures of a solid and a liquid, such as sugar and water.
- Not all substances dissolve in water. Those that dissolve are called soluble substances; those that do not dissolve are called insoluble substances.
- Solutions cannot be separated by sieving, filtering, hand sorting, or settling and decanting. This is because solute particles are dispersed between the solvent particles.
- Solutions can be separated by heating so that the solvent evaporates. The dry solute will be left behind.
- When we have dissolved so much solute in the solvent that no more solute can possibly dissolve, we say that the solution is saturated.
- The time it takes for a substance to dissolve is called the dissolving rate or the rate of dissolution.
- The rate at which a substance dissolves can be affected by 3 factors, namely:
  – The temperature of the solution;
  – Whether or not the solution is stirred (or shaken); and
  – The grain size of the solute.
- A solute will generally dissolve faster if the solvent in which it dissolves is warm.
- A solute will dissolve faster when the solution is stirred or shaken.
- A solute will dissolve faster if the size of its grains is small.