Name _____ Per___ Date _____ Mailbox_____
Science Unit: Chemistry

15-3 What are mixtures?

Objective ► Describe the physical properties of a mixture.

TechTerm

► **mixture:** two or more substances that have been mixed together but not chemically combined

Mixtures The earth's oceans are made up of salt water. Salt water contains particles of salt and other substances mixed in water. The substances in salt water are not chemically combined. The salt and the water keep their own properties. Salt water is an example of a **mixture.** A mixture contains two or more substances that have been mixed together but not chemically combined. The molecules in a mixture are not all alike. Salt water contains particles of salt and molecules of water.

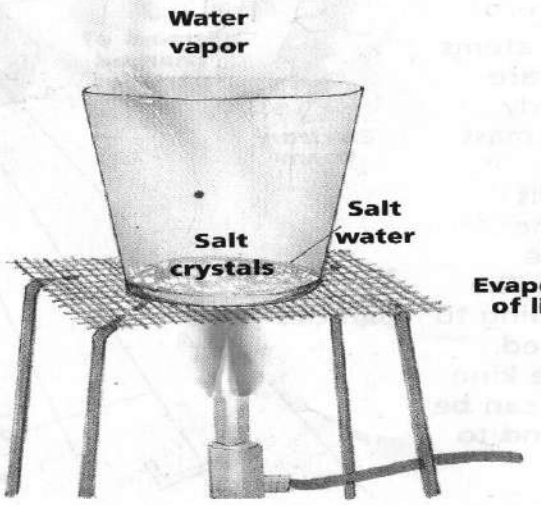
Define: What is a mixture?

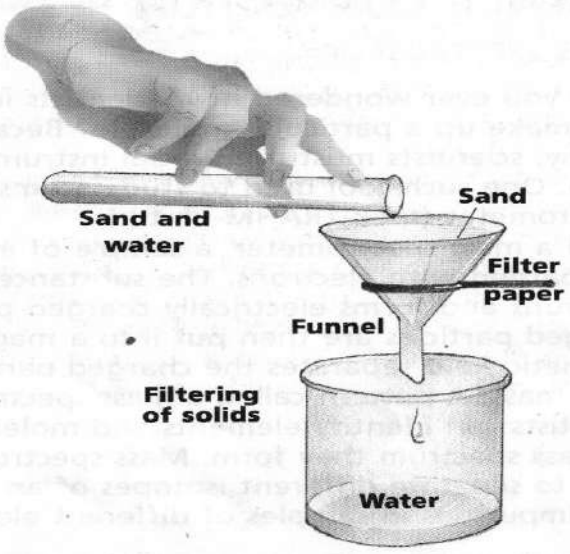
Making a Mixture The substances in a mixture can be present in any amount. A mixture of salt water may contain equal numbers of salt particles and water molecules. It also may have twice as many water molecules as salt particles. The amount of each type of substance present in a mixture can change. However, the substances always keep their own properties. All salt-water mixtures have the properties of both salt and water.

Infer: Why do the substances in a mixture keep their own properties?

Separating a Mixture The properties of the substances in a mixture can be used to separate the mixture. The substances in a mixture are not chemically combined. Therefore, they can be separated by physical means. Water evaporates when it is heated. If salt water is heated, the water will evaporate out of the mixture. Salt and other impurities will be left behind. Another way of separating a mixture is by filtering the mixture. Suppose you wanted to separate a mixture of sand and water. You could pour the mixture through a piece of filter paper. The water would pass through the paper. The sand would not pass through the paper. It would collect on the paper.

Name: What are two possible ways of separating a mixture?





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15-3 WHAT ARE MIXTURES?

READING SUMMARY

- The substances in a mixture keep their own properties
- Heating a mixture of iron and sulfur will produce the compound iron sulfide.
- A compound has a definitive chemical composition, while a mixture does not.
- A mixture can be separated by physical means, while a compound can be separated only by chemical means.

15-3 PRACTICE

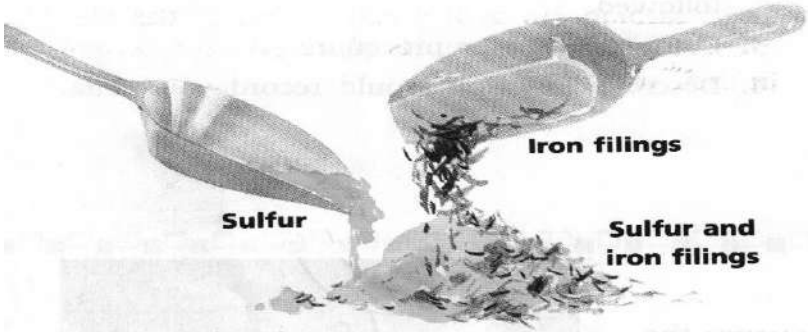
DIRECTIONS: Write true if the statement is true. If the statement is false, change the underlined term to make the statement true.

1. **Salt water is an example of a compound.**
2. **The substances in salt water are not chemically combined.**
3. **All the molecules in a mixture are alike.**
4. **The substances in a mixture keep their original properties.**
5. **A mixture can be separated by chemical means.**
6. **Salt water can be separated by filtering.**
7. PREDICT: How could a mixture of iron and sulfur be separated?
8. Classify: A teaspoon of instant coffee is place in a cup of water. Is this a mixture or a compound? Explain your answer.

15-4 How are compounds and mixtures different?

Objective ▸ Contrast the properties of compounds with the properties of mixtures.

Making a Mixture The substances in a mixture are not chemically combined. You can make a mixture of iron filings and sulfur simply by mixing the substances together. Each substance in the mixture will keep its own properties after being mixed. Iron filings are magnetic slivers of grey metal. Sulfur is a nonmetallic yellow powder. You can see the grains of yellow powder and slivers of grey metal in a mixture of these substances.



Infer: How could a mixture of iron filings and sulfur be separated?

Making a Compound A compound is made up of more than one element. The elements in a compound have been chemically combined. Iron sulfide is a compound. It contains the elements iron and sulfur. If you heat a mixture of iron filings and sulfur, you will produce the compound iron sulfide. Heating the mixture causes the iron filings and sulfur to combine chemically.

Explain: What happens when a mixture of iron filings and sulfur is heated?

Comparing Mixtures and Compounds Mixtures and compounds are different in several ways. A mixture of iron and sulfur does not have a definite chemical composition. The mixture might contain equal parts of each element. It also might have twice as much iron as sulfur. Each substance in a mixture of iron and sulfur keeps its own properties. A mixture of iron and sulfur can be separated by simple physical means.

The compound iron sulfide always has a definite chemical composition. A molecule of iron sulfide always contains one part iron and one part sulfur. This is because the elements in the compound have been joined chemically. When elements are combined chemically, each element loses its properties. The iron and sulfur in iron sulfide cannot be separated by physical means.

Table 1 **Comparing Mixtures and Compounds**

MIXTURES	COMPOUNDS
Made of two or more substances mixed together	Made of two or more substances chemically combined
Substances keep their own properties	Substances lose their own properties
Can be separated by physical means	Can be separated only by chemical means
Have no definite chemical composition	Have a definite chemical composition

Contrast: How are mixtures and compounds different?

https://youtu.be/A5H6DVe5FAI <- watch

What is the chemical composition of fool's gold? _____

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15-4 HOW ARE COMPOUNDS AND MIXTURES DIFFERENT?

READING SUMMARY

- The substances in a mixture keep their own properties
- Heating a mixture of iron and sulfur will produce the compound iron sulfide.
- A compound has a definitive chemical composition, while a mixture does not.
- A mixture can be separated by physical means, while a compound can be separated only by chemical means.

15-4 PRACTICE

COMPLETE ALL OF THE FOLLOWING

1. The elements in a _____ are combined chemically.

2. Each substance in a _____ keeps its own properties.

3. A _____ does not have a definite chemical composition.

4. A _____ can only be separated by chemical means.

5. A _____ always has the same chemical composition.

6. A_____ can be separated by simple physical means.

7. INFER: When a certain poisonous gas is combined with flammable metal, a fine white powder results. The powder is neither flammable nor poisonous. Is the powder a mixture or a compound? How do you know this?

8. HYPOTHESIS: Would all samples of salt water taste the same? Explain?

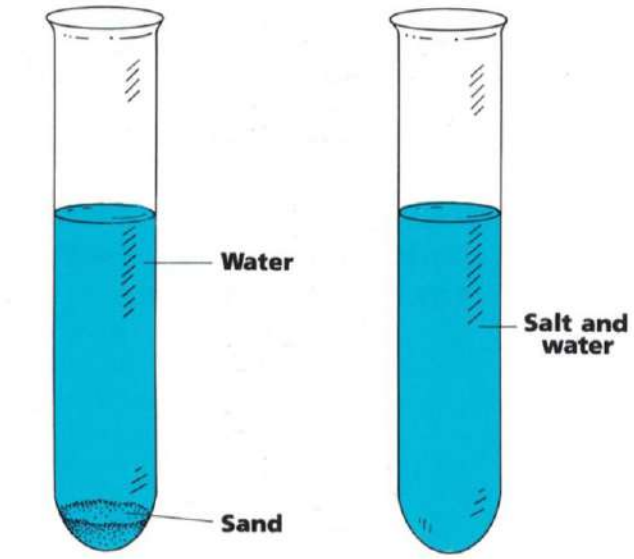
19-1 What is a solution?

Objective ▸ Describe the characteristics of a solution.

TechTerm

- **dissolve:** go into solution
- **solution:** mixture in which one substance is evenly mixed with another substance

Salt and Water What would happen if you added some sand to a test tube of water? The sand would settle to the bottom of the test tube. Suppose you then added some salt to another test tube of water. The salt disappears in the water. The salt is still in the water, but you cannot see it. The salt has dissolved (di-ZAHL-ved) in the water. When a substance **dissolves**, it goes into solution. The sand did not dissolve in the water.



Sand does not dissolve in water.

Salt dissolves in water.

Explain: Why does salt seem to disappear in water?

Solutions A mixture of salt and water is called a solution. A **solution** is a mixture in which one substance is evenly mixed with another substance. In a saltwater solution, particles of salt are evenly mixed with molecules of water.

Define: What is a solution?

Types of Solutions A liquid solution is formed when a solid dissolves in a liquid. Salt water is a liquid solution. A liquid solution may also be formed when a gas dissolves in a liquid. Club soda is a solution of the gas carbon dioxide dissolved in water. One liquid may dissolve in another liquid to form a liquid solution. Water and alcohol form this type of solution.

Liquid solutions are formed when solids, liquids, or gases dissolve in liquids. Solutions can also be formed when different substances dissolve in solids and gases. Table 1 shows some examples of different kinds of solutions.

Analyze: Why is air called a solution?

Table 1 Types of Solutions

SUBSTANCE	DISSOLVED IN	EXAMPLES
Liquid	Liquid	alcohol in water
	Gas	water vapor in air
	Solid	ether in rubber
Gas	Liquid	club soda (CO_2 in water)
	Gas	air (N_2, O_2, and other gases)
	Solid	hydrogen in palladium
Solid	Liquid	salt in water
	Gas	iodine vapor in air
	Solid	brass (copper and zinc)

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19-1 WHAT IS A SOLUTION?

READING SUMMARY

- When a substance dissolves, it goes into solution.
- A solution is a mixture in which one substance is evenly mixed with another substance.
- Salt water is an example of a solution made from a liquid and a solid.
- Solutions can form when a substance dissolves in a solid or in a gas.

19-1 PRACTICE

CHECK *Complete the following.*

1. Solutions are formed when substances _____ in other substances.
2. Salt water is a solution formed when a _____ dissolves in a liquid.
3. A mixture in which one substance is evenly mixed with another substance is called a _____ .
4. Club soda is an example of a solution formed when a _____ dissolves in a liquid.
5. Salt water is a solution formed when a solid dissolves in a _____ .

APPLY *Complete the following.*

6. **Classify:** Which of the following substances are solutions?
   - **a.** sugar
   - **b.** mud
   - **c.** club soda
   - **d.** flour
   - **e.** sea water
   - **f.** salt and pepper
   - **g.** sand
   - **h.** air
7. For each of the substances you classified as solutions in question 6, identify the type of solution formed.

19-2 What are the parts of a solution?

Objective ▸ Identify the parts of a solution.

TechTerms

- **insoluble** (in-SAHL-yoo-bul): not able to dissolve
- **soluble** (SAHL-yoo-bul): able to dissolve
- **solute** (SAHL-yoot): substance that is dissolved in a solvent
- **solvent:** substance in which a solute dissolves

Parts of a Solution All solutions are made when one substance dissolves in another substance. A solution of salt and water forms when salt dissolves in water. The part of a solution that dissolves is called the **solute** (SAHL-yoot). Salt is the solute in a solution of salt and water. The part of the solution in which a solute dissolves is called the **solvent.** Water is the solvent in a saltwater solution.

Contrast: What is the difference between a solute and a solvent?

Soluble Substances Water is the solvent in many types of solutions. Club soda is a solution in which water is the solvent and carbon dioxide is the solute. Because carbon dioxide dissolves in water, it is said to be **soluble** (SAHL-yoo-bul) in water. A substance is soluble in water if it dissolves in water.

Predict: What will happen when carbon dioxide gas is mixed with water?

Insoluble Substances Many substance do not dissolve in water. A concrete sidewalk does not dissolve in rainwater. Sand does not dissolve in a glass of water. A plastic container does not dissolve when you add water to it. These substances are **insoluble** (in-SAHL-yoo-bul) in water. A substance is called insoluble if it does not dissolve in another substance.

A substance may dissolve in one substance but not in another substance. Sugar dissolves in water. It is soluble in water. Sugar does not dissolve in oil. It is insoluble in oil. The type of solvent determines whether a solute is soluble or insoluble.

Analyze: How can a substance be both soluble and insoluble?

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19-2 WHAT ARE THE PARTS OF A SOLUTION?

READING SUMMARY

- The substance that dissolves in a solution is called a solute.
- The solvent is the substance in which a solute dissolves.
- A substance that dissolves in another substance is soluble in that substance.
- A substance is insoluble if it does not dissolve in a particular substance.
- A substance may be soluble in one solvent but insoluble in a different solvent.

19-2 PRACTICE

CHECK *Write true if the statement is true. If the statement is false, change the underlined term to make the statement true.*

1. Salt is the solute in a saltwater solution.
2. Cement is soluble in water.
3. The substance in which a solute dissolves is called a solvent.
4. Sugar is insoluble in water.
5. In a solution of sugar and water, water is the solute.

APPLY *Complete the following.*

6. **Classify:** Instant coffee is a solution formed from coffee powder and hot water. Identify the solute and the solvent in this solution.
7. Is wood soluble in water? How do you know?

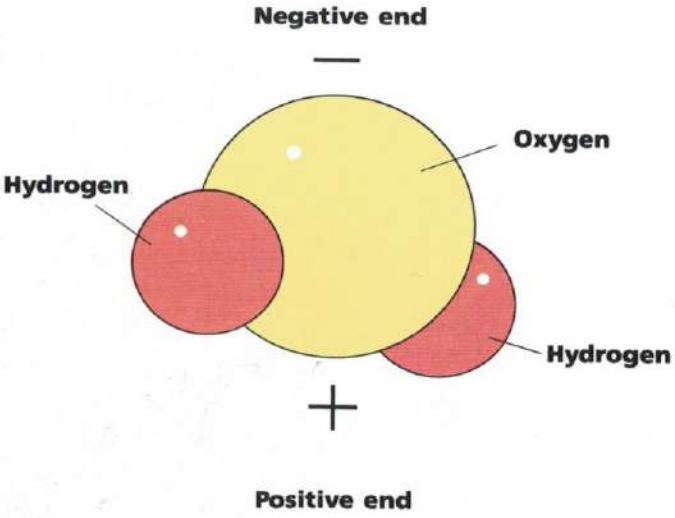
19-3 Why is water a good solvent?

Objective ▸ Explain why water is sometimes called the universal solvent.

TechTerm

- **polar molecule:** molecule in which one end has a positive charge and the other end has a negative charge

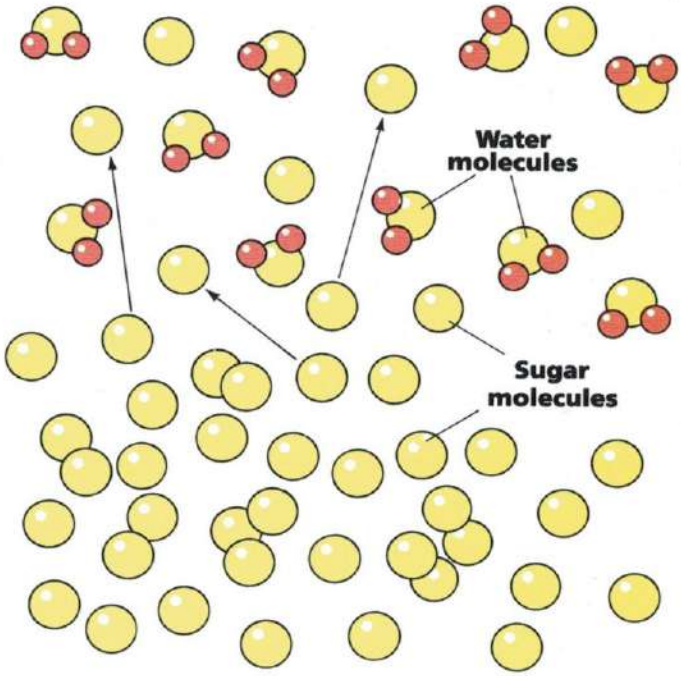
Water Molecules Water is a type of polar molecule. A **polar molecule** is a molecule in which one end has a positive charge and the other end has a negative charge. A molecule of water is made up of two atoms of hydrogen joined to one atom of oxygen. The hydrogen end of a water molecule has a positive charge. The oxygen end of a water molecule has a negative charge.



Explain: Why is a water molecule called a polar molecule?

The Universal Solvent Water is sometimes called the universal (yoo-nuh-VUR-sul) solvent. This is because many types of substances dissolve in water. The electrical charges in polar water molecules help dissolve different kinds of substances.

A solution forms when a solute mixes evenly with a solvent. The charged ends of a water molecule help spread a solute throughout the water. Suppose you place a sugar cube in a glass of water. The ends of the water molecules attract the molecules in the sugar cube. Each sugar molecule is pulled to a water molecule. As the sugar dissolves, sugar molecules are mixed throughout the water.



Describe: What happens to the sugar molecules when sugar is placed in water?

Force of Attraction Solutions form when the force of attraction between the solute and solvent is greater than the force of attraction between the particles in the solute. A sugar cube gets its shape from the force of attraction between its molecules. The sugar molecules will break away from the sugar cube only if they are pulled by a greater force of attraction. This is also true of other types of solutes.

Predict: What will happen if the force of attraction between solute particles is greater than the force of attraction between solute and solvent?

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19-3 WHY IS WATER A GOOD SOLVENT?

READING SUMMARY

- A molecule in which one end has a positive charge and the other end has a negative charge is called a polar molecule.
- Water is called the universal solvent because it can dissolve many different substances.
- Solutions form when the force of attraction between the solute and solvent particles is greater than the force of attraction between the solute particles.

_____

19-3 CHECK

1. Water is a _____ molecule.
2. Water is sometimes called the _____ solvent.
3. The hydrogen end of a water molecule has a _____ electrical charge.
4. The force of attraction between water molecules and sugar molecules is _____ than the force of attraction between the sugar molecules.
5. Solutions form when the force of attraction between the solute and solvent is greater than the force of attraction between particles of the _____.

APPLY

6. Infer: A substance put in a glass of water does not dissolve. What does this tell you about the force of attraction between particles of the substance?

   _____

   _____

7. Hypothesis: Will a teaspoon of water dissolve in a glass of water? Explain.

   _____

   _____

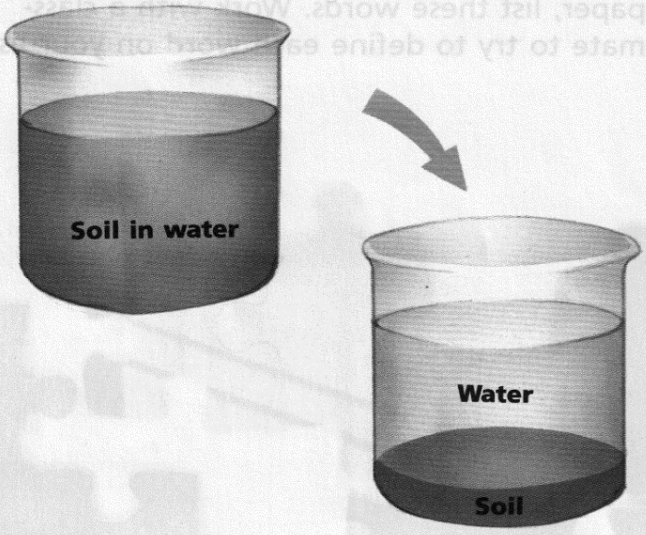
20-1 What is a suspension?

Objective ▶ Describe the characteristics of a suspension.

TechTerm

- **suspension** (suh-SPEN-shun): cloudy mixture of two or more substances that settle on standing

Suspensions If you add some soil to a jar of water, the water will become cloudy. If you let the mixture stand, you will notice that the soil particles settle to the bottom of the jar. A mixture of soil and water is an example of a **suspension** (suh-SPEN-shun). A suspension is a cloudy mixture of two or more substances that settle on standing. An important thing to remember about suspensions is that they are always temporary. The substances in a suspension may appear to be well mixed at first, but in time they will always separate.



Define: What is a suspension?
cloudy mixture of two or more substances that settle on standing

Particles in Suspensions The particles in a solution are much too small to be seen, even with the aid of a microscope. That is because the particles in a solution are atoms or molecules. However, the particles in a suspension are much larger than atoms or molecules. You can usually see the particles in a suspension without a microscope.

Compare: How does the size of particles in a suspension compare with the size of particles in a solution? Particles in a suspension are much larger than particles in a solution.

Properties of Suspensions An important property of suspensions is that the particles of a suspension scatter light. You can see this property if you darken the room and shine a flashlight through a mixture of soil and water. You will see the beam of light as it passes through the cloudy water. One way that you can tell the difference between a solution and a suspension is that the particles of a solution do not scatter light. Table 1 compares some of the properties of solutions and suspensions.

Table 1 **Properties of Solutions and Suspensions**

SOLUTION	SUSPENSION
Mixture	Mixture
Clear	Cloudy
Particles evenly mixed	Particles settle on standing
Particles too small to be seen	Particles can be seen

Observe: What property do suspensions and solutions have in common? Both are mixtures.

Examples of Suspensions A familiar example of a suspension is salad dressing. If you shake a bottle of salad dressing, the contents seem to mix. Once you put the bottle down, however, the ingredients quickly separate. That is why the labels on most bottles of salad dressing state "Shake well before using." Not all suspensions involve liquids. A common suspension of a solid in a gas is dust particles suspended in the air.

List: What are two common examples of suspensions? salad dressing and dust in the air

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20-1 WHAT IS A SUSPENSION?

READING SUMMARY

- A suspension is a cloudy mixture of two or more substances that settle on standing.
- The particles in a suspension are larger than the particles in a solution.
- The particles in a suspension scatter light.
- Some familiar examples of suspensions include salad dressing and dust in the air.

20-1 CHECK

Complete all of the following

9. If a suspension is allowed to stand for a time, the substances will always _____.

10. The appearance of a _____ is cloudy.

11. The _____ in a suspension are larger than atoms or molecules.

12. An example of a suspension in a gas is _____ in air.

13. Solutions and suspensions are similar in that both are_____.

APPLY

14. Contrast: How are the particles in a suspension different from the particles in a solution?

15. Classify: Look at Table 1 on page 366. Are the properties listed physical properties or chemical properties? How do you know?

20-2 How can a suspension be separated?

Objective ▸ Describe some ways to separate a suspension.

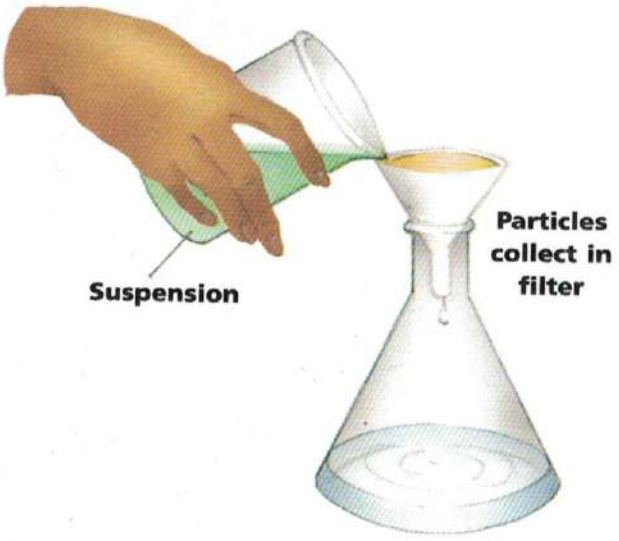
TechTerms

- **coagulation** (koh-ag-yoo-LAY-shun): use of chemicals to make the particles in a suspension clump together
- **filtration:** separation of particles in a suspension by passing it through paper or other substances

Settling Particles in a suspension settle on standing. Large particles settle out quickly. Smaller particles take a longer time to settle. You can see how this works if you mix sand and clay with water, and allow the mixture to stand. The sand will settle to the bottom in a few minutes. The clay will stay in the water much longer. You would have to let the mixture stand overnight in order for the clay to settle.

Explain: Why does sand settle out much faster than clay when mixed with water?

Filtration One way that a suspension can be separated quickly is by **filtration.** Filtration is the removal of particles in a suspension by passing the suspension through a filter. Filters can be made of paper or other substances. Filters have tiny holes, or pores, through which some substances can pass, but not others. Substances that cannot pass through the filter have particles that are larger than the holes in the filter.



Predict: What will happen to the particles in a suspension if they are larger than the holes in a filter?

Coagulation Another way to make a suspension separate quickly is to add chemicals to the suspension. The chemicals make the particles of the suspension stick together. The particles form clumps that are larger and heavier than the original particles. As a result, the particles settle out more quickly. This process is called **coagulation** (koh-ag-yoo-LAY-shun). Coagulation takes place when you cut your finger. Chemicals in your blood cause the blood to coagulate and form a clot.

Define: What is coagulation?

Separation by Centrifuge A third way to separate the substances in a suspension is to spin the mixture at high speeds. The device that is used is called a centrifuge (SEN-truh-fyooj). As the suspension is spun around, the particles in the suspension are pulled down to the bottom of the container. Use of a centrifuge greatly increases the rate at which a suspension settles.

Identify: What is a centrifuge?

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20-2 HOW CAN A SUSPENSION BE SEPARATED?

READING SUMMARY

- The particles in a suspension settle out on standing.
- Filtration is a method of separating a suspension by passing it through a filter.
- Coagulation is a process in which chemicals are used to make the particles in suspension clump together.
- A centrifuge is a device that separates a suspension by spinning it at high speeds.

_____

20-2 CHECK Complete all of the following

1. What happens when a suspension is left to stand overnight?
2. What is filtration?
3. How do the holes in a filter and the particles relate in terms of size?
4. What is coagulation?
5. What is one example of coagulation?
6. How is a centrifuge used to separate the particles in a suspension?
7. What is another name for the holes in a piece of filter paper?

20-2 APPLY

Classify: Decide whether each statement describes separation of a suspension by filtration, coagulation, or centrifuge.

a. A solution of ammonium hydroxide and alum is added to a clay- and – water suspension.

_____

b. A suspension is passed through a piece of linen cloth.

_____

c. A mixture of clay, sand, and gravel is spun at high speed.

_____

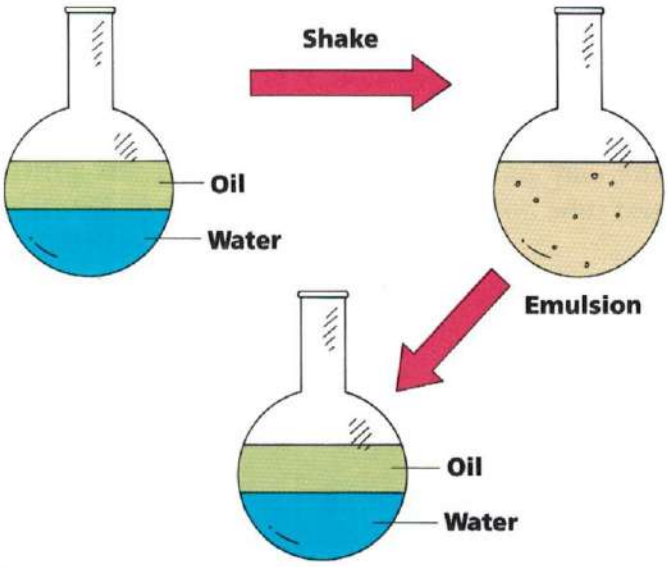
20-3 What is an emulsion?

Objective ▸ Describe and give examples of an emulsion.

TechTerms

- **emulsion** (i-MUL-shun): suspension of two liquids
- **homogenization** (huh-mahj-uh-ni-ZAY-shun): formation of a permanent emulsion

Emulsions When a liquid is suspended in another liquid, the result in an **emulsion** (i-MUL-shun). An emulsion is a suspension of two liquids. Milk, paint, and many medicines are examples of emulsions.



You can make an emulsion by mixing some cooking oil with water, and then shaking the mixture. This emulsion will not stay mixed for long. If you let the mixture stand, the oil and water will soon separate. An emulsion that does not stay mixed is called a temporary emulsion.

Predict: What will happen to a temporary emulsion?

Permanent Emulsions Many commercial products that are emulsions do not separate on standing. These emulsions are called permanent emulsions. The particles in a permanent emulsion are much smaller than the particles in a temporary emulsion. The particles in a permanent emulsion are small enough to stay in suspension.

A familiar example of a permanent emulsion is homogenized milk. **Homogenization** (huh-mahj-uh-ni-ZAY-shun) is the formation of a permanent emulsion. Fresh milk is a temporary emulsion that quickly separates into milk and cream. Fresh milk is homogenized in a machine that breaks down the cream into very small particles. The small particles of cream remain permanently suspended in the milk.

Contrast: What is the difference between a temporary emulsion and a permanent emulsion?

Emulsifying Agents Many detergents or other cleaning products contain substances called emulsifying (i-MUL-suh-fy-ing) agents. An emulsifying agent keeps an emulsion from separating. The soap in cleaning products is an emulsifying agent. Soap breaks apart grease or dirt into smaller particles. These particles are small enough to form a permanent emulsion with water. The dirt or grease is washed away in the water. Other emulsifying agents include gelatin and egg yolk. These substances are often used in food to keep ingredients from separating.

Identify: What is an emulsifying agent?

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20-3 WHAT IS AN EMULSION?

READING SUMMARY

- An emulsion is a suspension of two liquids.
- Temporary emulsions separate on standing.
- Homogenization is the formation of a permanent emulsion.
- Emulsifying agents are substances that prevent an emulsion from separating.

20-3 CHECK Complete all of the following

1. An emulsion is a suspension of a _____ in a liquid.

2. Oil and water separate on standing because they form a _____ emulsion.

3. The particles in a _____ emulsion are small enough to stay in suspension.

4. Soap is an example of an _____ agent.

5. Milk and cream form a permanent emulsion through the process of _____.

6. **Hypothesize:** Bile is produced by the liver. It emulsifies the fats that a person eats. Why is this important to the digestive process?

7. **Infer:** When you buy a can of paint, you usually have to stir the paint before you can use it. Why do you suppose it is necessary to stir the paint first?

20-4 What is a colloid?

Objective ▸ Describe and give examples of a colloid.

TechTerm

- **colloid** (KAHL-oyd): suspension in which the particles are permanently suspended

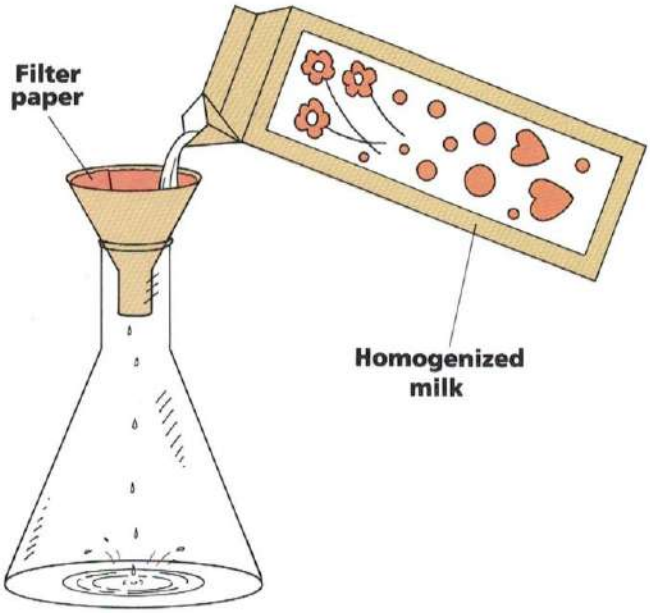
Colloids What do whipped cream, fog, mayonnaise, and smoke have in common? All of these substances are colloids (KAHL-oydz). A **colloid** is a suspension in which the particles are permanently suspended. Colloids do not separate on standing.

Colloids can be mixtures of different phases of matter. Table 1 shows some common types of colloids and examples of each type.

Table 1 **Types of Colloids**

NAME	PHASE	EXAMPLES
Foam	gas in liquid	shaving cream, whipped cream
Sol	solid in liquid	paint, dyes
Emulsion	liquid in liquid	mayonnaise
Fog	liquid in gas	clouds, fog
Smoke	solid in gas	smoke in air
Gel	liquid in solid	butter, jelly

Define: What is a colloid?



Colloid Particle Size The particles in a colloid are not as small as the particles in a solution. However, they are much smaller than the particles in an ordinary suspension. They cannot be seen with a microscope. Because the particles in a colloid are so small, a colloid cannot be separated by filtration. A colloid such as homogenized milk passes right through filter paper. The particles in milk are smaller than the holes in the filter.

Explain: Why can a colloid not be separated by filtration?

Movement of Colloid Particles Particles in a colloid are kept in suspension because they are being bombarded by the molecules around them. For example, the particles in smoke are always colliding with air molecules. These collisions keep the particles from settling out. These collisions also cause a colloid to scatter light. The cloudy appearance of a colloid such as milk is due to the scattering of light.

Explain: Why does a colloid appear cloudy?

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20-4 WHAT IS A COLLOID?

READING SUMMARY

- A colloid is a suspension in which the particles are permanently suspended.
- The particles of a colloid are larger than the particles of a solution, but smaller than those of an ordinary suspension.
- Particles of a colloid are kept in suspension because they are always colliding with the molecules around them.

20-4 CHECK *Write true if the statement is true. If the statement is false, change the underlining term to make the statement true.*

1. Particles in a colloid are smaller than those in a solution.

2. Colloids are permanent suspensions.

3. Colloids can be separated by filtration.

4. Colloids do not scatter light.

5. A colloid consisting of a liquid in a solid is called an emulsion.

6. Whipped cream is an example of a foam.