

Lesson C1–5

Understanding Soil Degradation

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area I. Using Basic Soil Science Principles

Lesson 5. Understanding Soil Degradation

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VII: Apply scientific principles to environmental services.

Benchmark: VII-B: Describe soil compositions and properties to demonstrate knowledge of soil science.

Performance Standard: 1. Describe soil geology. 2. Describe composition of soil. 3. Describe the biological properties of soil. 4. Identify the physical properties of soil. 5. Describe the chemical properties of soil. 6. Test soil samples to determine characteristics. 7. Explain classification of soil water. 8. Explain the relationship between soil classifications and land use.

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

1. Describe soil degradation.
2. Explain how construction can result in soil degradation.
3. Identify sources of contamination and explain how they result in soil degradation.
4. Explain soil erosion and how it results in soil degradation.
5. Identify other sources of soil degradation.

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

Porter, Lynn, et al. *Environmental Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 13)

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

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 1)

Illinois Master Gardener. University of Illinois at Urbana-Champaign, Cooperative Extension Service.

Plaster, Edward J. *Soil Science & Management*. Albany, New York: Delmar Publishers, 1997. (Textbook and Lab Manual, Chapter 18)

Sager, Robert J., et al. *Modern Earth Science*. Austin, Texas: Holt, Rinehart, and Winston, Inc., 1998. (Textbook, Chapters 13 & 16)

VAS U4052a, *Understanding Soils*. Urbana, Illinois: Vocational Agriculture Service.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

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

Accelerated erosion
Alkalization
Compaction
Construction
Contamination
Desertification
Natural erosion
Salinization
Soil degradation
Soil erosion

Interest Approach. Ask students what is meant by soil degradation. They may not be familiar with degradation. It may need some explanation or time to find its meaning. Once determined, allow students to offer suggestions for the meaning of soil degradation. Guide their discus-

sion to include all types of soil degradation, including nonagricultural sources. Help students see the ramifications of soil degradation from a human population standpoint. When discussion is complete, use the lesson objectives to lead into the specific lesson.

Summary of Content and Teaching Strategies

Objective 1: Describe soil degradation.

Anticipated Problem: What is soil degradation?

- I. **Soil degradation** is a lowering of the quality of soil or the loss of soil productivity. Soil degradation occurs because people do not understand soil and the consequences of certain of its uses. Minimizing soil degradation is important in maintaining a good environment. Soil degradation results from:
 - A. Construction
 - B. Contamination
 - C. Erosion

Use the definition above to discuss soil degradation. Ask students to identify activities that occur locally and may result in soil degradation. The discussion should include the three types listed above. Discuss the importance of minimizing soil degradation to the future of humans.

Objective 2: Explain how construction can result in soil degradation.

Anticipated Problem: How can construction result in soil degradation?

- I. Construction can result in soil degradation.
 - A. **Construction** is altering land by building:
 1. Roads
 2. Houses
 3. Offices
 4. Factories
 5. Other structures
 - B. Construction degrades the soil by replacing productive land with structures that prevent the production of plants or animals.
 - C. Construction degrades the soil when native grasses and trees are removed. This leaves the soil unprotected from erosion.
 - D. Large equipment may move topsoil around and cover it with subsoil.
 - E. Soil can be compacted when wet by heavy equipment.
 - F. Digging deep into the earth brings up subsoil and parent material. When it is spread on the surface, fertility is lowered.

Ask students to identify local construction projects that have removed land from production over the past five or ten years. Try to estimate how many acres of land were removed. Have students calculate how many bushels of corn, soybeans, or other locally grown crops could have been produced if the land remained in production. Emphasize that you are only looking at a small area. Consider how much construction is taking place in areas of larger populations. Use TM: C1–5A to discuss ways that construction contributes to soil degradation.

Objective 3: Identify sources of contamination and explain how they result in soil degradation.

Anticipated Problem: What are the sources of contamination and how do they result in soil degradation?

III. **Contamination** results when chemicals, oil, and other substances leak into the land.

- A. Some contaminants soak into the soil and destroy its ability to support plant growth.
- B. Other materials may pass through the soil and enter the ground water. This can contaminate water supplies.
- C. Land formerly used as dumps, mines, and factory sites may be rehabilitated. This involves removing contaminated soil and covering what remains with non-contaminated soil. This process is expensive.
- D. Soil may be contaminated by agricultural practices, such as:
 - 1. Use of too much fertilizer.
 - 2. Use of excess chemicals.
 - 3. Use of irrigation water containing salt.

Ask students what is meant by contamination. Ask them to identify ways they believe soil may become contaminated. Emphasize that contaminated soil can sometimes be rehabilitated, but that it is very expensive. Also, discuss that soil contamination may occur from both agricultural and non-agricultural sources. Discuss how contamination can reduce the productivity of the soil.

Objective 4: Explain soil erosion and how it results in soil degradation.

Anticipated Problem: What is soil erosion and how does it result in soil degradation?

IV. **Soil erosion** is the process by which soil is moved. When it is moved it may become pollution in water or air. Soil erosion results from:

- A. Natural causes. **Natural erosion** shapes the earth's landscape by rounding off mountains and filling in valleys which may form new, highly fertile areas. An example is the Mississippi Delta.
- B. Human actions. Human activity, such as construction and plowing may cause **accelerated erosion**, which removes topsoil at an excessive rate. In many places, soil is being lost faster than it is being formed. This will result in loss of soil fertility and productivity.

Define erosion for students using the above definition. Students should understand the difference between natural erosion and that caused by human activity. Students should realize that there is nothing that can be done about natural erosion. Also, some natural erosion can actually be beneficial. Explain how accelerated erosion reduces soil productivity.

Objective 5: Identify other sources of soil degradation.

Anticipated Problem: What are other sources of soil degradation?

- V. In addition to construction, contamination, and erosion, soil may suffer degradations from the following sources:
- A. Improper irrigation practices that result in salinization, alkalization and water logging. **Salinization** is an accumulation of soluble salts. **Alkalization** is an accumulation of exchangeable sodium. Both of these, as well as waterlogging, are harmful to plant growth.
 - B. Growing crops without replacing plant nutrients and soil organic matter. These soils are “mined” of nutrients. As fertility drops, soil organic matter is lost and soil structure deteriorates.
 - C. Pollution of soils with chemicals, industrial waste, human waste and improperly handled livestock waste. A large accumulation of heavy metals, salts or an acute accumulation of chemicals can render soil unproductive.
 - D. Overgrazing, deforestation and other practices that remove productive plant cover cause a condition called **desertification**. This problem is most common in low rainfall areas. Humus content and fertility drops. Surface soil is exposed and becomes subject to erosion.
 - E. **Compaction** is the packing of soil particles tightly together after years of tillage with heavy machinery. It can break down soil structure. Plant growth is reduced, organic matter drops, permeability is lost, and runoff increases.

A variety of teaching techniques can be used to help students master this objective. Use TM: C1–5B to discuss other sources of soil degradation. Students should identify sources of soil degradation that occur locally. Divide students into groups and have each group take one source of soil degradation. Have them develop solutions that might minimize the amount of soil degradation. When finished, students should share their findings with the remainder of the class. Use notes above, in addition to TM: C1–5B, to enhance discussion from students and record all solutions on a writing surface.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

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 activities. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=d, 2=a, 3=c, 4=e, 5=b, 6=f

Part Two: Completion

1. accelerated erosion
2. environment
3. lowers
4. alkalization
5. contamination

Part Three: Short Answer

1. Remove contaminated soil and cover the remaining soil with non-contaminated soil.
2. Soil fertility declines, organic matter is lost, and soil structure deteriorates.
3.
 - a. Construction—altering land by building roads, houses, etc.; removal of native grasses and trees; compacting soil.
 - b. Contamination—results when chemicals, oil, etc. leaks onto the land; kills plants, contaminates ground water.
 - c. Erosion—movement of soil by water and air.

Test

Lesson C1–5: Understanding Soil Degradation

Part One: Matching

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

- | | | |
|--------------------|---------------------|--------------------|
| a. compaction | c. soil degradation | e. contamination |
| b. natural erosion | d. salinization | f. desertification |

- _____ 1. An accumulation of soluble salts.
- _____ 2. Results after years of tillage with heavy machinery and often breaks down soil structure.
- _____ 3. The lowering of soil quality and productivity.
- _____ 4. The term used to describe the seeping of chemicals, oil, and other substances into land.
- _____ 5. Has caused the rounding off of mountains and filling in valleys without human activities interfering.
- _____ 6. A condition resulting from the removal of productive plant cover.

Part Two: Completion

Instructions. Complete the following statements.

- Human activities, such as construction and plowing, may cause _____, which removes topsoil at an excessive rate.
- Minimizing soil degradation is important in maintaining a good _____.
- Digging deep into the earth brings up subsoil and parent material, which, when spread on the surface, _____ the soil's fertility.
- _____ is an accumulation of exchangeable sodium in the soil, which is harmful to plant growth.
- The use of too much fertilizer or excess chemicals are examples of _____, a type of soil degradation.

Ways Construction Contributes to Soil Degradation

- 1. Native grasses and trees are removed leaving soil unprotected from erosion.**
- 2. Topsoil is covered with subsoil.**
- 3. Soil is compacted and mashed into deep ruts when it is wet.**
- 4. Digging deep into the earth brings up parent material and subsoil that is spread on the surface, lowering the fertility.**

Other Sources of Soil Degradation

- 1. Improper irrigation practices resulting in salinization, alkalization, and water logging.**
- 2. Growing crops without replacing plant nutrients and soil organic matter.**
- 3. Pollution of soils with chemicals, industrial waste, human waste, and improperly handled livestock waste.**
- 4. Overgrazing, deforestation, and other practices that remove productive plant cover.**
- 5. Compaction of soil after years of tillage with heavy machinery.**