

Lesson A3–5

Determining How to Prevent Agricultural Pollution

Unit A. Agricultural Literacy

Problem Area 3. Identifying the Relationship Between Agriculture and the Environment

Lesson 5. Determining How to Prevent Agricultural Pollution

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VIII: Understand environmental service systems.

Benchmark: VIII-A: Understand pollution control measures to maintain a safe facility environment.

Performance Standard: 1. Identify types of pollution (e.g. ground, surface water, air, noise, radioactive contamination). 2. Describe environmental impact from industrial and non-industrial processes.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain how agriculture pollutes the environment.
2. Explain how soil conservation can reduce environmental pollution.
3. Describe the role of livestock production in polluting the environment and the methods used to prevent it.
4. Describe how pesticide damage to the environment can be prevented.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany this lesson:

Camp, William G. and Thomas B. Daugherty. *Managing Our Natural Resources*. Albany, New York: Delmar Publishers, 1994. (Textbook, Chapter 7)

Porter, Lynn, et al. *Environmental Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 23)

Other Resources. The following resources will be useful to students and teachers:

Applied Environmental Science. Alexandria, Virginia: National Council for Agricultural Education, 1996.

Arms, Karen. *Environmental Science*. Austin, Texas: Holt, Rinehart and Winston, Inc., 1996.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of Student Lab Sheet

Terms. The following terms are presented in this lesson (shown in bold italics):

Anaerobic
Contact chemical
Contour farming
Cover crops
Drift
Fungicides
Herbicides
Insecticides
Pesticide
Rodenticides
Strip cropping
Systemic chemical
Terraces

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Present the students with the following situation.

Your town has approved a zoning change from agricultural to residential for an area on the edge of town. A large hog farmer farms the land that borders to the south. She utilizes the manure to supplement fertilizer needs of this and other fields.

Assume the city council is having an open forum for citizens to discuss the issues involved. What is your stance? Should the area be rezoned? Should the hog farmer be restricted from utilizing manure?

Now assume the zoning change passes, so you decide to build. Two years later you learn that a small stream passing through the subdivision regularly smells and is overgrown with algae. You suspect the hog farm is polluting the stream. What do you do?

When the students have reached some conclusion, mention that agricultural pollution is a concern and describe the objectives for this lesson.

Summary of Content and Teaching Strategies

Objective 1: Explain how agriculture pollutes the environment.

Anticipated Problem: How does agriculture pollute the environment?

- I. Agriculture, more than most other industries, relies on the natural resources of the earth. With each action, potential for pollution exists.
 - A. Knowing the possible sources of pollution can help prevent agricultural pollution.
 1. The shipment of seed, food products, and machinery can transport disease organisms.
 2. Misuse of chemical pesticides and fertilizers can cause pollution.
 3. Excess water from irrigation, food processing plants, and fish production can damage lakes and streams.
 4. Preparing food products produces some wastes that must be disposed of properly.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 23 in Environmental Science and Technology or Chapter 7 in Managing Our Natural Resources are recommended.

Objective 2: Explain how soil conservation can reduce environmental pollution.

Anticipated Problem: How can soil conservation reduce pollution?

- II. Soil erosion is a source of pollution of water. As soil erodes, it flows into lakes, streams, and ponds. This causes a buildup of sediment and pollution.
 - A. Several factors influence the rate of erosion.
 1. Increased rainfall and increased average intensity of rainfall in an area increases soil erosion.
 2. The most easily eroded soil textures are silt. The soil textures most difficult to erode are sands.
 3. As soil organic matter increases, soil erosion decreases.
 4. As length and slope increases, the velocity of water increases, giving it more cutting power.
 5. Increasing soil cover with crop residues reduces soil erosion.
 - B. Management practices can affect soil erosion.
 1. Cropping systems should be used that include grasses and legumes because they hold soil in place better.
 2. Grass waterways can reduce the flow of water across the land.
 3. **Contour farming** around a slope allows furrows to act as terraces. This slows the velocity of water runoff.
 4. **Strip cropping** involves planting alternate strips of legumes and grasses, small grains, and row crops.
 5. **Terraces** retard the flow of water.
 6. **Cover crops** can be planted to keep soil in place through the winter.
 7. Trees and grass should be planted on areas too steep to cultivate.
 8. Tillage should be minimized so that crop residue is left on the ground to protect soil and preserve moisture.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 23 in Environmental Science and Technology or Chapter 7 in Managing Our Natural Resources are recommended.

Objective 3: Describe the role of livestock production in polluting the environment and the methods used to prevent it.

Anticipated Problem: How does livestock production pollute the environment, and how can it be prevented?

- III. Livestock manure affects air, soil, and water quality.
 - A. Air pollution is caused by the release of gases and odors.

1. Methane gas, ammonia, and noxious odors are prevalent in livestock manure. They are a natural source of air pollution.
 2. **Anaerobic** conditions (without oxygen) often cause the odors and gases to be produced and lead to a decrease in air quality.
- B. Soil pollution is caused when substances in manure are mixed with soil. Depending on the level of substances, soil can become less fertile or at the worst, unfertile.
1. Heavy metals in manure (zinc and copper) pollute soil.
 2. Excessive levels of nitrogen, phosphorus, and potassium contribute to soil pollution.
- C. Surface and groundwater pollution occurs when substances contained in manure are dissolved in water.
1. Harmful bacteria, like fecal coliform bacteria, can be passed into water.
 2. Nitrates from stored manure can leach through the soil and make the water supply dangerous for young children.
- IV. To properly manage animal waste systems, several objectives should be considered.
- A. Available nutrients in manure should be maximized.
 - B. Store, transport, and dispose of animal waste using appropriate methods. This reduces risks to human and animal health.
 - C. Prevent surface and groundwater contamination. Follow the manufacturer's recommended guidelines for chemical application, storage, and disposal.
 - D. Ensure no waste is directly spilled into streams, rivers, lakes, or reservoirs.
 - E. Manage toxic fumes, odor, dust, flies, and rodents.
 - F. Only apply the amount of manure the crop can realistically use.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 23 in Environmental Science and Technology or Chapter 7 in Managing Our Natural Resources are recommended.

Objective 4: Describe how pesticide damage to the environment can be prevented.

Anticipated Problem: How can pesticide damage to the environment be prevented?

- V. **Pesticides** are products used to control insects, weeds, and other pests.
- A. **Insecticides** are used in both livestock and crop production. They control insects.
 1. **Systemic chemicals** are those that are taken up by the plant as it grows.
 2. **Contact chemicals** are those that kill the target pests when they come in contact with the chemicals.
 - B. **Herbicides** are used to kill weeds that reduce crop yields.
 - C. **Rodenticides** protect stored grain and other products from damage by rodents.
 - D. **Fungicides** protect seed against growth of fungi that reduce germination.

VI. Risks of pesticide use vary.

- A. **Drift** is the off target movement of pesticide mist or droplets.
 - 1. Wildlife, nontarget crops, surface water, and groundwater are potentially at risk if drift occurs.
 - 2. Several factors affect the drift of pesticides.
 - a. Larger droplet sizes decrease the risk of drift.
 - b. Lower pressure settings help to reduce drift.
 - c. Wind speed and wind direction are important factors in drift.
 - d. Temperature and humidity affect drift.
- B. Following label directions reduces the risk of pollution by pesticide use.
- C. Careful management of irrigation systems can reduce pollution by pesticides.
 - 1. Producers should use enough moisture to encourage plant growth and pesticide absorption.
 - 2. Too much water can wash pesticides below the plant root zone and into the groundwater.
- D. Alternative methods of pest control can be implemented.
 - 1. Integrated pest management involves using practices to control pests that reduce the potential for chemical contamination.
 - 2. Selectively spraying parts of a field where problems exist, rather than spraying the entire field, will reduce the potential for pollution.

Many techniques can be used to help students master this objective. Students need text materials to help understand the environment and achieve mastery learning. Chapter 23 in Environmental Science and Technology or Chapter 7 in Managing Our Natural Resources are recommended.

Review/Summary. Focus the review and summary of the lesson around the student learning objectives. Call on students to explain the content associated with each objective. Questions at the ends of the chapters in the recommended textbooks may also be used in the review/summary.

Application. Application can involve the following student activity using the attached lab sheet:

Controlling Agricultural Pollution—LS: A3–5A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=e, 2=h, 3=i, 4=c, 5=a, 6=f, 7=d, 8=g, 9=b

Part Two: Completion

1=Increasing

2=Integrated pest management

3=silt

4=Minimum tillage

5=Grass waterways

6=nitrate

7=herbicides

Part Three: Essay

Crop producers should utilize best management practices that both control pollution and increase profit. Minimum tillage, integrated pest management, contour farming, crop rotation, and other practices can be successful.

Test

Lesson A3–5: Determining How to Prevent Agricultural Pollution

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|--------------------|----------------|-------------------|
| a. anaerobic | d. cover crops | g. strip cropping |
| b. contact | e. drift | h. systemic |
| c. contour farming | f. pesticide | i. terraces |

- _____ 1. Movement of chemical to a nontarget organism.
- _____ 2. A chemical taken up into the plant as it grows.
- _____ 3. Mounds shaped around a slope to slow water movement.
- _____ 4. Planting a crop around a slope.
- _____ 5. Occurring without oxygen.
- _____ 6. Substance used to control or kill an unwanted organism.
- _____ 7. Plants used to hold soil in place during the winter.
- _____ 8. Planting alternating passes of different crops.
- _____ 9. A chemical that is active when it is absorbed by the target pest.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. _____ droplet size helps to reduce drift of chemicals.
2. _____ refers to the use of multiple methods to control pests in crops.
3. The most easily eroded soil texture is _____.
4. _____ increases the amount of crop residue remaining on the soil surface.
5. _____ help to slow down the flow of water in problem areas in a field.

6. Stored manure can leach _____ into the groundwater.
7. _____ are used to kill weeds.

Part Three: Essay

Instructions. Use the space below to complete the following.

- A. Describe how crop producers can utilize management practices to reduce pollution.

Agricultural Practices for Reducing Groundwater Nitrate

- **Reduce amounts of nitrogen fertilizers applied at one time.**
- **Adjust fertilizer application based on soil/plant tests.**
- **Apply fertilizer on an as needed basis.**
- **Use slow-release fertilizers.**
- **Use chemical inhibitors.**
- **Avoid full fertilizer application for spring planting.**
- **Spray plants with mild solutions of urea.**
- **Use cropping systems that derive nitrogen from legumes.**
- **Capture and treat animal wastes.**

Best Management Practices for Manure Applications

- **Incorporate manure applications.**
- **Apply manure uniformly.**
- **Apply manure in accordance with crop requirements.**
- **Do not apply manure to shallow soils over fractured bedrock.**
- **Carefully manage fall manure applications on excessively drained soils.**
- **Store manure in properly located and constructed facilities during periods when land application is not suitable.**
- **Manage abandoned barnyards and feedlots.**
- **Control runoff from barnyards and feedlots.**
- **Do not surface apply manure to no-till crop land.**

Lab Sheet

Controlling Agricultural Pollution

This activity will allow you to demonstrate a knowledge of agricultural pollution.

Purpose:

1. Demonstrate a knowledge of best management practices.

Materials:

Lab trays/cake pans
Soil
Toothpicks (fence)
Grass clippings (crop residue/corn)
Twigs (trees)
Wood blocks (buildings)

Procedure:

1. Construct a model farm that is designed to reduce agricultural pollution.
2. Consider the following:
 - a. Livestock manure
 - b. Chemical use
 - c. Soil erosion
 - d. Groundwater quality
3. Answer the following question.

Question:

1. Explain your choices of management practices.