Exploring Greenhouse Structures

Unit B. Floriculture

Problem Area 1. Greenhouse Crop Production

Lesson 1. Exploring Greenhouse Structures

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: VIII: Plan, implement, manage, and/or provide support services to facility
design and construction; equipment design, manufacture, repair, and service; and agricul-
tural technology.

Benchmark: VIII-A: Design machinery and equipment including vehicles, implements,
building, and facilities (e.g., feeding, feed storage).

Performance Standard: 1. Analyze site/equipment/permit requirements. 2. Develop
drawings. 3. Estimate material needs and costs. 4. Operate Computer Aided Drafting
Design (CADD) Software.

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

1. Identify greenhouse designs.
2. Review considerations for greenhouse frameworks.
3. Identify and describe greenhouse glazing materials.
4. Describe the functions of the headhouse.
5. Discuss the advantages of retractable-roof greenhouses.
6. Describe greenhouse bench options.
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:


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


List of Equipment, Tools, Supplies and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet
Computer
LCD projector
Samples of greenhouse glazing materials

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

Acrylic structured sheets
Bench
Even-span greenhouse
Fiberglass
Glass
Glazing
Greenhouse
Greenhouse framework
Headhouse
Hoop-house
Lean-to greenhouse
Polycarbonate structured sheets
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.

Ask the students if they have ever been in a greenhouse. Follow up the initial question by asking them to describe what they noticed in the greenhouse (i.e. light, warmth, humidity, etc.). Continue the discussion by linking their observations to the environmental needs of crops in a greenhouse.

Summary of Content and Teaching Strategies

Objective 1: Identify greenhouse designs.

Anticipated Problem: What are the common greenhouse designs?

I. A greenhouse is a structure enclosed by glass or plastic that allows light transmission for the growth of plants. There are four basic styles of greenhouse design.

A. The lean-to greenhouse shares a wall with a building and relies on the building structure to provide some support for the greenhouse roof.

B. Even-span greenhouse structures are single houses that have roofs with an even pitch and an even width. A common even-span greenhouse that uses arching pipes for the framework is called a hoop house.

C. Uneven-span greenhouses have unequal pitches and widths. Use of this style is limited to hillsides. Modern greenhouses are built on level ground. Therefore uneven span greenhouses are rarely built.

D. Ridge-and-furrow greenhouse structures consist of a number of greenhouses connected along the length of the house. The shared interior walls reduce energy costs and allow for large interior spaces. Ridge-and-furrow greenhouses are best oriented north and south to reduce permanent shadows on the crops created by the gutters.

Begin the lesson by clearly stating the teaching objectives. Following the interest approach, have the students read the appropriate sections in Floriculture: From Greenhouse Production to Floral Design. Discuss the content of the reading and have students keep notes during the discussion. Use TM: B1–1A to illustrate the four major greenhouse styles. Contact a commercial greenhouse to arrange a visit. During the visit note greenhouse styles, the construction materials used for the structure(s).
**Objective 2:** Review considerations for greenhouse frameworks.

**Anticipated Problem:** What considerations need to be addressed for greenhouse frameworks?

II. The greenhouse framework supports the greenhouse covering material.

A. Ideally, the framework should be strong, yet allow the maximum amount of light to reach the plants. It is best if it requires little maintenance.

B. Although costly, aluminum and aluminum/steel combination frameworks are popular because they are long lasting and considered to be low maintenance. Other framework materials include wood, galvanized steel, and angle iron.

Lead a class discussion based on the related readings in Floriculture: From Greenhouse Production to Floral Design. Use TM: B1–1B to illustrate the various components of the greenhouse framework. Ask a professional to appear as a guest speaker, and have him or her mention considerations in selecting greenhouse framework materials.

**Objective 3:** Identify and describe greenhouse glazing materials.

**Anticipated Problem:** What materials are used for greenhouse glazing?

III. The covering of the greenhouse is referred to as the glazing.

A. Considerations in choosing a glazing material include durability, light transmission, cost, and affects on heating costs.

B. Flexible sheets of polyethylene are stretched over the greenhouse framework. It is not very durable, but it is inexpensive.

C. Structured sheets, including polycarbonate, acrylic, and fiberglass materials have grown in popularity. Sheets made with double walls offer good insulation.

1. Polycarbonate structured sheets are most widely used because they have good light transmission, they resist hail damage, and they are easy to work with.

2. Acrylic structured sheets have high light transmission, but they cost more than polycarbonate sheets, are prone to hail damage, and are less flexible.

3. Fiberglass has dropped in popularity. It discolors after 7 to 10 years, is flammable, and provides poor insulation.

D. Glass is considered to be the best material for crop production. It has the highest light transmission. The fact that it is very long lasting can make it less costly than other glazing materials in the long run.

Obtain samples of greenhouse glazing materials from manufacturers. Have the students examine the materials as the advantages and disadvantages of each is discussed. Include the samples as part a practical examination at the end of the lesson. Use the readings in Floriculture: From Greenhouse Production to Floral Design as a supplement to the lesson. Discuss the content of the reading and have students keep notes during the discussion.
Objective 4: Describe the functions of the headhouse.

Anticipated Problem: What are the functions of the headhouse?

IV. Many of the tasks that support the production of greenhouse crops takes place in a structure attached to the greenhouse, known as a headhouse. The headhouse might be used as a storage area, a potting area, an office, and/or a shipping area.

Arrange a field trip to a local greenhouse. Prepare the students in advance for a field trip to a commercial greenhouse. During the visit have the students complete lab sheet LS: B1–1A, which includes the identification of the functions of the headhouse.

Objective 5: Discuss the advantages of retractable-roof greenhouses.

Anticipated Problem: What are the advantages of retractable-roof greenhouses.

V. Retractable-roof greenhouse designs allow the roof to be opened and closed.

A. The grower can open the roof when weather conditions are favorable to plant growth and close the roof when the crops need protection. When open, they provide plants with increased light levels and fresh air. Retractable-roof greenhouses can be used to prepare outdoor crops for the elements before leaving the greenhouse. Other advantages include reduced disease problems because of better ventilation, reduced irrigation due to rainfall, and more effective temperature control for DIF.

Use the readings in Floriculture: From Greenhouse Production to Floral Design as a supplement to discussing retractable-roof greenhouses. Also, refer to recent periodicals and sites on the Internet for information. During classroom discussion on retractable-roof greenhouses, have students keep notes. If possible, visit a local greenhouse with a retractable-roof greenhouse, and request a demonstration of how it functions.

Objective 6: Describe greenhouse bench options.

Anticipated Problem: Describe greenhouse bench options.

VI. The greenhouse bench is the structure that holds the plants above the ground.

A. Materials used for benches include expanded galvanized steel, aluminum, plastic, and rot resistant wood.

B. Benches are arranged in the greenhouse with aisle space and growing space in mind. Common layouts include conventional arrangements, peninsular arrangements, and movable benches.

1. Rolling benches are a type of movable bench used to maximize growing space by limiting space for aisles. The benches are placed on pipes, which allows them to be easily moved from side to side.
Supplement the lesson with readings found in Floriculture: From Greenhouse Production to Floral Design. Discuss the content of the reading and have students keep notes during the discussion. Use transparency masters TM: B1–1C, TM: B1–1D, TM: B1–1E, and TM: B1–1F to illustrate greenhouse bench systems.

**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. Use their responses as the basis for determining any areas that need re-teaching. Questions at the end of the chapters in the textbook may also be used in the review/summary. Use the lab activity in reviewing and reinforcing student learning.

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

LS: B1–1A—Greenhouse Field Trip Worksheet, Greenhouse Structures

**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=b, 2=h, 3=j, 4=d, 5=i, 6=g, 7=c, 8=a, 9=f, 10=e

**Part Two: Completion**

1. polycarbonate structured sheets
2. fiberglass
3. uneven-span
4. greenhouse framework
5. ridge-and-furrowed
6. acrylic structured sheets
7. greenhouse
8. structured sheets

**Part Three: Short Answer**

1. even-span
   uneven-span
   lean-to
   ridge-and-furrow

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2. The framework should be strong, yet allow the maximum amount of light to reach the plants. It is best if it requires little maintenance.

3. aluminum and aluminum/steel combinations
   wood
   galvanized steel
   angle iron.

4. Considerations in choosing a glazing material include durability, light transmission, cost, and affects on heating costs.

5. The headhouse might be used as a storage area, a potting area, an office, and/or a shipping area.

6. When open, they provide plants with increased light levels and fresh air. Retractable-roof greenhouses can be used to prepare outdoor crops for the elements before leaving the greenhouse. Other advantages include reduced disease problems because of better ventilation, reduced irrigation due to rainfall, and more effective temperature control for DIF.

7. Materials used for benches include expanded galvanized steel, aluminum, plastic and rot resistant wood.
Lesson B1–1: Exploring Greenhouse Structures

Part One: Matching

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

a. bench f. lean-to greenhouse
b. glass g. polyethylene
c. glazing h. retractable-roof greenhouse
d. headhouse i. ridge-and-furrow greenhouse
e. hoop-house j. rolling bench

_______ 1. Considered the best material for plant production as it provides the highest light transmission of any glazing material at 88% to 89%.
_______ 2. Structures have roofs that can be opened and closed.
_______ 3. Benches that rest on pipes for movement thus maximizing the growing space in the greenhouse.
_______ 4. Structure attached to the greenhouse that serves as a storage area and a work area.
_______ 5. Structure consisting of a number of greenhouses connected together along the length of the houses.
_______ 6. The most widely used glazing material consisting of flexible sheets, usually 6-mil in thickness.
_______ 7. The covering of a greenhouse.
_______ 8. The structure that holds the plants above the ground.
_______ 9. A greenhouse that shares a wall with a building and relies on the building structure to provide some support for the greenhouse roof.
_______ 10. A common even-span greenhouse that uses arching pipes for the framework.

Part Two: Completion

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

1. _____________________________ are most widely used because they have good light transmission, they resist hail damage, and they are easy to work with.
2. _____________________________ has dropped in popularity as a glazing material. It discolors after 7-10 years, is flammable and provides poor insulation.
3. ___________________________ have unequal pitches and widths. Use of this greenhouse style is limited to hillsides.

4. The _________________________ supports the greenhouse covering material

5. ________________________ greenhouse structures consist of a number of greenhouses connected along the length of the house. The shared interior walls reduce energy costs and allow for large interior spaces.

6. __________________________ have high light transmission, but they cost more than polycarbonate sheets, are prone to hail damage, and are less flexible.

7. A _________________ is a structure enclosed by glass or plastic that allows light transmission for the growth of plants

8. __________________________ including polycarbonate, acrylic, and fiberglass materials have grown in popularity as a glazing material.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are the four basic styles of greenhouse design?

2. What are the desirable qualities of the greenhouse framework?

3. What are four materials used for greenhouse framework?

4. What should be considered when selecting a glazing material?

5. What functions take place in the headhouse?

6. What are some advantages to retractable-roof greenhouses?

7. What are some materials used for greenhouse benches?
COMPONENTS OF GREENHOUSE FRAMEWORK

Ridge

Ventilator

Purlin

Sidewall

Truss

Anchor Support Post

(Courtesy, Interstate Publishers, Inc.)
PENINSULAR BENCH LAYOUT

Growing Area

Aisle

16–24"

5'

3'

8'

4'

3'

26'

48'

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CONVENTIONAL BENCH LAYOUT

Floor Plan

Ground Area 4000 sq ft
Bench Area 2820 sq ft
Aisle Area 1180 sq ft
LENGTHWISE BENCHES with END ACCESS AISLE

CROSS BENCHES with CENTRAL ACCESS AISLE

CROSS BENCHES with SIDE ACCESS AISLE
PARTS OF A MOBILE BENCH

- Movable Bench Top
- Support Frame
- Crank
- Roller
- Concrete Pier
- Roller Spacer
Greenhouse Field Trip Worksheet  
Greenhouse Structures

**Purpose:**
To identify greenhouse structures, their advantages and disadvantages, and their uses.

**Instructions:**
Answer the questions during a visit to a greenhouse operation. If necessary ask your greenhouse guide for assistance.

1. What greenhouse style(s) does this operation utilize?

2. What is the orientation of the greenhouses in terms of north, south, east and west?

3. What material is used for the framework(s)?

4. What glazing material(s) is used?

5. Why did they select that particular glazing material(s)?

6. What functions is the headhouse used for?

7. What types of benches are used in the greenhouse?