CHAPTER 4:

PESTICIDES AND THE ENVIRONMENT
I. Introduction

Chapter Objectives

By the time you finish this chapter, you will be able to:

- explain the meaning of the word environment;
- distinguish between point sources and nonpoint sources of environmental contamination by pesticides;
- list factors you should consider before you release a pesticide into the environment;
- explain why sensitive areas are important considerations for pesticide handlers;
- name the routes by which pesticides can move offsite into the environment;
- describe factors that influence whether pesticides will move offsite in the air;
- describe factors that influence whether pesticides will move offsite in water;
- describe ways that pesticides move offsite in or on objects, plants, or animals;
- recognize that nontarget plants and animals can be harmed by both pesticides and pesticide residues;
- describe harmful effects that pesticides can have on surfaces.

Terms To Know

Aquifer — An underground layer of permeable rock, sand, or gravel that contains water.

Back-siphoning — Movement of liquid pesticide mixture back through filling hose and into water source.

Bioaccumulation — Buildup of pesticide(s) in bodies of animals moving up the food chain.

Collection tray or pad — Safety system designed to contain and recover spills, rinsates, leaks, and other pesticide-containing substances.

Concentrate — Pesticide with high percentage of active ingredient.

Critical Habitat — Areas of land, water, or air space needed for endangered species survival.

Drift — Airborne movement of pesticide away from release site.

Ecosystem — System formed by interaction of community of organisms with environment.
Endangered species — Organisms whose survival as species has been designated by a Federal agency to be endangered or threatened.

Environment — Everything around us: air, soil, water, plants, houses, and buildings.

Groundwater — Water beneath earth’s surface between soil particles or rock.

Labeling — Pesticide product label and other accompanying materials that contain directions pesticide users are legally required to follow.

Nontarget — Any site or organism other than the one toward which control measures are being directed.

Offsite — Area beyond the target area where pesticide is being released.

Persistant — A term describing the enduring quality of some pesticides in the environment.

Permeability — The characteristic of a porous medium, such as soil, that identifies the ease with which gases or liquids can pass through it.

Pesticide handler — Person who directly works with pesticides, such as during mixing, loading, transporting, storing, disposing, and applying, or working on pesticide equipment.

Precautionary statement — Statement on pesticide labeling that alerts you to possible hazards from use of pesticide product and that sometimes indicates specific actions to take to avoid the hazards.

Rinsate — Pesticide-containing liquid that results from rinsing pesticide container, pesticide equipment, or other pesticide-containing materials.

Riparian zones — A belt of trees and shrubs located adjacent to and up-gradient from water bodies.

Runoff — Horizontal flow of pesticide in liquid away from the release site across the land surface.

Surface water — Water on top of earth’s surface, such as in lakes, streams, rivers, irrigation ditches, or storm drains.

Target — Site or pest toward which control measures are being directed.

Use site — Immediate environment where pesticide is being mixed, loaded, applied, transported, stored, or disposed of, or where pesticide-contaminated equipment is being cleaned.

Volatile — Evaporating rapidly; turning easily into gas or vapor.

Watertable — The upper level of a soil zone where all the spaces between the soil particles are filled with water.

The environment is everything around us. It includes not only the natural elements that the word “environment” most often brings to mind, but also people and the manufactured components of our world. Nor is the environment limited to the outdoors; it also includes the indoor areas in which we live and work.

The environment, then, is much more than the oceans and the ozone layer. It is air, soil, water, plants, and animals; it is houses, restaurants, office buildings, and factories and all that they contain. Anyone who uses a pesticide indoors or outdoors, in a city or in the country, must consider how that pesticide will affect the environment.

The applicator must ask two questions:

1. How will this pesticide affect the immediate environment at the site where it is being used?
2. What are the dangers that the pesticide will move off the use site and cause harm to other parts of the environment?

Pesticides can harm all types of ecosystems if they are not used correctly. The applicator is responsible for knowing and following good practices that achieve effective pest control with as little risk to the environment as possible. In addition, pesticide product labeling statements are intended to alert you to particular environmental concerns that a pesticide product poses. Remember that the lack of a particular precautionary statement does not necessarily mean that the product poses no hazard to the environment.

Both the public and the Environmental Protection Agency (EPA) are becoming increasingly concerned about harmful effects on the environment from the use of pesticides. EPA is looking closely at environmental effects as it considers new applications for product registration while, at the same time, reviewing existing pesticide registrations. In the past, hazards to humans have been the primary reason for EPA to classify a pesticide as a restricted-use product. Now, more pesticide labels list environmental effects, such as contamination of groundwater or toxicity to birds or aquatic invertebrate animals, as well as nontarget organisms, including endangered species. Thus, there is a reason for restrictions.

II. Sources of Contamination

When environmental contamination occurs, it is the result of either point source or nonpoint source pollution. Point source pollution comes from a specific, identifiable place or point. For example, a pesticide spill that ends up in a storm sewer is considered a point source for pollution. Nonpoint source pollution comes from a wide area. The movement of a herbicide after a broadcast lawn application into an irrigation canal is an example of nonpoint source pollution. Thus, point sources resulting in environmental contamination include:

- wash water from equipment and spills at equipment cleanup sites,
- improper disposal of containers, water from rinsing containers, and excess pesticides,
- leaks and spills at pesticide storage sites where they are not cleaned up correctly, and
- spills that occur while mixing concentrates or loading pesticides into application equipment.

These kinds of contamination are potentially involved with nearly every pesticide used. As a pesticide handler, especially if you use and supervise the use of restricted-use pesticides, you must become aware of the potential for environmental contamination during every phase of your pesticide operation. Many pesticide uses are restricted because of environmental concerns. Whenever you release a pesticide into the environment—whether intentionally or accidentally—consider the following:

- Are there sensitive areas at the pesticide use site that might be harmed by the pesticide?
- Are there sensitive offsite areas adjacent to the use site that might be harmed by contact with the pesticide?
- Are there conditions that might cause the pesticide to move offsite?
- Do you need to make any changes in application procedures in order to reduce the risk of environmental contamination?

III. Sensitive Areas

Sensitive areas are sites containing living things that are easily injured or contaminated by a pesticide. In Arizona these areas specifically include hospitals, schools, and parks.
Sensitive areas outdoors include, but are not limited to:

- areas where groundwater is near the surface or easily accessed (e.g., open wells, dry wells, very sandy soils);
- areas near surface water;
- areas near the habitats of endangered species;
- areas near apiaries (honeybee sites), riparian zones, wildlife refuges, or parks; and
- areas near backyard gardens, food or feed crops, or other sensitive plantings.

At times pesticides must be applied to a sensitive area to control a pest. When this is necessary, extra precautions should be taken. Practical factors to consider are time of the application (e.g., early in the morning), approaches to reduce drift, and the use of an untreated buffer zone around sensitive areas to minimize contaminating the area.

Sensitive areas have buffer zones around them created to keep highly toxic pesticides at a safe distance. For details on Buffer Zones see Chapter 8.

A sensitive area may be near a site that is used for an application, mixing/loading, storage, disposal, or equipment washing. You, the applicator, must take precautions to avoid accidental contamination of the sensitive area. For example, a permanent site for mixing/loading or equipment washing should be equipped with a collection pad or tray to catch and contain leaks, spills, or equipment waste water.

Typical pesticide labeling statements that are found under precautionary statements that alert you to these concerns include:

- Remove all animals from building prior to treatment and keep animals out until spray has dried
- Do not use around home gardens, schools, recreational parks or playgrounds
- Do not use in or around residences

IV. Pesticide Movement

Pesticides that move offsite may cause environmental contamination. Pesticides move in three ways:

1. In the air, through wind, air currents or vapors;
2. In the water, through runoff or leaching; and
3. On or in objects such as soil, equipment, plants, or animals (including humans) that are moved offsite.

The four factors influencing drift are:

1. Droplet or particle size
2. Height and direction of release
3. Whether the pesticide tends to form vapors
4. Wind speed and direction

Air

Airborne movement of spray droplets, vapors, or dust particles offsite from the intended site is called drift. Drift can happen with both ground and aerial applications. How much drift depends on such factors as the wind direction, nozzle size, nozzle pressure, pesticide formulation, how the material is applied, the volume of use, prevailing weather conditions (temperature and humidity), along with the area treated. Aerial applications of persistent pesticides such as chlorinated hydrocarbons have resulted in severe residue problems on crops over a mile away.
To reduce drift, applicators should consider the likelihood of drift before applying any pesticide. You should: (1) know your surroundings; (2) use as coarse a spray as possible and still obtain good coverage and control in order to increase droplet size; (3) do not apply in windy conditions (over 15 mph); (4) choose an application method and formulation that is less likely to cause drift; (5) use drift control/drift reducing agents; (6) apply pesticides early in the morning, but not during morning inversions; (7) use solid cone or fan spray nozzles that produce larger droplets; and (8) know which way the wind or air is moving. In Arizona, urban and rural areas exist side by side, and drift reduction is mandatory. Sensitive areas with Pesticide Management Area (PMAs) containing buffer zones have been established to help reduce pesticide drift from agricultural crops to residential areas. The Department of Agriculture is responsible for establishing PMAs.

Vapors

Pesticide vapors move about easily in air. High volume esters and some low volume esters are extremely troublesome in diverse cropping systems and turf. Fumigant pesticides are intended to form a vapor when they are released. Persons using fumigants must take precautions to make sure the fumigant remains in a sealed container until it is released into a sealed application site. The labeling of volatile pesticides often includes warning statements that the pesticide handler should heed. Any time you release a volatile pesticide in an enclosed area, consider the hazards not only to yourself and to other workers, but also to people, animals, and plants that are in or near the release site or that may enter the area soon after the release.

Typical pesticide labeling statements that alert you to avoid drift, and thus vapors, include:

- Do not apply when weather conditions favor drift from areas treated
- Do not allow drift onto plants intended for food or feed
- Drift from treated areas may be hazardous to aquatic organisms in neighboring areas

Water

Pesticide particles and liquids may be carried offsite in water. Pesticides can enter water through:

- drift, leaching, and runoff from nearby applications,
- spills, leaks, and back-siphoning from nearby mixing, loading, storage, rinsate, and equipment cleanup sites, and
- improper disposal of pesticides, rinsates, and containers

Runoff may occur when:

- too much liquid pesticide is applied, leaked, or spilled onto a surface, or
- too much rainwater, irrigation water, or other water gets onto a surface containing pesticide residue.

Runoff water in the outdoor environment may travel into drainage ditches, streams, ponds, or other surface water where the pesticides can be carried great distances offsite.

Typical pesticide labeling statements that alert you to these concerns include:

- Do not contaminate water through runoff, spills, or improper disposal of excess pesticide, spray mixtures, or rinsates
Do not allow runoff or spray to contaminate wells, irrigation ditches, or any body of water used for irrigation or domestic purposes

Do not apply directly to water and wetlands (swamps, bogs, marshes, and potholes)

Maintain a buffer zone (lay-off distance) of 100 feet from bodies of water

This product is water soluble and can move with surface runoff

V. Protecting Groundwater

Groundwater is water located beneath the earth’s surface. It is stored in the spaces between particles of sand, clay, and gravel below the root zone. It is also found in cracks and crevices in rock formations and large underground channels and caverns. Whether you must take special action to protect our groundwater depends mainly on the location of your use site. Groundwater contamination is of greatest concern in release sites where groundwater is close to the surface or where the soil type or the geology allows contaminants to reach groundwater easily (e.g., sandy soil, cracks in subsurface rocks). Surface water is just that: water found on the surface that can move several feet in a second or a minute. Groundwater may move only a few feet in a month or a year. An aquifer is a body of groundwater capable of providing significant quantities of water to a well or spring. Pesticide contamination of aquifers must be avoided, because these are your sources of drinking, washing, and irrigation water.

Sources of Groundwater

Groundwater is recharged (replaced) mostly from rain or snow that enters the soil. However, some water from lakes and streams and from irrigation also becomes groundwater. Water that is above the ground can move in three ways—it can evapo-
rate into the air; it can move across the surface, as in a stream or river; or it can percolate downward from the surface. Some of the water that moves downward is absorbed by plants and other organisms. A portion of the downward-moving water is held in the upper layers of the soil. The remaining water moves through the root zone and the relatively dry soil zone until it reaches a zone saturated with water. This saturated zone is the uppermost layer of groundwater and is called the water table. The water table is the dividing line between the groundwater and the unsaturated rock or soil above it.

By being aware of these considerations, you can considerably reduce the potential for groundwater contamination.

**Pesticide Contamination of Groundwater**

Water that is moving downward from the surface (leaching) containing pesticides may eventually reach the water table. There are several factors that determine whether a pesticide has the potential to reach groundwater:

- The practices (e.g., handling) followed by pesticide users
- The presence or absence of water on the surface of the site where the pesticides are released
- The physical or chemical characteristics (e.g., solubility) of the pesticides
- The type of soil (e.g., sand vs. loam or clay) at the site where the pesticides are released
- The distance from the surface to the water table and the type of geological formations through which the water must flow

**Practices for Pesticide Users**

The best way to keep from contaminating groundwater is to follow labeling directions exactly. Be sure to note whether the labeling requires you to take any special steps to protect groundwater. In addition, remember the following:

- **Never** use more pesticide than maximum label rates. Overdosing is illegal and potentially damaging to groundwater.
- Consider whether your application method presents any special environmental risks. For example, applying herbicides in a wash for bush control during the monsoon season may not be wise because of the potential contamination of groundwater.
- Take precautions to keep pesticides from back-siphoning into your water source. Locate pesticide storage facilities at least 100 feet from wells, floodplains, sinkholes, and other sites that directly link to groundwater. This prevents groundwater contamination from runoff or fire-fighting water.
• Whenever possible, locate mixing-loading sites and equipment-cleaning sites at least 100 feet from surface water or from direct links to groundwater. This will help prevent accidental back-siphoning, runoff, and spills from contaminating the water sources. If you must locate one of these work sites near a water source, use containment methods such as dikes, sump pits, and concrete pads to keep pesticides from reaching the water.

• Do not contaminate groundwater through improper disposal of unused pesticides, pesticide containers, or equipment and container rinse water. Dispose of all pesticide wastes in accordance with county and state regulations.

Water on the Treated Surface

If there is more water on the soil surface than the soil can hold, the water, along with any soluble chemicals it contains, is likely to run off or move downward to the groundwater. Prolonged heavy rain or excessive irrigation will produce excess water on the soil surface.

Rain

If weather forecasts or your own knowledge of local weather signs cause you to expect heavy rain, you may wish to delay outdoor handling operations—including mixing, loading, application, and disposal—to prevent wash-off, surface runoff, or leaching.

Irrigation

Pesticide movement into groundwater is affected by both the amount of water used in irrigation and how soon before or after a pesticide application the irrigation is done.

Pesticide Factors

Some pesticides are more likely than others to move to groundwater. Such movement depends mainly on:

- **solubility**—some pesticides dissolve easily in water and are more likely to move into water systems
- **adsorption**—some pesticides become tightly attached (strongly adsorbed) to soil particles and are not likely to move out of the soil and into water systems
- **persistence**—some pesticides break down slowly and remain in the environment for a long time

The above factors are interrelated. Pesticides most likely to move into groundwater are usually:

- highly soluble
- moderately to highly persistent
- not strongly adsorbed or held by the soil

Most nonpersistent pesticides are less likely to move to groundwater, even if they are highly soluble or not strongly adsorbed to soil. A pesticide that is strongly adsorbed or held to soil is less likely to move to groundwater even if it is persistent.

The pesticide label usually does not tell you about these properties of the pesticide product. Cooperative Extension, the National Resource Conservation Service (NRCS), the Department of Agriculture, product manufacturers, your local pesticide dealer, or the Material Safety Data Sheet (MSDS) may have specific information about the chemical properties of the pesticides you are using.

Soil Factors

Soil is also an important factor in the breakdown and movement of pesticides. Local soil maps can
be helpful in determining the types of soil in your area. The three major soil characteristics that affect pesticides are texture, permeability, and organic matter.

**Soil texture** is an indication of the relative proportions of sand, silt, and clay in the soil. Coarse, sandy soils generally allow water to move rapidly downward. Finer textured soils generally allow water to move downward at a much slower rate. Fine soils contain more clay, and sometimes organic matter, to which pesticides may attach.

**Soil permeability** is a general measure of how fast water can move downward in a particular soil. The more permeable the soil, the faster the chemicals will move. Permeable soils must be managed carefully in order to keep pesticides from reaching groundwater.

**Soil organic matter** influences how much water the soil can hold or bind before it begins to move downward. Soil containing high organic matter has greater capacity to stop the movement of pesticides. Soils in which plants are growing are more likely to prevent pesticide movement than dry bare soils. Arizona soils in general have very low organic matter.

**Geology**

The distance from the soil surface to the water table is the measure of how deep the groundwater is in a given location. If the groundwater is close to the soil surface (e.g., Yuma), pesticides are more likely to reach it. The depth to the water table does not stay the same throughout the year, but varies according to:

- whether the ground is frozen, and
- how much groundwater is withdrawn by pumping.

Spring runoff, summer monsoons, and heavy winter rain events are generally the times when the water table is closest to the soil surface. The water table often drops during the summer when evaporation and plant uptake are high and large amounts of groundwater are used for irrigation and other hot weather needs.

The permeability of the layers between the soil and groundwater is also important. If surface water moves downward quickly, pesticides are more likely to leach into groundwater. Gravel deposits are highly permeable, allowing water and pesticides to move downward to groundwater. Regions with limestone deposits are particularly susceptible to contamination because water moves rapidly to the groundwater through caverns or rivers with little or no filtration or chemical breakdown. On the other hand, layers of clay can slow or prevent water and pesticides from reaching the groundwater.

Sinkholes and dry wells are especially troublesome. Surface water often flows into these openings and disappears almost directly into the groundwater. If a pesticide is released into an area that drains into a sinkhole or an abandoned well, even a moderate rain may carry some of the pesticide directly to the groundwater.
The Certified Applicator’s Role

Groundwater concerns have resulted in the restriction and uses of some pesticides. As a certified applicator, you have a special responsibility to handle all pesticides safely in and near sites where groundwater contamination is particularly likely. Take extra precautions when using techniques that are known to cause contamination of groundwater.

When a pesticide product has been found in groundwater, or has characteristics that may pose a threat to groundwater, the pesticide product labeling may contain statements to alert you to the concern. Typical pesticide labeling statements include:

This chemical has been identified in limited groundwater sampling and there is the possibility that it can leach through the soil to groundwater, especially where soils are coarse or sandy and groundwater is near the surface

On or in Objects, Plants, or Animals

Pesticides can move away from the release site when they are on or in objects or organisms that move (or are moved) offsite. Pesticides may stick to shoes or clothing, to animal fur, or to blowing dust and be transferred to other surfaces. When pesticide handlers bring home contaminated personal protective equipment, work clothing, or other items, residues can rub off on carpeting, furniture, and laundry items, as well as onto pets and people.

Pesticides may stick to treated surfaces, such as food or feed products that are to be sold. To protect consumers, there are legal limits (tolerances) for how much pesticide residue may remain on crops or animal products that are sold for food or feed. It is illegal to sell products that exceed these tolerances. Pesticides that are applied to crops and animal products should not be above tolerance levels if the pesticides are applied as directed on the product label.

Illegal pesticide residues usually result when:

- too much pesticide is applied to the crop or animal
- the days-to-harvest, days-to-grazing, or days-to-slaughter directions on the pesticide labeling are not obeyed
- pesticides move out of the release site and contaminate plants or animals nearby

VI. Protecting Endangered Species

An endangered species is a plant or animal in danger of becoming extinct. There are two classifications of these plants and animals: endangered species and threatened species. Scientists believe that some pesticides may threaten the survival of some of America’s endangered species if they are used where these plants and animals still exist.

A federal law, the Endangered Species Act, was aimed at preserving numerous endangered plants

![Figure 4.3 EPA Endangered Species Resource](image-url)
and animals. The law restricts pesticide use in areas where pesticides may jeopardize the continued existence of endangered species. The Environmental Protection Agency’s objective is to remove or reduce the threat that pesticide use poses to endangered species. In order to reach the objective, EPA has put limitations on some pesticide-use patterns. Most limitations apply only to currently occupied habitat or range of each endangered species at risk. Some limitations apply where endangered species are being reintroduced into a habitat they previously occupied. Habitats, sometimes called critical habitats, are the areas of land, water, and air space an endangered species needs for survival. Such areas include breeding sites; sources of food, cover, and shelter; and surrounding territory that gives room for normal population growth and behavior.

**Limitations on Pesticide Use**

Read all pesticide labeling carefully to find out whether the use of that product requires you to take special steps to protect endangered species. The label will direct you to another source for the details about what you must do. When limitations do apply, they usually will be in effect only in specific geographic locations. Use of a particular pesticide is usually limited in a particular location when:

- the site is designated as the current habitat of an endangered species, and
- the endangered species at that site might be harmed by the use of the pesticide within (or close to) its habitat

**Habitats of Endangered Species**

The U.S. Fish & Wildlife Service is responsible for identifying the current habitat or range of each endangered species. For aquatic species, the restricted habitat often will include additional zones around the body of water to keep drift, runoff, or leachate from reaching the water sources. The U.S. Fish and Wildlife Service is identifying the habitats so that pesticide use will be limited only in locations where it is absolutely necessary. For this reason, limitations on pesticide use may apply to one property, while a similar adjoining property may not have these limitations.

**Importance of Protecting Endangered Species**

Hundreds of animals (including fish, birds, mammals, reptiles, amphibians, insects, and aquatic invertebrates) and thousands of plants have been listed as endangered or threatened species under the provisions of the Endangered Species Act. Some of these animals and plants are ones that everyone knows about, such as the bald eagle. Others are tiny, little-known creatures that may rarely be seen by anyone except trained naturalists.

Regardless of the size or apparent significance of these endangered species, it is important that each be allowed to survive. Mankind’s well-being depends on maintaining biological diversity. Biological diversity is the variety and differences among living things and the complex ways they interact.

Diversity is necessary for several reasons listed below:

**Agriculture**

Nearly all of today’s crops started as wild species. Genes from wild species often are used to create new hybrids that have resistance to plant diseases and insects, better climatic tolerance, and higher yields. Having different varieties available is necessary insurance against devastating crop failures caused by climate extremes or major pest outbreaks.
Medicine

Many of today’s most important medicines come from obscure plant and animal species. A mold is the source of the miracle drug penicillin; tree bark is the source of quinine, a cure for malaria. Scientists are testing countless plant and animal species around the world for sources of cures for major diseases.

Preserving Choices

No one can predict which species may be essential to the future of our species. A species that is allowed to become extinct might have been the key to stopping a global epidemic or to surviving a major climate change.

Interdependence

The extinction of a single species can set off a chain reaction of harm to other species. The disappearance of a single kind of plant from an area, for example, may lead to the disappearance of other plants, certain insects, and higher animals.

Natural Balance

Extinction has always been a natural part of an ever-changing process. During most of history, species have formed at a rate greater than the rate of extinctions. Now, however, human activity is greatly speeding up the rate of extinctions. People, plants, and animals live together in a delicate balance. The disappearance of species could easily upset that balance.

Stability

The more diversity that exists in an ecosystem, the more stable it is likely to be. There is less likelihood of huge swings in populations of particular organisms. There is also less likelihood of dev-

The Certified Applicator’s Role

Pesticides have the potential to harm living organisms, including endangered species:

- Pesticides can kill endangered plants and animals directly
- Pesticide residues in the habitat of the endangered organisms can disrupt or destroy their sources of food and shelter
- Pesticide application, drift, runoff, and leachate can contaminate water ingested by or inhabited by endangered organisms
- Some pesticides can build up to dangerous levels in endangered predators that feed on plants or animals exposed to pesticides

As a certified applicator, you have a clearly defined legal responsibility to protect endangered species against the hazards posed by pesticides. Careful use of pesticides in and around the key habitat areas will help these limited number of plants and animals to survive.

Typical pesticide labeling statements that alert you to concerns about endangered species include:

Under the Endangered Species Act, it is a federal offence to use any pesticide in a manner that results in the death of a member of an endangered species. Prior to making applications, the user must determine that the endangered species are not located in or immediately adjacent to the site to be treated. If the users are in doubt whether or not endangered species may be affected, they should contact the regional U.S. Fish and Wildlife Service Office (Endangered Species Specialist) or personnel of the State Fish and Game Office. Be advised that county endangered species maps are available from the County Extension Office.
VII. Harmful Effects on Nontarget Plants and Animals

Nontarget organisms may be harmed by pesticides in two ways:

1. The pesticide may harm the nontarget organism by immediate direct contact, or

2. The pesticide may leave a residue that causes delayed direct exposure and harm.

Harmful Effects from Direct Contact

Pesticides may harm nontarget organisms that are present during a pesticide application. Poorly timed applications can kill bees and other pollinators, or other wildlife that are active in or near the target site. Even tiny amounts of some pesticides may harm them or destroy their source of food.

Pesticides applied over large areas—such as in mosquito or biting fly areas—must be chosen with great care to avoid poisoning nontarget plants and animals. Read the warnings and directions on the pesticide labeling carefully to avoid harming nontarget organisms during a pesticide application.

Drift from the target site may injure wildlife, livestock, pets, sensitive plants, and people. For example, drift of herbicides can damage sensitive nearby plants, including crops, vegetable gardens, or ornamental plantings. Drift also can kill beneficial parasites and predators that are near the target site.

Pesticide runoff may harm fish and other aquatic animals and plants in ponds, streams, and lakes. Aquatic life also can be harmed by careless tank filling or draining, and by rinsing or discarding used containers.

Typical pesticide labeling statements that alert you to these concerns include:

Phytotoxic. Do not spray on plants

Extremely toxic to aquatic organisms. Do not contaminate water during cleaning of equipment or disposal of wastes

Harmful Effects from Residues

A residue is the part of a pesticide that remains in the environment for a period of time following the application. Pesticides break down after they are released into an environment. The breakdown time ranges from less than a day to several years. The rate of pesticide breakdown depends mostly on the chemical structure of the pesticide active ingredient. The rate of pesticide breakdown may also be affected by environmental conditions at the release site, such as:

- surface soil type, and soil pH
- surface moisture
- presence of soil microorganisms
- temperature
- exposure to direct sunlight
- pesticide chemical composition

Persistent pesticides leave residues that stay in the environment without breaking down for long periods of time, usually over a year’s time. These pesticides are sometimes desirable because they provide long-term pest control and may reduce the need for repeated applications (e.g., termiticides). However, some persistent pesticides that are applied to or spilled on soil, plants, lumber, and other surfaces, or into water, can later cause harm to sensitive plants or animals, including humans, that come into contact with them.

Labeling that indicates a particular pesticide product is likely to be persistent includes:

This product can remain phytotoxic for a year or more
When using persistent pesticides, consider whether their continued presence in the environment is likely to harm plants and animals.

When pesticides build up or accumulate in the bodies of animals moving up the food chain, this is called biomagnification or bioaccumulation. When the same mixing/loading site or equipment cleaning site is used frequently without taking steps to limit and clean up spills, pesticides are likely to accumulate in the soil, plants, and animals; objects that come into contact with the soil may be harmed. When pesticides accumulate in the soil, there is also a higher likelihood that the pesticides will move offsite and contaminate the surrounding environment including surface or groundwater.

Sometimes animals can be harmed when they feed on plants or animals that have pesticide residues on or in them. There is special concern for predator birds or mammals that feed on animals that have been killed by pesticides. The predators may be harmed by the pesticide residues remaining on or in the bodies of the dead animals.

Typical pesticide labeling statements that alert you to these concerns include:

**Toxic to fish, birds, and wildlife. This product can pose a secondary hazard to birds of prey and mammals; or**

**Bury or otherwise dispose of dead animals to prevent poisoning of other wildlife.**

**Harmful Effects on Surfaces**

Sometimes surfaces are harmed by pesticides or pesticide residues. Some surfaces may become discolored by contact with certain pesticides. Other surfaces may be pitted or marked by contact with some pesticides. Some pesticides can corrode or obstruct electronic systems or metal. Sometimes a pesticide will leave a visible deposit on the treated surface.

Typical pesticide labeling statements that alert you to these concerns include:

**Do not spray on plastic, painted, or varnished surfaces;**

**Do not spray directly into any electronic equipment or into outlets or switches, or any other location where the pesticide may foul or short-circuit contacts and circuits; or**

**A visible deposit may appear on some dark surfaces.**
Chapter Four
Pesticides and the Environment — Question and Answer Review

1. Q. What is the environment?

   A. Environment is everything that surrounds us indoors and outdoors including natural elements, manmade objects, people, and other living organisms.

2. Q. Explain what is meant by point source and nonpoint source contamination of the environment by pesticides, and give an example of each.

   A. Point source pollution comes from a specific, identifiable place or point. A pesticide spill that moves into a storm sewer is an example of point source pollution. Nonpoint source pollution comes from a wide area. The movement of pesticides into streams after broadcast applications is an example of nonpoint source pollution.

3. Q. Name four ways that careless pesticide handling could lead to point source pollution.

   A. 1. Mismanagement of wash water and spills produced at equipment cleanup sites.
   2. Improper disposal of containers, water from rinsing containers, and excess pesticides.
   3. Failure to correctly clean up leaks and spills at pesticide storage sites.
   4. Spilling pesticides while mixing concentrates or loading pesticides into application equipment.

4. Q. What environmental factors should you consider any time you accidentally or intentionally release a pesticide into an environment?

   A. 1. Whether there are sensitive areas in the environment at the pesticide use site that might be harmed by contact with the pesticide.
   2. Whether there are sensitive offsite areas near the use site that might harmed by contact with the pesticide.
   3. Whether there are conditions in the immediate environment that might cause the pesticide to move offsite.
   4. Whether you can change any factors in your pesticide application or use site to reduce the risk of environmental contamination.

5. Q. What is a sensitive area? Give four examples of sensitive areas that you must be especially careful to protect when you are handling pesticides.

   A. Sensitive areas are sites or living things in environments that are easily injured by a pesticide. Some examples of sensitive areas are places where pesticides might get into groundwater or surface water; homes, schools, playgrounds, hospitals, and other places where people are present; places
where there are animals—endangered species, bees, other wildlife, livestock, pets; places where crops, ornamental plants, or other sensitive plants are growing; and areas where food or feed is processed, stored, or served.

6. Q. List three routes by which pesticides can move offsite.

A. 1. In air, through wind or through air currents generated by ventilation systems.
   2. In water, through runoff or leaching.
   3. On or in objects, plants, or animals (including humans) that move or are moved offsite.

7. Q. What four factors influence whether a pesticide will move offsite in the air?

A. 1. Droplet or particle size.
   2. Height and direction of release.
   3. Whether the pesticide tends to form vapors.
   4. Wind speed.

8. Q. Name two circumstances that might cause a pesticide to move offsite in water.

A. 1. Too much liquid pesticide is applied, leaked, or spilled onto a surface.
   2. Too much rainwater, irrigation water, or wash water gets onto a surface that contains pesticide residue.

9. Q. Give some examples of ways that pesticides can move offsite on or in objects, plants, or animals.

A. Pesticides may be carried offsite if they stick to such things as shoes or clothing, animal fur, blowing dust or water—anything that moves from the use site to another location. Pesticide residues may remain on treated surfaces, such as food or feed products, when they are taken from the use site to be sold.

10. Q. In addition to direct contact with the pesticide during application or through drift or runoff, how else may nontarget plants and animals be harmed by a pesticide?

A. Nontarget plants and animals may be harmed by the pesticide residues that stay in the environment for a period of time after the release. These can be residues that remain in soil or on surfaces, or they may be residues that build up in the bodies of animals, harming those animals themselves and sometimes other animals that feed on them.

11. Q. What kinds of damage can some pesticides cause to surfaces?

A. Surfaces may become discolored, pitted or marked, corroded or obstructed, or be left with a visible deposit.
12. Q. Which pesticide handling activities pose a threat to groundwater or endangered species?

A. All handling activities may pose a threat, including mixing, loading, applying, equipment cleaning, storage, transportation, disposal, and spill cleanup.

13. Q. Why is the location of your pesticide use site the main factor that determines whether you must take special action to protect endangered species or groundwater?

A. Special limitations on pesticide use are usually in effect only in locations where endangered species live or are being introduced and in areas where groundwater is especially likely to be contaminated.

14. Q. How will you know if you must take special action to protect endangered species or groundwater?

A. The pesticide labeling will tell you if special measures are necessary, but may not contain the detailed instructions that you must follow. The labeling may instruct you to get these from another source.

15. Q. What are some factors that determine whether pesticides will reach groundwater?

A. The factors include: practices followed by pesticide users; presence or absence of water on the surface of the site where the pesticides are released; chemical characteristics of the pesticides; type of soil at the pesticide release site; location of the groundwater; its distance from the surface and the type of geological formations above it.

16. Q. How can you help to prevent pesticides from reaching groundwater?

A. Avoid using more pesticide than the labeling directs; avoid application methods that present special risks; keep pesticides from back-siphoning into your water source; locate pesticide storage facilities at least 100 feet from wells, springs, sinkholes, and other sites that directly link to groundwater; locate mix-load sites and equipment-cleaning sites at least 100 feet from surface water or from direct links to groundwater or take precautions to protect those sites; dispose of unused pesticides, pesticide containers, and equipment and container rinse water correctly.

17. Q. Explain why the amount of water on the surface of the soil at the pesticide use site is an important factor in groundwater contamination.

A. If there is more water on the soil than the soil can hold, the water (along with any pesticides it contains) is likely to move downward to the groundwater more rapidly than in unsaturated soil.
18. Q. Explain how the solubility, adsorption, and persistence of a pesticide affect its ability to move into groundwater.

A. Solubility—Pesticides that dissolve easily in water are more likely to move into water systems.

Adsorption—Pesticides that become tightly attached (strongly adsorbed) to soil particles are not likely to move out of the soil and into water systems.

Persistence—Pesticides that do not break down quickly remain in the environment for a long time, and are more likely to move into groundwater.

19. Q. Define drift.

A. Drift is the movement of spray droplets, dust particles, or vapor aways from the application site.

20. Q. How do pesticides reach groundwater?

A. Pesticides applied correctly to a site may be moved downward with rain or irrigation water, reaching the water table below.

21. Q. Can pesticide pollution actually aid the pests you’re trying to control? How?

A. Yes. Pesticides can destroy the predators and parasite that naturally control pests.

22. Q. Name three factors that affect drift.

A. Particle size, nozzle design and orientation, pressure, temperature, humidity, evaporation, height of release, and air movement.

23. Q. What is a persistent pesticide?

A. Persistent pesticides may remain in the environment for long periods without breaking down.

24. Q. Briefly describe the hydrologic cycle.

A. Water falls to earth as precipitation. The precipitation runs off the surface to become surface water. Water also seeps through the soil to become groundwater. Water returns to the atmosphere through evaporation and transpiration. This is the hydrologic cycle.

25. Q. Name the three ways pesticides break down after application.

A. Pesticides break down through microbial degradation, chemical breakdown, and photodegradation (Ultraviolet light).
26. Q. Why do organophosphates often pose low environmental hazards?

A. Organophosphates degrade relatively quickly and thus remain in the environment for only a short period.

27. Q. Can persistent pesticides be relatively harmless to the environment?

A. Yes. Persistence is not always bad for the environment, although there have been cases when it was. Long lasting or persistent pesticides are important for long-term protection of structures from termites.