UNIT II - PLANT SCIENCE

Lesson 3: The Growing Medium

Competency/Objective: Describe the importance of the growing medium to plants

Study Questions

1. **What is soil?**

2. **What are the components of soil?**

3. **What is a growing medium?**

4. **What is a soilless mix and where is it used?**

5. **What is hydroponics?**

References

1. *Exploring Agriculture in America* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2000, Unit II.

2. Transparency Masters

   TM 3.1 Components of Soil
   TM 3.2 Relative Sizes of Sand, Silt, and Clay
   TM 3.3 What Is in a Soilless Mix?
   TM 3.4 Aquarium Hydroponic System

3. Activity Sheets

   AS 3.1 Examining Soil
   AS 3.2 Water-Holding Capacity of Soil (Instructor)
   AS 3.3 Design Your Own Medium

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TEACHING PROCEDURES

A. ***Review***

The major parts of plants are essential to the growth and reproduction of the plant. The roots and stem absorb and transfer nutrients, the leaves are the primary site for photosynthesis, and the flower is the site of sexual reproduction. Many plants can also be reproduced by asexual (vegetative) methods using stems, leaves, and roots.

B. ***Motivation***

1. Obtain a soil profile(s) (monolith(s)-undisturbed sample in a frame) from the soil and water conservation district in your area and measure the depth of topsoil. Discuss other differences that can be seen.

2. Obtain samples of different colors of soil (light, dark, red, mottled, gray, etc.) and ask students why there is a variation in color. There are several explanations as follows. Color of soil can be a result of rainfall and vegetation. In general, more rainfall results in more vegetation. This increased organic matter coats the mineral particles of soil and gives it a dark color. Brighter subsoils (red and yellow) result from low-moisture levels. Dark subsoils (gray tones) result from poor air and water relationships as evident in water-logged soils.

3. What is the difference between soil and dirt? Discuss this question with students.

4. Ask students the ways soil is important to them.

C. ***Assignment***

D. ***Supervised Study***

E. ***Discussion***

Q1. <u>What is soil</u>?

A1.

a) Soil is the naturally occurring top layer of the earth=s surface that provides food, water, air, and support for plant life.

b) Soil is a natural resource that humans depend on for food, clothing, and materials for shelter.

c) Soil is composed of a great amount of life. Scientists agree there is more life below the surface of the earth than there is above it. The life-forms are earthworms, insects, bacteria, fungi, and many other microscopic organisms.

d) Soil is not dirt. Dirt is misplaced soil.

Prepare for AS 3.1 by obtaining some soil. Using a spade, obtain soil that includes the vegetation on top, the topsoil, and subsoil. Place the soil on shop or classroom tables and have students identify and list all items found in the soil. Depending on the time of year and weather conditions, this activity could be conducted outside at a field or other location near the school. In either case, the instructor will do the digging and provide the soil. When completing AS 3.1, the students must be encouraged to examine and sort

through the soil. This activity will lead into identifying the components of soil. The students will also identify items that cannot be seen (fungi, bacteria, etc.).

Q2. **<u>What are the components of soil</u>?**

A2.

The ideal soil contains the following components:

- **a) 45% mineral matter - inorganic (not from plants or animals) and varies in size**
  - **1) Sand - largest particles**
  - **2) Silt - medium-size particles**
  - **3) Clay - smallest particles**
- **b) 5% organic matter - originates from a living source, usually a plant or animal**
- **c) 25% water**
- **d) 25% air**

Use TM 3.1 to review components of soil and TM 3.2 to demonstrate relative sizes of mineral matter particles. Conduct AS 3.2 to illustrate the water-holding capacity of soil. Have students assist you as you conduct this activity. The instructor may want to organize this activity by groups. In this case, ensure that proper safety rules are followed.

Q3. **<u>What is a growing medium</u>?**

A3.

- **a) Growing medium (singular) or growing media (plural) are the materials in which the roots of plants grow.**
- **b) The growing medium supports, or anchors, the plant in place, even after watering.**
- **c) The growing medium must retain sufficient moisture, yet be porous enough to allow excess water to drain.**

Plants derive nutrients from a variety of growing media. Each plant has its own medium that supports its growing needs best.

Q4. **<u>What is a soilless mix and where is it used</u>?**

A4.

- **a) A soilless mix is a medium that contains no soil.**
- **b) Soilless mixes contain various combinations of the following materials.**
  - **1) Perlite - gray-white material of volcanic origin used to improve aeration**
  - **2) Vermiculite - heat-treated mica (a very thin, layered mineral) with a high moisture-holding capacity**
  - **3) Peat moss - partially decomposed vegetation with a high moisture-holding capacity**
  - **4) Tree bark - usually the bark of fir, pine, or cedar as a source of organic matter**
- **c) Almost all greenhouses and nurseries use a soilless medium to grow plants in flats, pots, and other containers.**

Use TM 3.3 to discuss the items found in a soilless mix. Put each of the items (perlite, vermiculite, peat moss, and tree bark) in a separate sealed plastic bag and pass them around the class during discussion.

Have students examine the contents of a soilless medium and identify each of the components listed on the label. Finally conduct AS 3.3 to have students design their own medium. Before conducting this activity, pasteurize the sand and soil by heating at 180° F for at least 30 minutes.

Q5. <u>What is hydroponics</u>?

A5.

a) Hydroponics is a method of growing plants in water (nutrient solution) rather than soil.
b) This technique is used to grow high-value crops in greenhouses, especially during the winter.
c) Some hydroponic systems use sand, gravel, rockwool, peatlite, or sawdust, rather than soil.
d) Bare root systems mist the roots of plants at regular intervals with a nutrient solution, use shallow pools with plants floating on the surface, or use recirculating streams of nutrient solutions.

Explain hydroponics to the students using TM 3.4 to illustrate.

F. ***Other Activities***

1. Invite an agronomist, horticulturist, soil conservationist, turf manager, etc., to speak to the class.

2. Take a field trip to a greenhouse to assist in mixing media and transplanting seedlings, and to observe a hydroponics system, etc.

3. Take a soil sample of the school lawn and have students analyze the soil using a soil testing kit. Kits can be obtained from companies such as NASCO, 1-800-558-9595. Optionally, the sample can be sent to a commercial lab for analysis and students can review the analysis.

4. Tour a golf course and have the superintendent discuss how the course was managed relative to the growing medium.

5. Grow plants hydroponically in an aquarium or at the school greenhouse.

6. Have students investigate the produce department at area grocery stores and report if vegetables have been grown hydroponically. Rather than ask produce workers, have students check for labels indicating the process was used. Optionally, this activity could be assigned for extra credit to have one student call an area store.

G. ***Conclusion***

The plant's underground environment is very important to its overall health. Nearly every product people use or consume can be traced back to the soil. The ideal soil is 45% mineral matter, 5% organic matter, 25% water, and 25% air. The growing medium is the material in which the roots of plants grow and is critical to the overall health of a plant. Today almost all greenhouses and nurseries use a soilless mix to grow plants in flats, pots, and containers. Hydroponics is a technique of growing plants in water (nutrient solution) rather than soil.

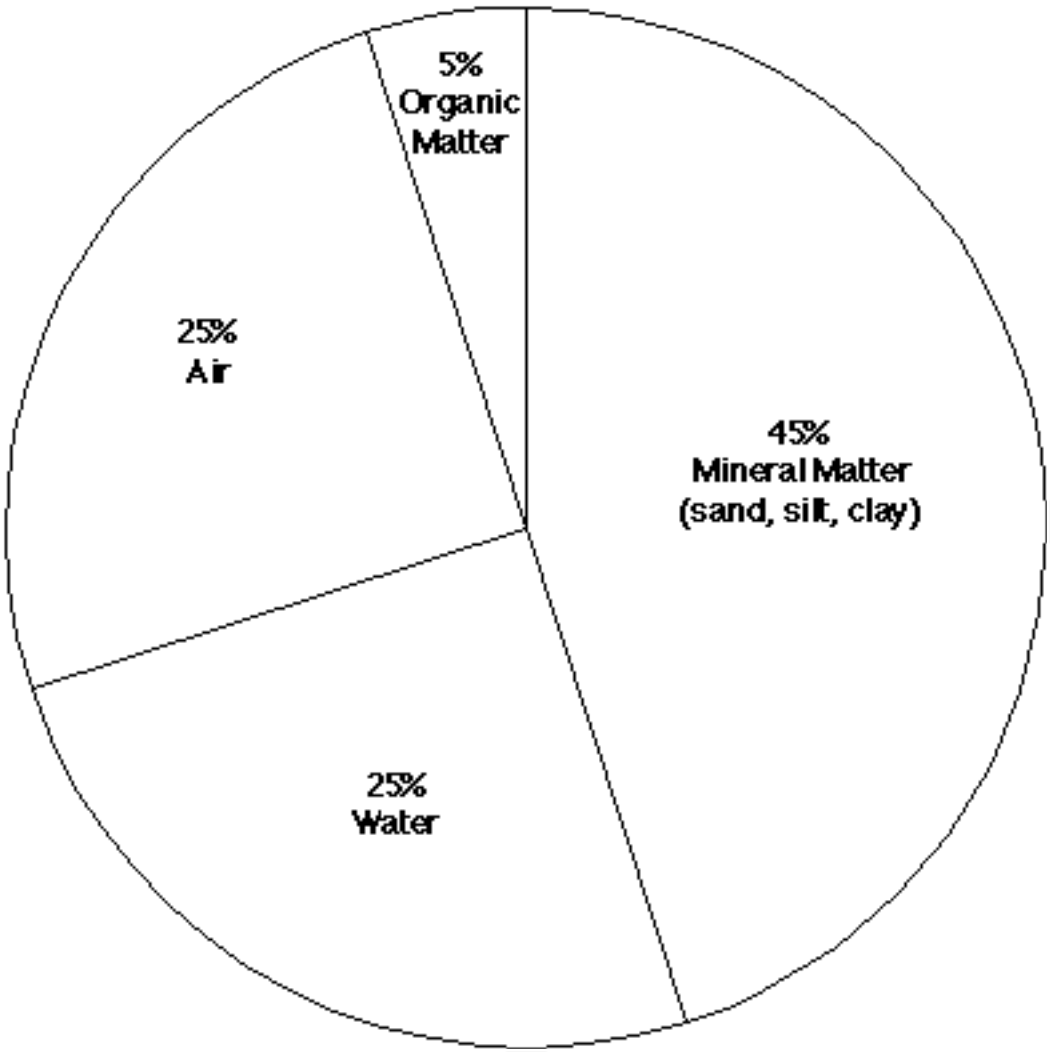
H. ***Answers to Activity Sheets***

The instructor should determine if the answers are appropriate.

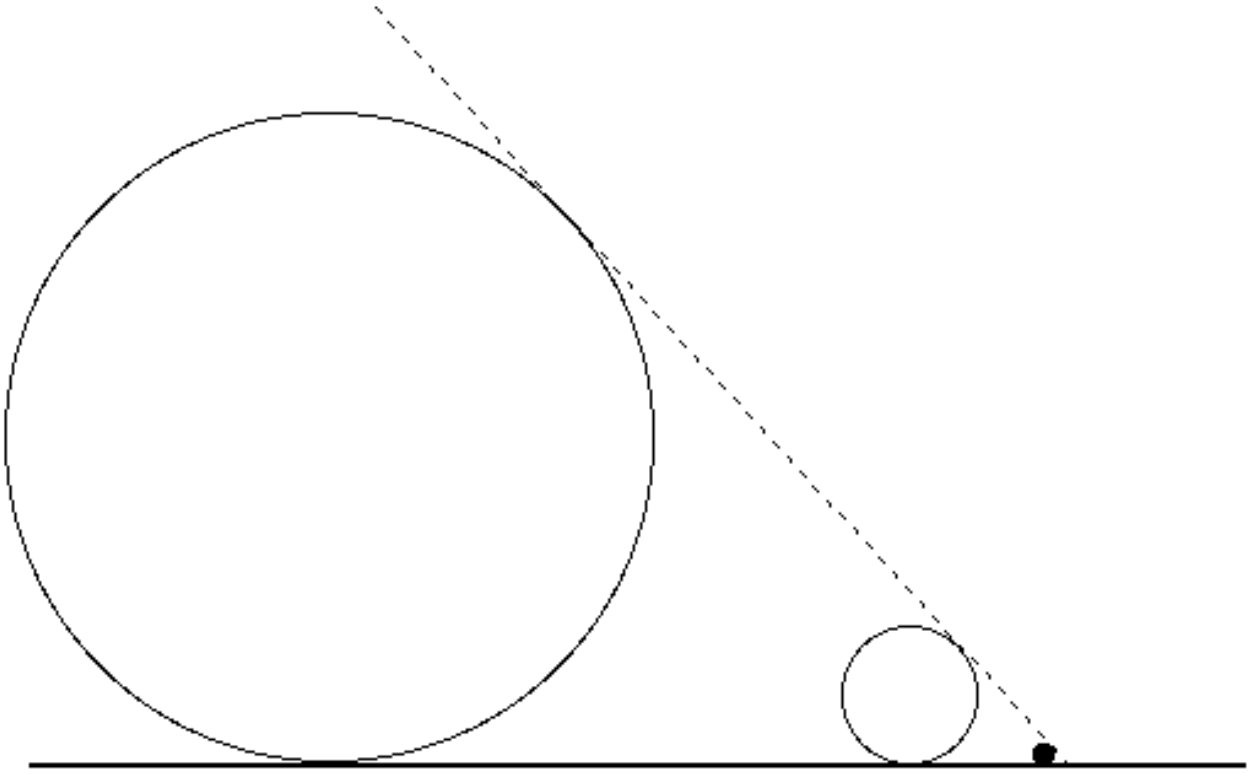
I. ***Evaluation***

A unit test is provided at the end of this unit. If a lesson quiz is needed, use questions pertaining to this lesson from the unit test.

Components of Soil



Relative Sizes of Sand, Silt, and Clay



What Is in a Soilless Mix?

Perlite

- **Gray-white material of volcanic origin**
- **Improves aeration**

Vermiculite

- **Heat-treated mica**
- **Improves moisture-holding capacity**

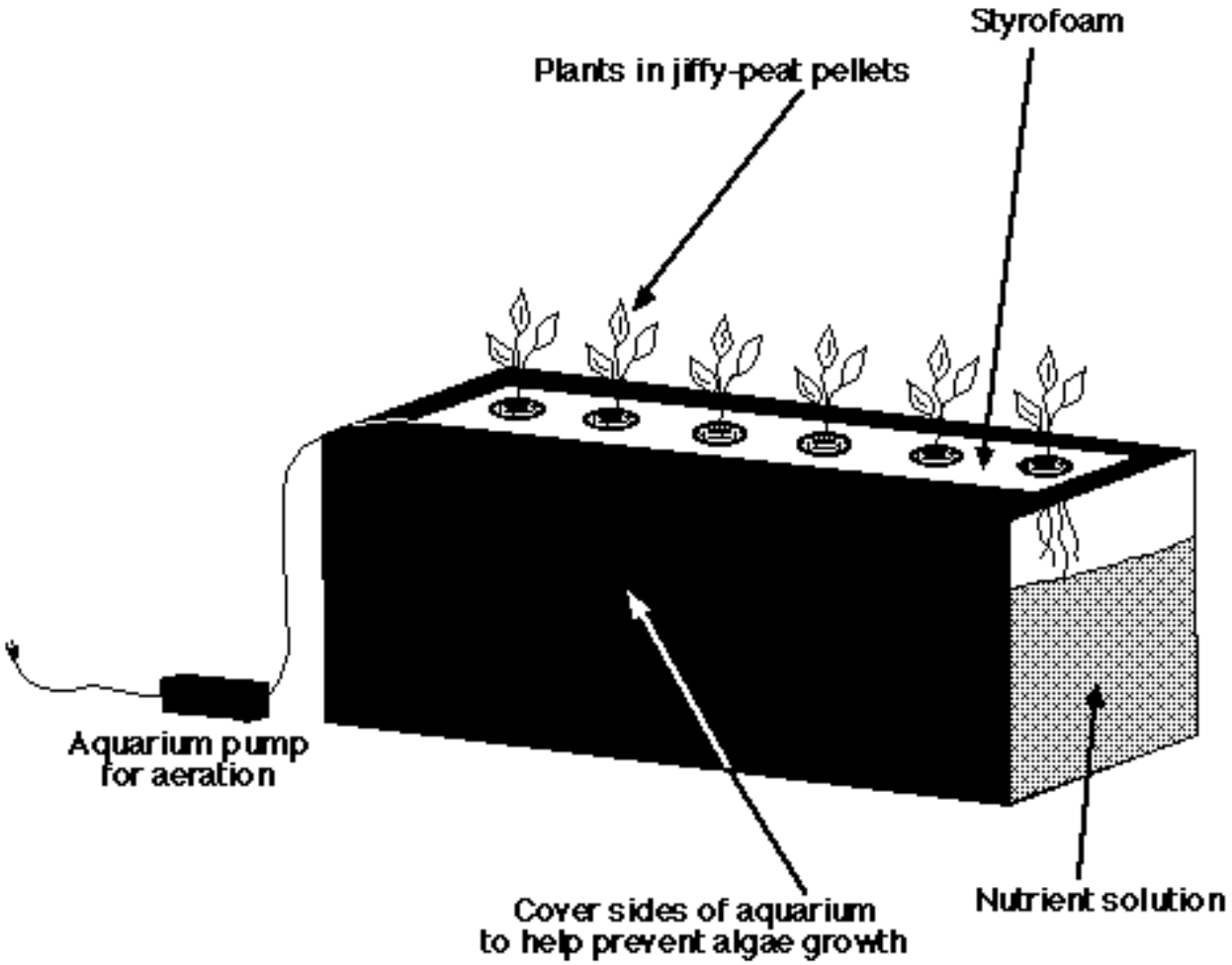
Peat Moss

- **Partially decomposed vegetation**
- **Improves moisture-holding capacity**

Tree Bark

- **¼" diameter or less pieces of fir, pine, or cedar bark**
- **Source of organic matter**

Aquarium Hydroponic System



Lesson 3: The Growing Medium Name_____

Examining Soil

Objective: Students will identify characteristics of soil.

Materials and Equipment:

Soil provided by instructor

Procedure:

1. Examine the soil and answer the following questions.

   a) What kinds of debris or plants are on the soil surface?

   b) What color is the soil near the surface?

   c) What color is the soil near the bottom?

   d) Are there rocks or other materials buried in the soil?

   e) Describe the texture of the soil when you run it between your fingers. Is it grainy or smooth?

   f) How does your soil sample differ from the samples collected by other groups?

2. Find items in the soil (e.g., sand, rocks, insects, roots, grass, clay) and provide a sample that represents each one.

3. What are other items in the soil that cannot be seen?

Water-Holding Capacity of Soil

Objective: Students will identify the water-holding capacity of soil.

Materials and Equipment:

Three 1-gallon containers (e.g., plastic milk containers)
Three soil samples with different particle sizes (sand, loam, and clay)
Measuring equipment to collect water (1/2 gallon)
Timer

Procedure:

1. With a nail and hammer, punch small holes in the caps of the 1-gallon containers. Cut a hole in the bottom of each container so soil and water can be added.

2. Select three students to assist. One student fills the first gallon container with sand, another student fills the second with loam, and the third student fills the last container with clay. Do not completely fill each container, but rather fill the container about ¾ full.

3. Have each student place the measuring equipment under his/her container to collect the water.

4. Each student then slowly pours ½ gallon of water into his/her container.

5. The entire class records the following observations in the table below.

SOIL	**AMOUNT OF WATER COLLECTED**				
	After 1 min.	After 2 min.	After 3 min.	After 4 min.	After 5 min.
Sand					
Loam					
Clay					

6. Students record their conclusions from this experiment.

Lesson 3: The Growing Medium Name_____

Design Your Own Medium

Objective: Students will design a medium for plants.

Materials and Equipment:

Seedlings or small plants started by you or supplied by the instructor
Cups/containers for measuring parts
Quart or ½ gallon container for medium
Flats or containers for mixing the ingredients
Perlite
Vermiculite
Peat moss
Pasteurized sand
Pasteurized soil

Procedure:

1. Select each ingredient you want for your medium.

2. Match the total amount of medium to your container size. For example, a medium for a quart container could consist of 1 cup (part) of peat moss, 1 cup of perlite, 1 cup of sand, ½ cup of vermiculite, and ½ cup of soil.

3. Measure each ingredient using cups or containers and record the information in the chart below.

INGREDIENT	WEIGHT OR PARTS

4. Mix and blend the ingredients so your medium is a uniform consistency.

5. Transplant the seedling or small plant into your container.

6. Pour your medium around the plant's root system and then fill the entire container.

7. Water the plant and check for dryness at regular intervals. Water when the medium is dry to the touch.