

## Lesson C4–7

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# Using Soils and Growing Media

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**Unit C.** Basic Principles of Agricultural/Horticultural Science

**Problem Area 4.** Identifying Basic Principles of Plant Science

**Lesson 7.** Using Soils and Growing Media

### **New Mexico Content Standard:**

**Pathway Strand:** Plant Systems

**Standard: I:** Apply principles of anatomy and physiology to produce and manage plants in both a domesticated and natural environment.

**Benchmark: I-B:** Test appropriate materials or examine data to evaluate and manage soil/media nutrients.

**Performance Standard:** 1. Collect and test soil/media and/or plant tissue. 2. Interpret tests of soil/media and/or plant tissue. 3. Identify soil slope, structure and type. 4. Evaluate soil/media permeability and water-holding capacity. 5. Determine the chemical properties of soil/media. 6. Determine land use capability. 7. Determine the biological functions of microorganisms of soil/media.

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

1. Identify the components of soil and soilless media.
2. Describe the differences between soil-based and soilless media.
3. Identify the elements involved in the formation of soil.
4. Describe the process of soil sterilization.

**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 the lesson:

Reily, Edward H. and Carroll L. Shry. *Introductory Horticulture*. Albany, New York: Delmar Publishers, 1997. (Textbook, Chapter 4)

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2002. (Textbook and Activity Manual, Chapter 6)

**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 6)

Parker, Rick. *Introduction to Plant Science*. Albany, New York: Delmar Publishers, 2000. (Textbook, Chapter 5)

## 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):

Growing media  
Hydroponics  
Parent material  
Perlite  
Soil  
Soilless media  
Topography  
Vegetation  
Vermiculite  
Weathering

**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.

*Bring samples of various media to class. Display them to students and ask them if they have seen any of the media in use locally. What types of plants were being grown in the media? What was the condition of the plants? After a few minutes of discussion, move on to the lesson content.*

## Summary of Content and Teaching Strategies

**Objective I:** Identify the components of soil and soilless media.

**Anticipated Problem:** What types of growing media are available and what are their functions?

- I. **Growing media** provides a means by which plants anchor themselves and obtain nutrients.
  - A. Soil is the most common growing media.
    1. **Soil** is the outermost layer of the earth's crust that provides nutrients for plant growth.
    2. There are 16 essential elements for plant growth. Plants obtain 13 of these nutrients directly from the soil.
  - B. **Soilless media**—a substance in which plants are grown that contains no topsoil.
    1. **Vermiculite**—composed of heat-treated mica. Mica is a soft, chalk-like rock that aids in aeration and water holding capacity. This lightweight material is mined in the U.S. and Africa.
    2. **Perlite**—Volcanic rock that has been crushed and heated to 1800°F. Perlite is most often used as a substitute for sand and can be rather costly. Adding perlite to growing media increases its drainage and aeration.
    3. **Tree bark**—Before using tree bark as a growing media, it should first be composted. Some tree barks contain compounds that can be harmful to certain plants; by composting, this material is broken down.
    4. **Hydroponics**—Growing plants without the use of a solid growing media. Instead, a nutrient solution is used to provide the plant with needed nutrients. These nutrient solutions can be bought from supply stores, however, nutrients from fish wastes are a commonly used source of nutrients for hydroponically grown plants. In a hydroponics system, a means for anchoring and supporting the plants must be developed.

*A number of techniques are available to help students in understanding this objective. Use TM:C4–7A to help students become aware of the sixteen essential elements and their functions. Display TM:C4–7B and use it in illustrating the substances used in soilless media. The recommended resources also have a good deal of information. Assigned reading of the suggested textbook chapters will prove useful. Follow the*

reading with a class discussion of this objective's content. Use student responses to questions to determine any concepts that need to be covered again.

**Objective 2:** Describe the differences between soil-based and soilless media.

**Anticipated Problem:** How is soilless media different from soil and what are the advantages of each.

- II. When comparing soilless and soil media, it is important to understand that one is not always superior to the other. There are certain conditions in which one may be more advantageous than the other. The main difference between soil and soilless media is that soilless media contains no soil.
  - A. Disadvantages of soil media include:
    1. Soil can vary in structure and texture.
    2. Soil can be very costly to ship because of its weight.
    3. Soil must be mixed to compensate for lacking materials; soilless media can be purchased ready to use.
    4. Soil that is not sterilized contains weed seeds, insect eggs and disease organisms. Sterilizing soil involves both equipment and labor costs which add to the total cost.
  - B. Disadvantages of soilless media
    1. Soilless media can become very costly if it is the only growing media utilized.
    2. Soilless media may not be readily available from local sources.

*Display TM:C4–7C to illustrate the disadvantages of soil and soilless media. Conduct an analysis of local soils to gauge the amount of clay it contains. Follow this up with assigned reading of the suggested chapters in the recommended resources. Classroom discussion will also be helpful in identifying any concepts that need to be retaught.*

**Objective 3:** Identify the elements involved in the formation of soil.

**Anticipated Problem:** How is soil formed?

- III. All soil begins as solid rock. Through the processes of erosion and weathering, it is broken down into smaller pieces and eventually into soil. There are several factors that influence how soil is formed.
  - A. Factors affecting soil formation.
    1. **Parent Material**—the original materials from which soil is developed.
    2. **Time**—Time is an important in the soil forming process because it occurs over a long period. The longer the material has been exposed to weathering the more broken down it will be.

3. **Climate**—Climate is a factor in soil formation. Freezing and thawing, rainfall, and other factors influence the breakdown of rock. If plants cannot grow because of cold or hot temperatures, there will not be any organic matter added to the soil.
  4. **Vegetation**—the amount of plants growing in an area is important because it influences how much organic matter is added to the soil. Areas that have increased vegetation will have darker soil due to higher organic matter content.
  5. **Topography**—Topography refers to the slope or the characteristics of the land. The slope of the land will affect how much water will pass through certain areas of the soil and how much erosion of topsoil occurs.
- B. Processes of soil formation.
1. Heating and cooling of soil causes the soil to expand and contract. Heating and cooling are two types of weathering. **Weathering** is the breakdown of the original material by natural forces. Weathering can be physical or chemical.
    - a. Physical weathering includes wind, water, plant roots, ice, or gravity.
    - b. Chemical weathering is the breakdown of soil materials by chemical reactions between the rock and other elements in the environment.
  2. Forces of water and wind also aid in the soil formation process. Both factors cause rock to be worn away a little at a time. The force of water in streams, rivers, and oceans also cause rocks to hit one another and break into smaller pieces.

*A variety of tools are available to help students gain an understanding of this concept. Display TM:C4–7D to illustrate the factors that influence soil formation. The recommended resources will also be useful. Have the class read the suggested chapters in the textbooks. Use classroom discussion and student comments to determine if any areas require reteaching.*

**Objective 4:** Describe the process of soil sterilization.

**Anticipated Problem:** What are three methods of sterilizing soil?

- IV. Most growing media contains some soil. All growing media mixes containing soil should be sterilized before they are used. **Sterilization** of soil helps to kill off any harmful pests (bacteria or fungi) and weed seeds that may be found in the soil. Sterilization can be accomplished by several methods.
- A. **Steaming**—Heating of the soil to 180°F and steaming at this temperature for 30 minutes.
  - B. **Chemical**—the use of chemical sprays, fumigants, or dry formulations of pesticides to kill off harmful organisms that might be in the soil.
  - C. **Electrical**—This form involves the use an autoclave that is used on small amounts of soil. This method is very costly and only effective on small samples of soil.

*Display TM:C4–7E to the class. Use it to help reinforce an understanding of soil sterilization and the methods used to sterilize soil. Follow this up with assigned reading of the suggested chapters in the recommended resources. Use classroom discussion to identify any areas that require further emphasis.*

**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 end of each chapter 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.

**Evaluation.** Evaluation should focus on student achievement of the lesson objectives. Various techniques can be used, such as student performance on the application activities. The self-check section at the end of each chapter in the suggested references will be helpful. A sample written test is attached.

## **Answers to Sample Test:**

### ***Part One: Completion***

1. growing media
2. Hydroponics
3. tree bark
4. soil, nutrients
5. solid rock
6. weathering,

### ***Part Two: Short Answer***

1. Vermiculite, perlite, tree bark, hydroponics
2. To kill unwanted seeds, bacteria, insect eggs, and fungi that might be in the soil.
3. Parent material, time, climate, vegetation, and topography.



## Sixteen Essential Plant Nutrients

Nutrient	Influence/Function
<b><i>Non fertilizers</i></b>	
Carbon	Building block for carbohydrates, proteins, fats, nucleic acids
Hydrogen	Building block for carbohydrates, proteins, fats, nucleic acids
Oxygen	Building block for carbohydrates, proteins, fats, nucleic acids
<b><i>Primary macronutrients</i></b>	
Nitrogen	Produces stem and leaf growth; gives plants dark green color
Phosphorus	Stimulates root development and growth; aids in cell division; encourages flower bud formation; improves winter hardiness; helps plants to a vigorous and rapid start
Potassium	Increases plant vigor and disease resistance; aids in the transport of foods through the phloem; has key role in opening and closing stomata; thickens cell walls
<b><i>Secondary macronutrients</i></b>	
Calcium	Maintains strength of cell walls; promotes early root growth
Magnesium	Essential for chlorophyll and photosynthesis; activator for many plant enzymes
Sulfur	Stimulates root growth; needed for protein formation
<b><i>Micronutrients</i></b>	
Boron	Essential for pollination and reproduction
Copper	Regulates several chemical processes
Chlorine	Involved in photosynthesis
Iron	Important in chlorophyll formation
Manganese	Important in chlorophyll formation; part of enzymes involved in respiration and nitrogen metabolism
Molybdenum	Part of enzymes involved in nitrogen metabolism
Zinc	Important in chlorophyll formation; part of enzymes involved in respiration

# Types of Soilless Media

1. Vermiculite
2. Perlite
3. Tree Bark
4. Hydroponics

# **Disadvantage of Soil vs. Soilless Media**

## **Soil Disadvantages:**

- **Soil quality and structure can vary**
- **Soil is costly to transport because of weight**
- **Soil must be mixed to compensate for lacking materials**

## **Soilless Disadvantages:**

- **Can be costly if used as primary media**
- **May not be readily available from local sources**

# **Factors Affecting Soil Formation**

- 1. Parent Material**
- 2. Time**
- 3. Climate**
- 4. Vegetation**
- 5. Topography**

# **Sterilizing Soils**

**Soil Sterilization—Helps to kill any harmful pests and weed seeds carried in the soil**

## **Common Soil Sterilization Methods:**

- **Steaming—involves heating soil to 180°F**
- **Chemical—involves the use of sprays, fumigants, and dry formulations to kill harmful organisms**
- **Electrical—uses an autoclave and soil amounts of soil.**