



solubility

Lesson 4

Solubility**Learning Outcomes**

After completing this lesson you will be able to

- identify factors that affect solubility
- investigate one of the factors that affect solubility

Speeding the Process of Dissolving

Have you ever tried to make a drink crystal mixture, or mix sugar into coffee or tea? In each case, you were dissolving a solute into a solvent.

What if you had a limited time to create your drink? How could you make the solute dissolve faster? **Solubility** is the ability of a substance to go into solution by dissolving. The following factors have been shown to affect solubility rate:

- particle size
- stirring
- heat/temperature



- quantitative
- qualitative
- dilute
- concentrated

Lesson 5

Quantitative and Qualitative**Learning Outcomes**

After completing this lesson you will be able to

- describe the concentration of a solution in qualitative and quantitative terms
- explain the difference between saturated and unsaturated solutions

Learning Activity: The Importance of Being Quantitative

1. Prepare a solution of unsweetened drink mix, sugar, and water in a small paper cup, without referring to the directions. Taste your solution, and then write down your observations in the space provided.

2. Is there a way you could improve the taste? Try adding more ingredients to make it better. When you have settled on an acceptable solution, write a set of instructions on how to make a palatable (tasty) drink, including specific amounts of each ingredient to use.

Qualitative versus Quantitative

Aunt Sally was known for her homemade pumpkin pie. She won many ribbons at the local fair for her tasty pies. Everyone in her family loved the pies, and one day her niece asked her for the recipe.

Aunt Sally gave her the recipe and her niece used it to bake a pie for the next family dinner. The niece was especially sure to add the extra pinch of nutmeg, and dash of ginger that Aunt Sally said was so important. When the pie was done it looked and tasted good, but didn't quite taste the same as her aunt's award-winning pie. When the niece asked what she had done wrong or differently, Aunt Sally replied that maybe their pinches weren't quite the same size. As well, Aunt Sally said that she also tasted her mixture before baking and sometimes added extra spices or sugar, depending on the type of pumpkin she used.



Aunt Sally's recipe was more of a **qualitative** one. She didn't have a definite set of quantities, but decided how much to add according to how it tasted.

Harry, Aunt Sally's nephew, worked for a large bakery. The bakery pumpkin pies were sold in grocery stores within the city. The bakery made large batches of pumpkin mixture. In order to make a consistently good-tasting product, they had to use a definite recipe that could be followed by any of the workers at the bakery. The fact that the recipe called for definite, measured quantities of substances makes it **quantitative**.

Questions: Qualitative versus Quantitative

1. What would assist you in writing accurate instructions for someone else on how to make a tasty drink without continuously having to taste test and add more of an ingredient?

2. What kinds of things do we measure qualitatively in daily life?

3. What are some of the things that we measure quantitatively?

4. If you were receiving medication mixed by a pharmacist, would you rather he or she used quantitative (measured amounts) or qualitative (without measuring) qualities to prepare it? Why?

5. A dilute solution is one in which a small amount of solute is dissolved in a solvent, whereas a concentrated solution has a large amount of solute dissolved in a solvent. What term might be used to describe a watery tasting drink solution: **diluted** or **concentrated**? Explain your answer.

6. You can purchase orange juice in one-litre containers. You can open and drink this juice without adding water. There are also frozen juices to which you have to add water in order to drink them. What term is used to describe the latter type of solution: **diluted** or **concentrated**? Explain your answer.

7. Which of the following is a more concentrated solution?

Circle the correct answer.

- a) 5 grams per 100 mL
- b) 37 grams per 100 mL
- c) 17 grams per 100 mL



Vocabulary

saturated

Lesson 6

Saturated and Unsaturated Solutions

Learning Outcomes

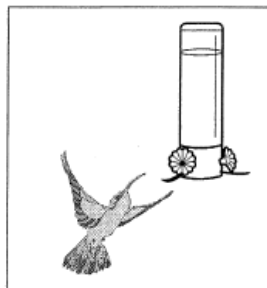
After completing this lesson you will be able to

- explain the difference between saturated and unsaturated solutions

Case Scenario: Hummingbird Feeders

A company that makes hummingbird feeders for indoor aviaries would like to include, with its product, instructions on how to make the liquid food that goes into the feeders. The feeders are built to release the sugary liquid when a bird sticks its beak into the sipping holes.

Hummingbirds require a lot of energy to survive; thus, they require high concentrations of sugar. Therefore, the water must be **saturated** (no more solute will dissolve in it at a given temperature) with the sugar. It has been found that if too much sugar is added, the sugar comes out of solution and the sipping holes clog up.



3. Answer the following questions:

- a) Did you stir the solution as you added the sugar? _____
If you did not stir, what problem might this have caused?

- b) What differences would you notice in the hummingbird feeder that you filled with your saturated solution?

- On a really hot day? _____

- On a really cool day? _____

Lesson 7

Safe Use and Disposal Methods of Substances**Learning Outcomes**

After completing this lesson you will be able to

- recognize the importance of proper disposal methods
- identify some hazardous wastes

Read the following text about hazardous materials. Note that the underlined words are explained at the end of the article.

Hazardous Materials

Headlines about hazardous material spills can be scary. Sometimes, entire communities must be evacuated until a spill is cleaned up. Who performs this sometimes dangerous work? They're called emergency response teams, and they have to be ready for just about anything.

Hazardous materials are chemicals (such as paints or bug killers), biological agents (such as disease-causing materials), or physical agents (such as radioactive materials) that are dangerous to humans or to animals and plants. Hazardous waste is unusable hazardous material that results from the activities of human society. Research institutes, industrial plants, individual households, and government agencies all generate chemical waste. About one percent is classified as hazardous.

(continued)

Hazardous Materials: Reprinted from <<http://www.pbs.org/ktca/newtons/13/hazmat.html>>. Used with permission.

A hazardous spill occurs when hazardous material or waste gets into the environment in an uncontrolled fashion. Many manufacturing processes use hazardous materials or generate hazardous waste, but a hazardous spill doesn't always come from a chemical plant or a factory.

Any substance in the wrong place at the wrong time in too large an amount can cause harm to the environment. What if a tank truck dumps milk into a small stream, for example? Or a giant vat of mayonnaise splits open at a food processing company? Those spills may be classified as hazardous, too.

The response to a spill depends on the situation. When the emergency response team is notified of a spill, it must quickly decide what sort of danger is likely. Members of the team collect appropriate clothing and equipment and travel to the scene. There they try to contain the spill, sometimes testing a sample to identify it.

If necessary, they decontaminate themselves before leaving the area. Once the material has been identified, other personnel arrive to remove it.

In the past, hazardous wastes were buried in special landfills. Some industrial and government operations also used fields, pits, ponds, and lagoons as disposal sites. Over the years many of these leaked, contaminating soil and drinking water. Spill cleanup can take many more permanent forms, including incineration, neutralization, and vitrification (sealing the waste at high temperature in glass).

New techniques look very promising. For example, certain bioengineered organisms can digest specific hazardous chemicals. Some of these organisms have already been used on oil slicks from ocean spills.

(continued)

Key Words

Emergency Response Team: the people first on the scene to help with a hazardous material spill.

Hazard: material or situation that causes harm under particular circumstances.

Spill: the cleanup process of removing hazardous materials from the spill site and rendering them harmless or storing them under safe conditions.

Questions: Hazardous Materials

Think about the article you just read and answer the following questions.

1. How can we as a society prevent hazardous spills from happening in the first place?

2. What would you want to know if a hazardous waste spill happened near your home?

Disposing of Some Common Household Hazardous Wastes

We use many different types of mixtures, solutions, and solvents in our homes. These materials assist us in our daily chores or ensure that devices in our homes or garages work well.

Things like soaps, detergents, paint thinner, and engine oil may assist us, but they are harmful to the environment and our health if we do not dispose of them properly. For example, these substances may pollute our soil — and eventually our drinking water — if they are poured into the ground.

Read the following poster from the City of Winnipeg that discusses the city's suggested disposal techniques of hazardous waste. Then answer the questions that follow.

Household Hazardous Waste Disposal

Spring/Summer 2001

Please dispose of household hazardous waste products safely by taking them to a hazardous waste collection depot.

Hazardous waste should:

- **NEVER** be placed out for recycling/garbage collection
- **NEVER** be dumped in sewers, drains or open bodies of water
- **NEVER** be buried in the ground
- **NEVER** be burned
- **NEVER** be disposed of in landfills

Improper disposal of leftover hazardous waste products can:

- cause harmful chemicals to enter the environment and contaminate our land and water.
- cause long term health problems or seriously injure you, recycling/garbage collectors and landfill operators.
- damage the sewer in your home and the City's sewer system.

FREE Household Hazardous Waste Collection Depot

Miller Environmental Corporation

65 Trottier Bay (off Chevrier Blvd.) Phone: 925-9615

Open the first and last Saturday of each month from April to the end of September, 9:00 am - 4:00 pm

Use as much of the product as you can before you consider it waste.

See if your family and friends can use it!

Examples of Household Hazardous Waste Products:

- leftover paint
- aerosol cans
- varnish remover
- insect repellent
- cleaners (toilet, oven, drain)
- car batteries
- chemical lawn fertilizers
- paint brush cleaners/solvents
- propane cylinders
- antifreeze (radiator/windshield)
- BBQ and camping fuel
- swimming pool chemicals
- weed, insect killer
- gasoline

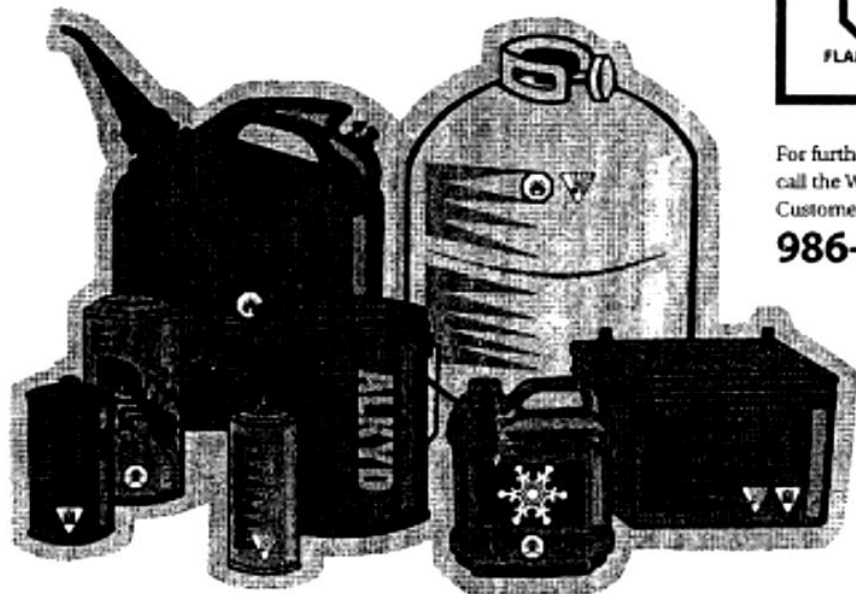
Be a label reader!

These danger symbols identify many hazardous waste products.



For further information call the Water and Waste Department Customer Service Centre at

986-5858



Winnipeg
Water and Waste Department

Manitoba
Conservation



Questions

1. List some things that should *never* be done with hazardous wastes.

2. List several examples of hazardous wastes.

Would You Like to Know More?

Contact your local municipal office to find out about the safe disposal practices in your community.

Read the following information about recycling oil.

Recycling Oil

- Each year in Manitoba, approximately 14 million litres of used oil, along with millions of used oil filters and used oil containers, are improperly discarded.
- Many consumers improperly dispose of used oil products because of limited recycling facilities and lack of knowledge or information about recycling.
- Used oil products contain small quantities of substances that could contaminate air, soil and ground water; for example, trace metals, chlorinated solvents, gasoline, polynuclear aromatic hydrocarbons, glycols and PCBs.
- Millions of litres of used oil are thrown in the trash, often ending up in landfills, from which the oil can contaminate ground and surface water and reduce soil productivity. In addition, oil is poured down sewers and drains, disrupting treatment plants and contaminating waterways.
- Just 1 litre of used oil can pollute 1,000,000 litres of fresh water.
- There is a market for used oil. Re-refining used oil completely restores the original lubricating properties of the oil and takes about one-third of the energy of refining crude oil to lubricant quality.
- Used oil can be re-refined into lube oil or other petroleum products.
- Oil filters are a source of scrap metal and used oil. An undrained oil filter can contain between 250 millilitres (1 cup) to 1 litre of used oil that is available for recycling. Filters are 80 to 85 per cent steel.
- Virtually all oil containers today are plastic. Once drained, the containers are either a supply of recyclable plastic or an energy recovery source.

Recycling Oil: Reprinted from <<http://www.usedoilrecycling.com/marrc/index.html>>. Used with permission.

Questions: Recycling Oil

Based on the facts you just read, answer the following questions:

1. If improperly disposed of, what parts of the environment can oil affect?

2. For what purposes can re-refined oil be used?

3. What two parts of an oil filter can be recycled?
