

Unit 1 – Pure Substances and Mixtures

Chapter 3: Separating Mixtures

3.2 Separating Mechanical Mixtures

Vocabulary:

sorting – physically separating large pieces of a mechanical mixture so that similar pieces are together

floating – a separation technique in which a “lighter” component rises to the top of a liquid where it can be skimmed or poured off

settling – a separation technique in which a “heavier” component sinks to the bottom of a liquid, and the liquid can be poured off

sieve – a device used to separate the components of a mixture, with many visible holes that allow smaller solid pieces and liquids to pass through while blocking the larger solid pieces

sieving – the process of passing a mechanical mixture through a sieve to separate out other larger pieces of matter

filter – a device with many small holes that trap solid pieces of a mixture but allow liquids and gases to pass through

filtration – the process of passing a mechanical mixture through a filter to separate out solid pieces from a liquid or gas

dissolving – mixing completely with a solvent to form a solution

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1. Four methods of separating a mechanical mixture are: sorting, settling, filtration and dissolving.
2. a) metals in a scrap yard can be separated by sorting
b) salt and sand can be separated by mixing the two substances with water. The salt will dissolve into the water, while the sand will settle at the bottom
c) sand and gravel can be separated by pouring the mixture into a sieve with holes small enough to trap the gravel but large enough to let the sand through
d) sand and water can be separated using a filter – the water will pass through the filter but the sand will not
3. Air filters make the air healthier for people to breathe by allowing clean air to pass through, but trap tiny solid particles that make the air harmful to breathe.
4. A filter is similar to a sieve in that both are used to separate mixtures by trapping larger substances in holes that allow smaller substance to pass through. However, a filter has much smaller holes than a sieve, so that it is used to separate tiny, insoluble solids from liquids or gases. Sieves can separate larger solids from smaller solids or liquids.

3.4 Protecting the Environment by Separating Mixtures

Vocabulary:

sewage – the mixture of water and waste that is flushed down toilets and sink drains

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1. The two main ways to avoid water pollution are to identify and limit water pollution sources and to treat polluted water before it reaches rivers and lakes.
2. Settling is used in primary sewage treatment to separate solid wastes from liquid waste.
3. There are three main steps in the sewage treatment process. During the primary treatment, sieving, floating, and settling are used to separate the water from solid materials and components such as oil and grease. In the secondary treatment, bacteria break down any remaining human waste and plant matter. In the final (tertiary) treatment, any nitrogen or phosphorus in the water is removed through filtration, exposure to ultraviolet radiation or ozone, or the use of bacterial. The water is then treated with chlorine to get rid of any remaining organisms.
4. Pollutants can get into water through exposure to factory waste. Pesticides, salts, and fertilizers from farms and roads also pollute water. Pollutants also get into water through accidental spills or leaks.
5. It is very difficult to separate oil and water once they are mixed because they are both liquids. As a result, many kinds of separation techniques are not very effective.
6. Oil spills can endanger wildlife by polluting the oceans, destroying the homes of the animals that live there. The oil can also poison the wildlife.

3.5 Separating Solutions

Vocabulary:

evaporate – change from a liquid to a gas

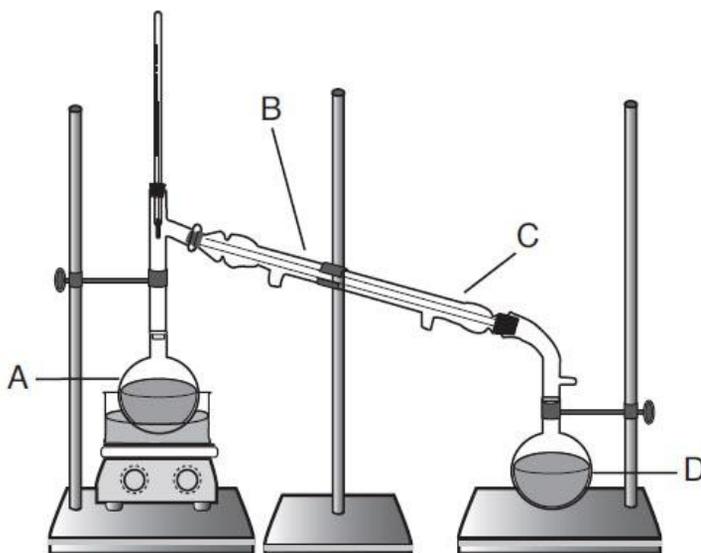
evaporation – the process by which a sample of matter changes from a liquid to a gas

distillation – the process of separating liquids in a solution by heating the solution, trapping and cooling the gas, and collecting the resulting pure liquid

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1. Sugar can be separated from a sugar-and-water mixture by boiling the mixture until the water evaporates, leaving the sugar behind.

2. In the process of distillation, a mixture of liquids is heated (label **A** in the diagram below) until one of the liquids reaches its boiling point and evaporates. The gas rises and is directed into a condenser (**B**). Cold water in the condenser cools the gas until it becomes a liquid again (**C**), and then this liquid is collected in a separate container (**D**).



3. a) Maple syrup is made by evaporation. The maple sap is boiled to remove the water and concentrate the sugar and other substances.

b) When you boil maple sap, water leaves the mixture. Whether or not this process is harmful to the environment depends on how you heat the sap. Water is not harmful to the environment, but if certain types of fuels (such as natural gas or wood) are used to heat the mixture, gaseous pollutants could be released.

3.7 Mixtures in Industry

Vocabulary:

electric generator – a machine with moving parts that produce electricity when they spin

radioactive – a term used to describe pure substances whose particles naturally split into smaller particles, releasing energy as they break apart

nuclear energy – the energy released when the particles of pure substances like uranium split apart

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2. a) Wheat grains mixed with stones and large sticks could be separated by using a sieve.
b) Wheat grains mixed with pieces of metal could be separated by using a magnet.
c) A mixture of different oil components that evaporate at different temperatures could be separated through the process of distillation.

3. Several methods of separating mixtures are used in the process of making flour. Screens filter out the wheat grains from sticks and stones. Vacuum extractors remove lighter impurities such as dust. Magnets remove iron and steel pieces that are mixed in with the grains.

4. a) Uranium can be used to produce electricity because it is a radioactive substance. As it breaks down, it releases energy that can be used to generate electricity.
b) Electricity can be produced by adding uranium to the core of a nuclear reactor. As the uranium breaks apart and releases energy, it heats the water surrounding the core. The water boils and evaporates, and the resulting steam turns the blades of turbines that generate electricity.

5. Uranium is obtained from uranium ore, a kind of rock, but crushing the ore and adding a solution that dissolves the uranium. The solution is then sieved and evaporated, leaving behind the solid uranium.

6. a) Uranium ore cannot be treated the same way as regular garbage because it is highly radioactive, and it could contaminate soil and water if it were buried in a landfill.
b) Uranium ore is sometimes disposed of by mixing it with melted glass, and burying the mixture deep within an unused mine.

7. Nuclear Power Risks: An accident could result in leaked radiation that could cause deadly diseases such as cancer. Moreover, nuclear waste is very harmful to the environment.

Nuclear Power Benefits: It does not produce pollution leading to acid rain, and it does not release carbon dioxide, which contributes to the problem of climate change.

WHAT DO YOU REMEMBER? – sample answers

- (a) One method of separating sewage to produce cleaner water is to use floating and settling to remove solids, grease, and oil.

(b) One method of separating wheat grains to produce white flour is to use a series of sieves.

(c) One method of separating petroleum to produce gasoline is to use a fractional distillation column.
- (a) One way to separate a solution that contains two liquids is to use distillation.

(b) One way to reclaim a solid solute from a solution is to evaporate the liquid, which will leave the solid behind.
- (a) A salad can be separated by sorting.

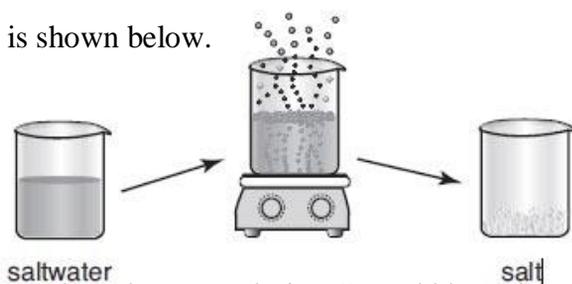
(b) Gold dust can be separated from water and other rocks by using settling.

(c) The iron in a pile of scrap metal can be separated from the other materials using a magnet.

(d) Dust and pollen can be removed from air using a filter.

(e) A mixture of salt and sand could be separated by dissolving the salt in water.
- A filter separates the components of a mechanical mixture by allowing any liquids and gases to pass through tiny holes in the filter. Solid materials cannot pass through the filter and are trapped.
- A magnet cannot be used to separate any kind of mixture. It can be used only if one of the components of the mixture is attracted to magnets, but the other component is not.

6. A sample diagram is shown below.



To separate salt from a salt-and-water solution, I would heat the solution to a boil and evaporate the water. The salt would be left behind.

7. It is important to remove harmful materials from waste before putting waste into the environment because those harmful materials could damage the environment and poison plants and animals, including people.

WHAT DO YOU UNDERSTAND?

- (a) A filter can separate dust from air. Air will move through the filter, but dust will be trapped.

(b) A magnet can be used to separate paper clips and erasers. The magnet will pick up the paper clips, but not the erasers.

(c) Settling can separate soil from water. The soil will settle to the bottom of the container of water.

(d) A sieve can be used to separate pebbles from sand. The pebbles will get caught in the sieve, but the sand will pass through.

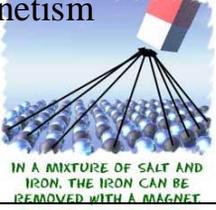
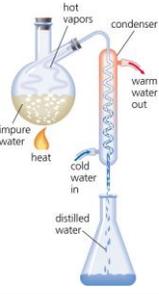
(e) Dissolving can sort sugar from sand. The sugar will dissolve in water, leaving the sand behind.

(f) Floating can separate sawdust and sand. The sawdust will float on water, but the sand will sink.
- Many separating techniques would be needed to separate this mixture. The waste paper would have to be sorted out by hand. It has similar properties to the compost, but is more easily distinguished. Magnets could be used to separate the steel cans from everything else. The floating and settling could be used to separate the bottles. The plastic bottles would float and the compost would sink.
- (a) Wheat grains might arrive at a flour mill mixed up with stones, sticks, and so on. This is a mechanical mixture.

(b) When the wheat grains have been crushed it is still a mechanical mixture.

(c) Petroleum that arrives at a refinery is a solution.

Separating Mechanical Mixtures (review chart)

separation method	example	used for separating...
Settling and Flotation 	- salad dressing	- heavy parts of a mixture from lighter parts - mixtures in which one component of the mixture floats in water and the other component sinks in water
Magnetism 	- paper clips and staples from paper to be recycled	- mixtures in which one component of the mixture, but not the other, is attracted to a magnet
Sieving or Sifting 	- spaghetti from boiling water	- larger substances that will be trapped by the sieve and smaller or liquid substances that will pass through the sieve
Filtration 	- liquid or gas passes through, solid (residue) remains in filter	- solids that are too small to be trapped by sieves
Evaporation 	- reducing maple syrup	- liquid evaporates and a solid (residue) is left behind
Distillation 	- 100% pure water	- a two step process that heats a solution to change one part into gas and then cools the gas/vapour to liquid form and collects it
Dissolving	- salt and pepper	- pour water into salt & pepper mixture, dissolving salt and leaving pepper (salt water can be boiled to recover salt)
Picking apart	- raisins and cereal	- manually separating mixtures
Centrifuging	- washing machine	- centrifuge spins, centripetal forces act on the contents of the tube – the components of the mixture end up separated according to density, with the densest on the bottom and the least dense at the top