

Unit B: Establishing a Fruit Garden

Lesson 1: Recognize the Characteristics of Soils and the Soil Requirements for Fruit and Nut Crops

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

1. Explain how the resources soil provides help in supporting life.
2. Explain the contents of soil.
3. Describe the biological nature of soil.
4. Describe the four ways plants use soil.
5. Describe the soil requirements for fruit and nut crops.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed with use of this lesson plan
- Purdue University Cooperative Extension Service Horticulture Publications on apples and grapes http://www.hort.purdue.edu/ext/garden_pubs.html

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint slides
Transparency Masters
Copies of student lab sheets
Soil samples from the local area
Small shovels
Buckets
cups

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

Mineral matter	tilth
Organic matter	hygroscopic water
Pore spaces	soil aeration

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.

Obtain different samples of soil common to Afghanistan. Sit them out around the room and have students take turns going to each sample and writing down characteristics of the soil. Observe things like texture, color, organic matter, etc. Once the observations have been made, have the students sit down and tell their characteristics so the teacher can write them on the board.

**** Use this activity to lead into objective 1.**

Summary of Content and Teaching Strategies

Objective 1: Explain how the resources soil provides help in supporting life.

(PowerPoint Slide #3)

- I. Soil is a layer on the earth's crust that provides a combination of resources. These resources allow the growth of plants and animals. These resources include:

(PowerPoint Slide #4)

- A. Oxygen—needed for adequate root growth.
- B. Temperature—soil absorbs heat from the sun. It also loses heat to the atmosphere. This allows satisfactory temperatures for plant growth and seed germination.

(PowerPoint Slide #5)

- C. Water—utilized for growth of plants.
- D. Carbon—utilized in the form of organic matter in the soil.
- E. Nutrients—provided as minerals. They are broken down as nitrogen and recycled through decaying material in the soil.

****Quiz the class over the importance of soil for growing fruits and nuts. Call on students randomly to give you the answer. Focus your questions on the major resources in soil that help plants to grow.**

Objective 2: Explain the contents of soil.

(PowerPoint Slide #6)

- II. Soil is composed of four primary components. They are mineral matter, organic matter, air, and water. In addition, there are numerous living organisms in the soil, such as bacteria, insect larvae, earthworms, and fungi. Soils may vary from one area to another, but most will contain these basic components.

(PowerPoint Slide #7)

A. Solid portions (50% of soil volume) represent the space occupied by mineral and organic matter.

1. **Mineral matter**, which accounts for about 45% of the soil, is partially decomposed rock material. It is the sand, silt, and clay that is found in the soil. These vary in amount depending on the type of soil. The amounts of sand, silt, and clay also determine the soil's ability to hold water and provide nutrients.

(PowerPoint Slide #8)

2. **Organic matter**, which accounts for about 5% of the soil, is partially decomposed plant and animal matter. Most organic matter is from plant leaves, roots, and stems. Organic matter gives soil its dark color. Organic matter contributes to the soil's fertility as well as improved aeration and water holding capacity.

(PowerPoint Slide #9)

B. **Pore spaces** (50% of soil volume) represent the space occupied by air and water. There is a constant fluctuation in the amount of air and water found in the soil.

(PowerPoint Slide #10)

1. Air, which accounts for about 25% of the soil, is part of the pore space in the soil. When soils are wet the amount of air will be less. When soils are dry the amount of air will be more. There is a constant fluctuation in the amount of air and water found in the soil.
2. Water, which accounts for about 25% of the soil, is also part of the pore space in the soil. When it rains water will enter the soil or flow off of the soil's surface.

(PowerPoint Slide #11)

****This is a slide showing a chart of the components of soil. Ask the students to explain the information found on the PowerPoint Slide. Additional information from the Principles of Soils course can be used if it appears the students need additional information about soil.**

Objective 3: Describe the biological nature of soil.

(PowerPoint Slide #12)

III. Abundant life can be found in soil.

A. Forms of life in soil include:

1. Earthworms
2. Insects
3. Bacteria
4. Fungi
5. Other organisms

(PowerPoint Slide #13)

- B. Bacteria and fungi have an important role in the soil. They break down organic matter and release nutrients.
- C. Earthworms, ants, crawfish, moles, and other organisms improve the soil **tilth**, the ease at which soil can be worked. These organisms create

openings in the soil as they tunnel. This enhances drainage and improves air exchange.

****Give students a copy of LS: B 1-1 and have them complete the lab activity. The lab can be conducted in groups if there are not enough materials for each student.**

Objective 4: Describe the four ways plants use soil.

(PowerPoint Slide #14)

- IV. Plants depend on soil to provide four basic needs.
- A. Anchorage—soil acts to provide a firm support as roots grow throughout the soil.
 - B. Water—soil provides nearly all of the water used by plants. Water is absorbed through the plants' roots.

(PowerPoint Slide #15)

- C. Oxygen—nearly all living organisms need oxygen. Plants release oxygen during photosynthesis but consume oxygen during respiration. Plant parts above the ground have an ample supply of oxygen; however, those below the ground (roots) have less oxygen available. This increases the need for good **soil aeration**, the exchange of soil and atmospheric air in order to maintain adequate oxygen for plant roots.

(PowerPoint Slide #16)

- D. Nutrients—of the 16 nutrients considered to be essential for plant growth, 13 are obtained from the soil. Root hairs absorb the nutrients dissolved in soil water.

****Prior to the next objective make copies of TM: B 1-1 “Fruit Tree Soil Types” and pass out to the class. Use this sheet during discussion of Objective 5.**

Objective 5: Describe the soil requirements for fruit and nut crops.

(PowerPoint Slide #17)

- V. Not all fruit and nut trees require the same conditions for growth. For example, Blueberries might not grow well on soil that supports citrus trees.
- A. Tree fruits and nuts.

(PowerPoint Slide #18)

- 1. Apples
 - a. Successful orchard soils may range from sand to clay types.
 - b. Require plenty of humus to hold moisture
 - c. Avoid droughty soils and eroded soils with no distinct horizons between topsoil and subsoil.

(PowerPoint Slide #19)

- 2. Pears
 - a. Slightly acidic soils preferred

- b. more likely to withstand poor drainage, but are less able to tolerate dryness.
- c. The ideal soil is a deep; rich loam somewhere between light and heavy.

(PowerPoint Slide #20)

- 3. Pomegranates
 - a. The pomegranate does best in well-drained ordinary soil
 - b. also thrives on calcareous or acidic loam as well as rock strewn gravel.

(PowerPoint Slide #21)

- 4. Peaches
 - a. will grow well in a wide range of soil types
 - b. deep soil ranging in texture from a sandy loam to a sandy clay loam is preferred
 - c. Peach trees are extremely sensitive to poorly drained soils

(PowerPoint Slide #22)

- 5. Cherries
 - a. Like fertile soil so high organic matter would be good
 - b. Moist but well drained soil needed
 - c. Intolerant of compacted soil

(PowerPoint Slide #23)

- 6. Plums
 - a. Prefer a slightly acidic and well drained soil
 - b. Depending upon variety, plums can be grown on heavy soils or slightly loamy soils

(PowerPoint Slide #24)

- 7. Apricots
 - a. Prefer pH of 6.0-7.0
 - b. Need well-drained loam soils with a minimum depth of about 1.5 meters

(PowerPoint Slide #25)

- 8. Mulberries
 - a. prefer warm, well-drained, almost loamy soil.
 - b. somewhat drought resistant, but fruit will drop during dry weather

(PowerPoint Slide #26)

- 9. Almonds and other nut trees
 - a. Different nut trees require different soils and grow best in elevated, well-drained areas.
 - b. Most require light soils because they have very deep taproots that need to reach an adequate source of water.

(PowerPoint Slide #27)

- B. Small fruits
 - a. Grapes
 - a. Soil conditions favorable to root growth include good aeration, loose texture, moderate fertility, and good internal and surface drainage.

- b. Proper soil drainage is very important
- c. Compacted soils prevent root growth and contribute to yield loss and limited vine survival.

(PowerPoint Slide #28)

- b. Bramble fruits (raspberries, blackberries)
 - a. Soil drainage is very important, however moist soil is required
 - b. Sandy loams and loams are desirable, heavy soils are not.
 - c. A good supply of organic matter and deep well-drained subsoil are important.

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 on **PowerPoint Slide #29** can also be used as review.

Application: Have the students go outside and take a survey of the soil around the school. Once they determine the characteristics of the soil have them pick the fruit and nut crops that would grow well for that soil type.

Evaluation: Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

Answers to Sample Test:

Matching

- 1. C
- 2. G
- 3. H
- 4. B
- 5. A
- 6. D
- 7. F
- 8. E

Short Answer

1. Various answers. Use TM: B 1-1 to grade student answers.

2. Anchorage- the roots grow into the soil holding the plant down
Water- soil holds water and allows roots to take water up to the tree
Oxygen- Roots need oxygen to conduct chemical processes
Nutrients- proper nutrients are provided by the soil and will improve tree growth.

Biology of Soil

Student Lab Activity

Purpose:

To discover what organisms are living in the soil around the school.

Materials:

- Data sheet
- Shovels or garden trowels
- Buckets or cups
- Magnifying glass
- Water

Method:

Using shovels or garden trowels, dig around in the soil to find any insects or other organisms present. Record these on your data sheet.

Take a scoop of soil and place it in your cup or bucket. Pull out any organic matter you may find and record it on your data sheet.

Make observations about the soil including type, drainage, color and other characteristics. Record these on your data sheet.

Dig a shallow hole about 6" deep and fill it with water. Observe how quickly the water percolates through the soil. Judging by the speed of water movement, discuss the drainage of the soil.

Conclusion:

After making these observations determine what fruit and nut trees would grow best in this type of soil and explain why. Determine what would need to be done to the soil if you wanted to plant a fruit tree unsuitable for this area. If this soil is unsuitable for any fruit or nut trees explain why.

LS: B 1-1

Biology of Soil

DATA SHEET

1. List any insects and other organisms you found in your soil sample. If you do not know their name, describe them as best as possible and draw pictures. If you did not find any organisms in your soil, why do you think this is?

2. Describe any organic matter you found in your soil sample. If you did not find any organic matter, why do you think this is?

3. Describe your soil sample. Discuss characteristics such as color, texture, drainage, etc. From your experiment testing drainage, what would you consider the drainage of this soil to be?

4. What fruit or nut trees would grow best on this soil? (TM: B-1 "Fruit Tree Soil Types" will help you). If this soil is not suitable for fruit and nut trees, explain why and what you could do to improve the soil.

Fruit Tree Soil Types

Fruit	Soil type	Drainage	Other Characteristics
Apples	Sandy to clay can produce a successful orchard; soil needs plenty of humus	Well drained	Avoid droughty soils and eroded soils with no distinct horizons between topsoil and subsoil
Pears	Deep, rich loam and slightly acidic	More likely to withstand poorly drained, less tolerant to dryness	
Pomegranates	Ordinary soil	Well drained	thrives on calcareous or acidic loam as well as rock strewn gravel
Peaches	sandy loam to sandy clay loam are preferred	Extremely sensitive to poorly drained soils	Grows well in a wide range of soil types
Cherries	Fertile soils with high organic matter	Moist but well drained	Intolerant of compacted soil
Plums	Grown on heavy to slightly loamy soils depending upon variety	Well drained	Prefer slightly acidic soil
Apricots	Loam soils with minimum depth of 1.5 meters	Well drained	Prefer pH of 6.0 to 7.0
Mulberries	prefer warm, almost loamy soil	Well drained	Can tolerate drought but will drop fruit when too dry
Almonds and other nuts	Require different soils depending upon species	Elevated and well drained soils	Most require light soils and have deep taproots that need to reach water
Grapes	Light loamy soils, compaction is bad for root growth	Well drained, most soils cause root rot	Soils need good aeration, moderate fertility
Bramble Fruits (raspberry, blackberry)	Sandy loam or loam with high organic matter	Moist but well drained	Deep well-drained subsoil

Test

Unit B Lesson 1: Recognizing the Characteristics of Soils for Fruit and Nut Crops

Part One: Matching

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

- | | | |
|-------------------|----------------------|--------------------|
| a. permeable | d. infiltration | g. percolation |
| b. tilth | e. leaching | h. capillary water |
| c. organic matter | f. hygroscopic water | |

- _____ 1. Partially decayed plant and animal matter.
- _____ 2. The downward movement of water through the soil.
- _____ 3. Water that is held against the forces of gravity and may move sideways or upward.
- _____ 4. A quality of soil that allows the movement of water and air.
- _____ 5. The ease with which soil can be worked.
- _____ 6. The process of water soaking into the soil.
- _____ 7. A thin film of water around individual soil particles.
- _____ 8. The process of carrying away dissolved minerals in water.

Part II Short Answer

Instructions. Use the space provided to answer the following questions.

1. Pick 2 fruit or nut trees and describe the type of soil, drainage and special characteristics needed to grow this fruit or nut tree.

2. Describe the 4 ways plants use soil.