

Important Concepts . . .

Preview Review



Science

Grade 9 TEACHER KEY

*W3 - Lesson 5: Transfer of Materials through the
Air, Ground, and Water/Biological Impacts of
Hazardous Chemicals*

Important Concepts of Grade 9 Science

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W1 - Lesson 2	Electrical Circuits
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W3 - Quiz	

Materials Required

Textbook:
Science in Action 9

Science Grade 9

Version 5

Preview/Review W3 - Lesson 5 TEACHER KEY

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Preview/Review Concepts for Grade Nine Science

TEACHER KEY



***W3 - Lesson 5:
Transfer of Materials through
the Air, Ground, and Water/
Biological Impacts of Hazardous Chemicals***

OUTLINE

By the end of this lesson, you should

- explain how pollutants travel through the air
- explain how pollutants travel through groundwater
- explain how pollutants travel through soil
- identify biodegradation
- give an example of how hazardous chemicals affect living things

GLOSSARY

biodegradation - breakdown of materials by organisms such as earthworms, bacteria, and fungi; “bio” refers to living things and “degrade” means to break

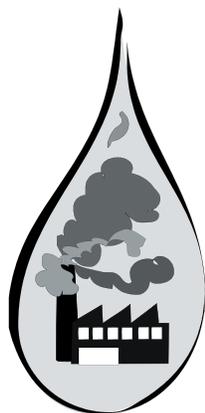
biomagnification - increase in concentration of a chemical or element as it moves up the food chain

dispersion - scattering of a substance away from its source

groundwater - the water that fills all interconnected spaces in the soil

leachate - liquid that dissolves and carries substances as it passes through soil

W3 - Lesson 5: Transfer of Materials through the Air, Ground, and Water/Biological Impacts of Hazardous Chemicals



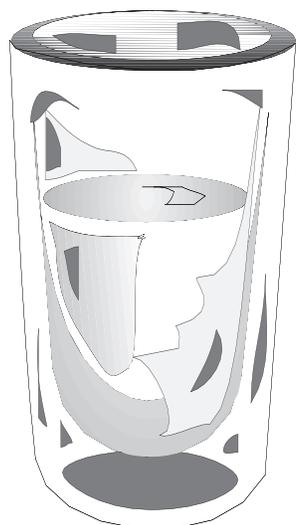
Have you ever seen the cleanup of old gas tanks at a gas station? Due to present environmental standards, the replacement of old tanks is required for gas stations. Not only are the tanks replaced, but a large majority of the dirt that surrounded the tanks is dug out and replaced. This lesson is about how pollutants can spread through the air, water, and ground and how living organisms are affected by hazardous chemicals.

Transfer of Pollutants through the Air, Water, and Soil

Smokestacks of factories release pollution into the air. This is an example of a source of pollution. The chemicals are then dispersed through the air and land on the ground or in water. An example of a chemical released from a smokestack is sulfur dioxide (SO_2). We can follow where a molecule of sulfur dioxide travels after it is released into the air.



Several factors determine how far a molecule of sulfur dioxide travels. The properties of the pollutant, wind speed, direction of the prevailing winds, and amount of precipitation all affect the distance a pollutant travels.

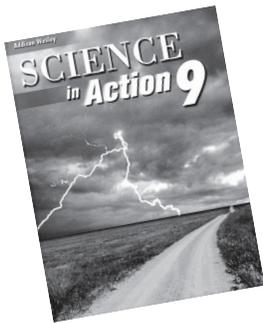


When sulfur dioxide reaches the ground, it can enter groundwater. In the soil of the groundwater zone, all open spaces are filled with water. The top of the groundwater zone is the **water table**. This is the source of water from wells, and that is often used for drinking and washing.

One of the concerns about pollutants in groundwater is that the water can move in all directions carrying the chemical either very quickly or slowly. One factor that can affect contamination of groundwater is the number and connection of pores in the soil, or the permeability of the soil. A sandy soil is more permeable than a clay soil, which may be impermeable.

Sulfur dioxide can also enter a body of water through surface runoff. Perhaps you have heard the phrase, “If it’s on the land, then it’s in the water.” Fertilizers from farmer’s fields and storm sewers are examples of how pollutants can enter water. One factor that affects how far a substance travels in water is whether it can dissolve easily in water. Sulfur dioxide combines with water to produce sulfuric acid. Substances that cannot dissolve in water can attach to grains of soil and become highly concentrated close to the source of pollution.

Once on the ground, pollutants (such as our sulfur dioxide molecule) move down through the soil. The composition of the soil affects how far the chemicals can travel. Water that moves down through the soil can also dissolve substances in the soil and carry them along. This is referred to as **leachate**. A large content of organic material in the soil can slow or stop the movement of the chemical. Chemicals can also be changed in the soil. For example, acids can be neutralized by calcium carbonate (limestone) in the soil.



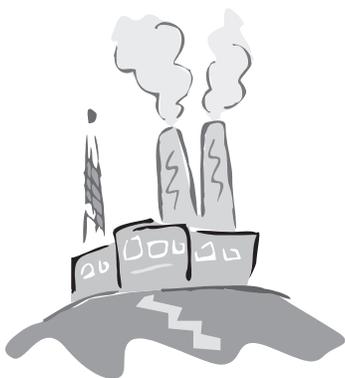
Read pages 237-242 of *Science in Action 9*.

1. Identify the source of the following substances that contaminate groundwater.
 - a. gasoline **underground storage tanks and pipelines**
 - b. bacteria **septic tanks and sewage treatment ponds**
 - c. nitrates **household chemicals**
 - d. salt **de-icing roads, agricultural use, vehicle exhaust, industrial products**
 - e. mercury **landfill sites, mine waste**
 - f. pesticides **organic substances occurring naturally or produced by humans**

2. Can chemicals move better through sandy soil or clay?
Explain your answer.

Chemicals move better through sandy soil because it has lots of pores in it (permeable.) Clay soil does not have many pores (impermeable.)

3. Imagine that a fertilizer plant is being built close to a small town that relies on river water as its source of drinking water. The river flows from west to east.

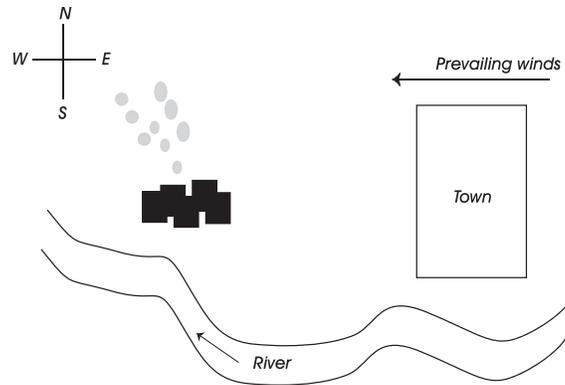


- a. What concerns should residents have about this plant?

They should be concerned that pollution from the fertilizer plant could enter their water source or travel through the air and cause respiratory problems.

- b. If the plant was east of town and the prevailing winds came from the west, would the town still have concerns? Draw a diagram to show your understanding.

The town would not be as concerned about their water supply because the pollutants would be blown east of town, downstream of their water source. They still could have concerns if the winds shifted occasionally.



4. Identify two factors that affect how far an air pollutant can travel.

wind speed and precipitation

Breakdown of Waste

Hazardous chemicals in the soil break down over time. There are three main ways in which this occurs: biodegradation, phytoremediation, and photolysis.



Biodegradation is the breakdown of materials by organisms such as earthworms, bacteria, and fungi. Two types of bacteria are involved in this process. Aerobic bacteria break down substances in the presence of oxygen. Anaerobic bacteria break down substances in an oxygen free environment. For example, anaerobic bacteria deep in the soil remove chlorine from harmful PCB's (polychlorinated biphenyls). Some factors that affect the rate of biodegradation are temperature, soil moisture, pH, oxygen supply, and nutrient availability.



Phytoremediation is a process by which plants uptake metals, hydrocarbons, solvents, pesticides, radioactive materials, explosives, and landfill leachates from the ground. The plants are allowed to grow and are then harvested. The harvested plants are then burned or composted.

Photolysis is the process by which light breaks down compounds. For example, nitrogen dioxide (NO₂) is broken down by light to form nitrogen monoxide and an oxygen atom.

Read pages 244-247 of *Science in Action 9*.



5. Explain how temperature can affect the rate of biodegradation.

The warmer the temperature, the higher the rate of biodegradation. Very little biodegradation happens during the winter.



6. Identify and describe a different method for encouraging biodegradation.

Planting vegetation encourages biodegradation.

Larger numbers of bacteria and fungi are found in soils that have plants. These organisms live on or in the roots of plants.

7. Give a specific example of phytoremediation.

Sunflowers have been used at Chernobyl to remove radioactive substances from groundwater.

8. What is photodegradable plastic? How does it break down? What is one problem with this type of plastic?

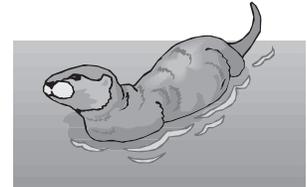
This is a type of plastic that is made of chemicals that react when exposed to sunlight. After 3 months the plastic becomes a fine powder. This type of plastic will not break down if it is buried in a landfill where sunlight cannot reach it.

Hazardous Chemicals Affect Living Things

One of the big problems with the release of harmful chemicals in the soil and water is the uptake of these chemicals into living things. Mercury in a body of water is often found in fish. When humans eat the fish, the concentration of mercury in the human is larger than it was in the fish. This is called **biomagnification**. The fishing regulations in Alberta state how many fish an adult or child can safely consume because of mercury contamination.



Another example of how living organisms have been affected by hazardous chemicals was shown by the Exxon Valdez oil spill that occurred off the southern coast of Alaska in 1989. Two hundred sixty thousand barrels of crude oil were spilled. This spill affected plants, animals, and humans. Sea birds and sea otters were covered with oil. Many died because their fur or skin could no longer protect them against the cold temperatures.



Read pages 248-251 of *Science in Action 9*.

9. Make a word diagram to show how biomagnification of mercury can occur.

Mercury in waste → algae → insects → fish → humans



10. Identify how plants, fish, and humans were affected by the Exxon Valdez oil spill.

Floating algae were killed.

Fish eggs did not hatch and young fish either died or became physically deformed. Adult fish could swim, but they lost habitat and food resources.

Humans were no longer able to fish for a living. The tourist trade in the area decreased due to the oily mess.

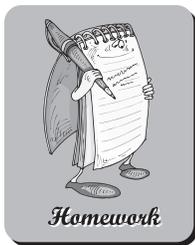


Internet Websites

The addresses for the websites below were valid at the time of printing.

<http://www.pca.state.mn.us/kids/kidsQuizGarbage.cfm>

<http://edugreen.teri.res.in/explore/air/air.htm>



Homework

11. Research ways that you can help reduce air, soil, and water pollution. Give one example of each.

air *carpool, walk, or bike wherever you can*

soil *reduce the amount of trash by recycling as much as you can*

water *switch to a detergent that is phosphate free*



