

GREENHOUSE OPERATION AND MANAGEMENT

Unit II: Growing Structures

Lesson 3: Energy Conservation and Environmental Protection

Objective/Competency:

Identify energy- and cost-saving factors in greenhouse structures.

Study Questions

1. What greenhouse modifications and procedures can be used to conserve energy?
2. What modifications and procedures can be used in a greenhouse to protect the environment?

References/Supplies/Materials

1. *Greenhouse Operation and Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 2002.
2. Activity Sheet

AS 2.3 Windbreak
3. Scott, S. V., Master Gardener. "Evergreens in the Landscape."
<<http://outreach.missouri.edu/jasper/hort/mg/globe/069.htm>>
4. Slusher, John P. "Planning Tree Windbreaks in Missouri." School of Natural Resources, University of Missouri-Columbia. <<http://muextension.missouri.edu/xplor/agguides/forestry/g05900.htm>>
5. Starbuck, Christopher J. "Landscape Plantings for Energy Savings." Department of Horticulture, University of Missouri-Columbia.
<<http://muextension.missouri.edu/xplor/agguides/hort/g06910.htm>>

TEACHING PROCEDURES

A. Review

Building on Lessons 1 and 2 regarding greenhouse structures and the mechanical workings, Lesson 3 explores both energy conservation and environmental protection and their relationship to greenhouse operations.

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B. Motivation

Why are energy conservation and environmental protection important to the greenhouse owner? Ask students to explain the pros and cons of both topics. Ask for specific examples of how a greenhouse owner can conserve energy and protect the environment.

C. Assignment of Study Questions

Encourage students to keep and update the portfolio they are creating for Unit II Activity.

D. Supervised Study

Lead students in collecting the information needed to answer and discuss the study questions. The instructor may choose to work on one study question at a time or have students answer all the questions before the discussion. Another option is to have students work in cooperative learning environment and have groups work on different study questions.

E. Discussion

Lead students in a discussion of the study questions. Supplement students' responses and information with additional materials when needed.

1. What greenhouse modifications and procedures can be used to conserve energy?

If not planned properly, a greenhouse can consume a lot of resources and cut into the greenhouse owner's profits. Proactive steps can be taken.

A. Optimize natural light intensity.

1. Minimize need for supplemental electric lighting.
2. Ensure large trees, buildings, etc., do not shadow growing structures.
3. Paint inside surfaces (benches, frames, etc.) with white latex paint. Do not use oil-based paint.

B. Optimize heating and cooling efficiency.

1. Invest in quality heating, cooling, and ventilation systems.
 - a. Energy efficient
 - b. Using economical and available fuel
2. Routinely maintain for optimal efficiency.

C. Create energy-saving structures.

1. Check structure for air leaks.
 - a. Make sure vents and fan louvers seal tightly.
 - b. Seal holes or cracks in greenhouse covering.
 - c. Install weather stripping around doors, etc.
2. Protect from extremes in the elements.
 - a. Insulate north-facing side during winter.
 - b. Create windbreaks to protect plants from harsh weather.
 - c. When needed, provide shade if there is high-intensity light and high temperature.

- d. Install thermal blankets inside walls and roof.
3. Consider direction and intensity of natural elements (wind, sun, snow, frost) when selecting a site.

2. What modifications and procedures can be used in a greenhouse to protect the environment?

These solutions are particular to a greenhouse operation, but some of the ramifications are global. The misuse of chemicals can injure the person applying them and can also affect the environment. Care must be taken when draining fertilizer because those compounds can leach into the water table and contaminate it. Humidity and pests affect the crops directly.

- A. Minimize the use of hazardous chemicals.
 1. Know and follow federal, state, and local regulations governing the use of chemicals in a greenhouse.
 2. Use the least toxic method of controlling pests.
- B. Minimize risk for plant disease.
 1. Maintain the proper level of humidity.
 2. Use appropriate watering method.
- C. Minimize risk of infestation.
 1. Place screens over vents.
 2. Construct screened entry.
 3. Inspect all new material upon arrival before placing them in the greenhouse.
- D. Minimize runoff pollution.
 1. Have good drainage to avoid contaminating the water table.
 2. Have an irrigation system that can be recycled.

F. Other Activity and Strategy

Invite a speaker from the Department of Natural Resources to talk about the interactions between a greenhouse operation and the natural environment.

G. Conclusion

Energy conservation and environmental protection are important concepts to a greenhouse grower. The implications extend beyond a greenhouse operation and can adversely affect many individuals.

H. Answers to Activity Sheet

Instructor's discretion

I. Answers to Assessment

1. Risk of pests entering the greenhouse
2. Optimizes natural light intensity
3. The student may list any two of the following:

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- A. Insulate north-facing side during winter
- B. Install thermal blankets inside walls and roof
- C. Screen high-intensity light bursts in spring
- 4. The student may list any three of the following:
 - A. Minimize chemical usage
 - B. Minimize risk of pest infestation
 - C. Keep humidity at the appropriate level for the crop
 - D. Drain waste liquids properly to avoid runoff pollution
- 5.
 - A. Optimize natural light intensity
 - B. Optimize heating and cooling efficiency
 - C. Create energy-saving structures

UNIT II: GROWING STRUCTURES

Name_____

Lesson 3: Energy Conservation and Environmental Protections

Date_____

ASSESSMENT

Short-Answer Questions: Write the answers in the space provided.

1. When placed over ventilation openings, what do tight-fitting covers help reduce?

2. What is the benefit of painting interior structures with white latex paint?

3. What are two methods to protect a greenhouse from extremes in the elements?
 - A.

 - B.

4. What are three procedures used in a greenhouse that protect the environment?
 - A.

 - B.

 - C.

5. What are three modifications that help conserve energy in the greenhouse?
 - A.

 - B.

 - C.

UNIT II: GROWING STRUCTURES

AS 2.3

Lesson 3: Energy Conservation and Environmental Protections

Name_____

Windbreak

Objective: Justify how a windbreak helps conserve energy.

Directions: Use information from AS 2.1 and AS 2.2 in which you designed the structure and environmental controls for a model greenhouse. Now devise a windbreak that helps conserve energy. Use textbooks, magazines, catalogs, university Extension publications, and the Internet to find information. Three suggested web sites are listed below. Answer the following questions. (You may work with another student.)

- Scott, S. V., Master Gardener. "Evergreens in the Landscape" <<http://outreach.missouri.edu/jasper/hort/mg/globe/069.htm>>
- Slusher, John P. "Planning Tree Windbreaks in Missouri." School of Natural Resources, University of Missouri-Columbia. <<http://muextension.missouri.edu/xplor/agguides/forestry/g05900.htm>>
- Starbuck, Christopher J. "Landscape Plantings for Energy Savings." Department of Horticulture, University of Missouri-Columbia. <<http://muextension.missouri.edu/xplor/agguides/hort/g06910.htm>>

1. Where is the windbreak placed?
2. Why? Be specific and name sources that justify your choice.
3. What is the windbreak made of?
4. Why?
5. How much energy can be saved? Estimate but cite reference.

UNIT II ACTIVITY

Growing Structures

Name_____

Greenhouse Portfolio

Objective: Generate a portfolio that incorporates information from the three lessons in Unit II.

Directions: In groups, use information from completed activity sheets, photographs, sketches, and other references including the Internet to create a greenhouse portfolio. Include information about all the structural and internal mechanisms needed to build a new commercial greenhouse. Because this is a group project, the work is based on consensus. Be sure you and your coworkers agree on the contents of your portfolio. Include all of the information listed below. Once completed, give the portfolio to the instructor who will give your group another group's portfolio for Phase II of this activity.

Phase I: The Portfolio

- Wholesale or retail operation
- Type of crop: floriculture, olericulture, or ornamental
- Site selection
- Climate
- Topography
- Availability of resources: water, utilities, materials, labor
- Land considerations
- Marketing concerns
- Legal considerations
- Type of structure
- Framing and covering material
- Interior layout
- Flooring
- Benches
- Temperature monitoring system
- Heating and cooling systems
- Ventilation
- Irrigation method
- Control of light intensity
- Monitor and control of carbon dioxide
- Energy conservation ideas
- Attention to environmental protection

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Phase II: The Critique

Objective: Appraise another group's portfolio.

Directions: Evaluate how thoroughly each topic was discussed in the other group's portfolio. Answer the following questions and prepare a professional-looking critique. Give your answers and the critique to the instructor upon completion.

1. How complete is this plan? Are all of the questions answered? (Blueprints are not necessary.)
2. Are there any areas insufficiently addressed or forgotten altogether?
3. Is this plan practical or unrealistic? Why?
4. What energy conservation measures are indicated?
5. What environmental considerations are indicated?
6. Are the costs of materials discussed?
7. Is the cost and ease of upgrade discussed?

