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ABSTRACT

This curriculum guide, the last in a set of six, contains teacher and student materials for a unit on energy conservation prepared as part of a seventh- and eighth-grade agricultural science curriculum that is integrated with science instruction. The guide contains the state goals and sample learning objectives for each goal for students in grades 8-10 and a teacher presentation outline for the unit. The unit, which begins by listing the agricultural practices and science concepts to be taught, along with activities and applications, contains the following components: teaching steps, lesson outlines, teacher's presentation outlines for each day, student information guide, terms and definitions, worksheets, student activity note sheets, student activity information sheets, student activity record sheets, quizzes, practice problems, and 14 transparency masters. Teacher's activity sheets and tests have answers provided. The unit covers the following topics: energy conservation in landscape design, homestead improvement, nursery practices, and the design of agricultural facilities. (KC)

7th and 8th Grade Agriculture Science Curriculum

Teacher Materials

Energy Conservation

1. Heat Energy
2. Electromagnetic Spectrum
3. Solar Energy
4. Mechanical Advantage
5. Electrical Energy
6. Energy Conservation

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ENERGY CONSERVATION
BIOLOGICAL AND PHYSICAL SCIENCES
STATE GOAL FOR LEARNING 1

As a result of their schooling, students will have a working knowledge of the concepts and basic vocabulary of biological, physical and contemporary technological society.

SAMPLE LEARNING OBJECTIVES FOR GOAL 1

By the end of GRADE 8, students should be able to:

C3. Use the fundamental units of length, mass, and time found in the metric system of measurement.
I1. Recognize now the sun affects air temperatures and pressures.
P1. Compare an object to its actual size when a scale is given.

By the end of GRADE 10, students should be able to:

G1. Recognize that good conservation practices depend on understanding the balance between living things and their environment.

STATE GOAL FOR LEARNING 2

As a result of their schooling, students will have a working knowledge of the social and environmental implication and limitations of technological development.

SAMPLE LEARNING OBJECTIVES FOR GOAL 2

By the end of GRADE 8, students should be able to:

B2. Understand the dependence of society on geologic resources.
B3. Understand the positive and negative aspects of the consumption of renewable and nonrenewable resources.
B4. Relate our future energy supply to finding new sources and wise use of current supplies.
E1. Contrast the present limitations of the earth's natural resources with consumer demands.
G2. Identify activities that can be used to conserve energy.

By the end of GRADE 10, students should be able to:

B3. Relate future energy to the need for new resources.

STATE GOAL FOR LEARNING 3

As a result of their schooling, students will have a working knowledge of the principles of scientific research and their application in simple research projects.

SAMPLE LEARNING OBJECTIVES FOR GOAL 3

By the end of GRADE 8, students should be able to:

A5. Demonstrate effective participation as a member of a laboratory group.
B2. Demonstrate alternative procedures for solving a problem.
B3. Understand the need to acquire, organize, and evaluate data.
B6. Relate a laboratory procedure that another student can follow.

By the end of GRADE 10, students should be able to:

A5. Evaluate reasons for obtaining conflicting data.
B3. Demonstrate the ability to draw conclusions from collected data.
B4. Demonstrate various ways to display the same data.

STATE GOAL FOR LEARNING 4

As a result of their schooling, students will have a working knowledge of the processes, techniques, methods, equipment and available technology of science.

SAMPLE LEARNING OBJECTIVES FOR GOAL 4

By the end of GRADE 8, students should be able to:

A1. Recognize the need foe appropriate instruments to aid in observation.
D1. Evaluate the validity of a prediction through experimentation.
E1. Use standard units to measure properties of objects.
J1. Identify the variables in an experiment and suggest ways to control them.

By the end of GRADE 10, students should be able to:

D1. Revise a prediction on the basis of additional information.

PHYSICAL DEVELOPMENT

STATE GOAL FOR LEARNING 3

As a result of their schooling, students will be able to understand consumer health and safety, including environmental health.

SAMPLE LEARNING OBJECTIVES FOR GOAL 3

By the end of GRADE 8, students should be able to:

A2. Perform with appropriate safety equipment in safe environments.
G1. Know safety procedures needed in schools and the home to prevent accidents.

By the end of GRADE 10, students should be able to:

A2. Perform with appropriate safety equipment in safe environments.

LANGUAGE ARTS

STATE GOAL FOR LEARNING 4

As a result of their schooling, students will be able to use spoken language effectively in formal and informal situations to communicate ideas and information and to ask and answer questions.

SAMPLE LEARNING OBJECTIVES FOR GOAL 4

By the end of GRADE 8, students should be able to:

C2. Distinguish among statements of observation, opinion, and judgment.
E2. Use information effectively in an oral message.

By the end of GRADE 10, students should be able to:

E1. Organize information in an oral message.

MATHEMATICS

STATE GOAL FOR LEARNING 1

As a result of their schooling, students will be able to perform the computations of addition, subtraction, multiplication, and division using whole numbers, integers, fractions, and decimals.

SAMPLE LEARNING OBJECTIVES FOR GOAL 1

By the end of GRADE 8, students should be able to:

B3. Add and subtract integers.
H4. Read diagrams, flowcharts, and schematics.

STATE GOAL FOR LEARNING 2

As a result of their schooling, students will be able to understand and use ratios and percentages.

SAMPLE LEARNING OBJECTIVES FOR GOAL 2

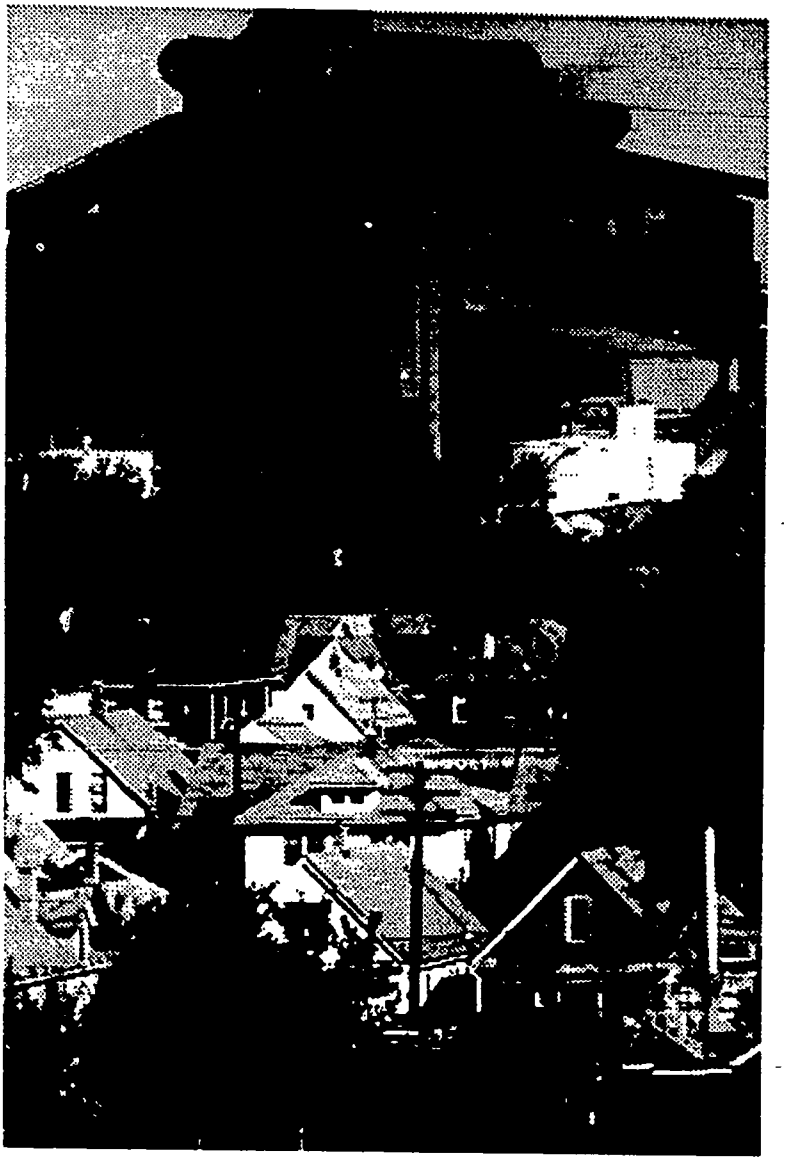
By the end of GRADE 8, students should be able to:

C2. Write proportions involving corresponding lengths in similar figures.

By the end of GRADE 10, students should be able to:

B1. Write proportions equivalent to a given proportion.

ENERGY CONSERVATION



TEACHER PRESENTATION OUTLINE

ENERGY CONSERVATION

AGRICULTURAL PRACT'CES

Landscape Design
Landscape Implementation
Homestead Improvement
Nursery Practices
Design of Agricultural Facilities

SCIENCE CONCEPTS

Energy Conservation
Solar Orientation
Solar Angles

Landscaping is the art of arranging and fitting together of land,plants, and buildings for human use and enjoyment. Landscaping is an integral part of the field of ornamental horticulture. Energy conservation is the careful use of our natural energy sources. By landscaping a building to reduce temperatures in the summer and reduce heat loss in the winter, both aesthetics and energy conservation can be achieved.

AGRICULTURAL APPLICATIONS FOR 7&8TH GRADE PHYSICAL SCIENCES:

UNIT TITLES:	ACTIVITIES & APPLICATIONS
Energy Conservation	Use of landscaping; pg. 27 Landscaping homes & Ag facilities; pg. 27 Microclimate & Landscape; pg. 29 Landscaping for Summer Cooling; pg. 29 Landscaping for Winter Warming; pg. 30 Landscape Energy Efficiency Activity; pg. 35

TEACHING STEPS

(for teacher to follow)

A. Materials Provided in Teaching Kit:

tracing paper
landscape symbols
house plan
construction paper

B. Additional Materials Needed for Student Activities:

Chalk
Scissors
Tape Measure or Yard Sticks
Glue or Tape

C. Lesson Outline

D. Teacher's Presentation Outline

E. Audio Visual Materials:

1. IMPORTANCE OF ENERGY CONSERVATION
2. SOLAR ANGLES
3. EARTH'S ROTATION
4. EARTH'S ORBIT
5. LANDSCAPING
6. ENERGY EFFICIENT LANDSCAPE
7. ORIENTATION OF HOUSE IN WINTER
8. ORIENTATION OF HOUSE IN SUMMER
9. CHOOSE A STRATEGY
10. PRINCIPLES TO AID IN SUMMER COOLING
11. PRINCIPLES TO AID IN WINTER WARMING

F. Student Handouts and Quizzes

Student Information Guide
Work Sheet A
Work Sheet B
Work Sheet C
Work Sheet D
Student Activity Note Sheet
Student Activity - 1 Information Sheet
Student Activity - 2 Information Sheet
Student Activity - 1 Record Sheet
Quiz 1

LESSON OUTLINE:

Day 1:

Discussion of Attention Step/Problem Statement.
Explanation of General Information about Energy Conservation.
Explanation of the Solar Angles.
Assignment of Student Information Guide on Energy Conservation.
Student Completion of Work Sheet A during class.
Explanation of Scientific Terms.
Student Completion of Work Sheet B during class or as homework.
Individual Study using Computer Study Guide.

Day 2:

Discussion of Scientific Terms Work Sheet (Work Sheet B).
Demonstration of Observing Shade Patterns throughout the day.
Student Activity of Observing Shade Patterns throughout the day.
Assignment of Student Activity - 1 Record Sheet.
Discussion of Student Activity - 1 Record Sheet.
Individual Study using Computer Study Guide.

Day 3:

Explanation of Landscaping your Home for Energy Efficiency.
Student Completion of Work Sheet C during class.
Individual Evaluation using Computer Study Guide.

Day 4:

Demonstration of Activity Designing An Energy Efficient Landscape.
Student Activity of Designing An Energy Efficient Landscape.
Individual Evaluation using Computer Quiz.

Day 5:

Discussion of Student Activity - 2.
Review of information on Energy Conservation, Solar Angles, and Landscaping your home for energy efficiency.
Student Completion of Work Sheet D during class.
Individual Evaluation using Computer Quiz.
Student Completion of Quiz 1.

ENERGY CONSERVATION

TEACHER'S PRESENTATION OUTLINE

DAY 1

Teaching Note: *Discuss the Attention Step/Problem Statement with the class.*

ATTENTION STEP/PROBLEM STATEMENT

Divide the class into small groups and have them brainstorm about different ways to conserve energy in the home. Have the students report their answers back to the class and make a master list. Answers will vary, however a partial list of ways to conserve energy in the home is found below:

1. Insulate your home.
2. Keep weather stripping and caulking around windows and doors in good repair.
3. Use insulated drapes on windows.
4. Open your blinds on sunny days in the winter & close them at night. In the summer, close the blinds on sunny days. Keep windows and doors closed during the hottest part of the day.
5. Set the thermostat at a higher temperature in the summer and lower temperature in the winter.
6. Turn off lights and other appliances, like the TV, when you are not using them.
7. Use energy-efficient appliances.
8. Insulate your hot water heater.
9. Reduce water usage by taking shorter showers. (Heating water accounts for about 13% of a family's energy usage.)
10. Wash and dry only <u>full</u> loads of clothes and dishes in the washing machine, clothes dryer, and dishwasher.
11. Landscape your home for energy efficiency.

OBJECTIVES:

KNOWLEDGE OBJECTIVES:
Students will know:
- definition of energy conservation
- two reasons for interest in energy conservation
- importance of alternative energy sources
- importance of energy conservation
- three factors that influence angle of sun
- awareness of earth's elliptical orbit
- definition of landscaping
- principles of an energy efficient landscape
- importance of solar access in winter
- how to aid in the prevention of overheating of the house in the summer
- three landscape principles to aid in summer cooling
- two landscape principles to aid in winter warming

PERFORMANCE OBJECTIVES:
Students will:
- observe the angle of the sun at different times during the day
- measure shadows of landscape features
- draw an energy efficient landscape plan

ENERGY CONSERVATION

Teaching Note: ***Explain the following general information about the importance of energy conservation to the class.***

GENERAL INFORMATION ABOUT ENERGY CONSERVATION

Lecture Note: ***Use overhead # 1 (Importance of Energy Conservation)***

- Energy conservation is the careful use of our energy resources. Many Americans have focused their attention on using energy more efficiently since the energy crisis of the mid-1970's. Two reasons for the interest in energy conservation are the high economic cost of energy and the fear that some day it will not be available for us to use.

- Our major sources of energy are fossil fuels--coal, oil, and natural gas. All of our major energy sources are non-renewable. Once these resources have been used up, they cannot be replaced. Although scientists do not agree on when our fossil fuels will be depleted, most scientists agree that our fossil fuels will eventually run out and we will need different energy sources to heat our homes, run our cars, and keep our industry producing goods. By conserving energy, we can reduce the amount of fossil fuels we consume. The more energy we save now, the longer our current supply of fossil fuels will last.

- Research and time is still needed to switch to alternative energy sources. Alternative energy resources are being researched and developed. Many alternative energy systems are still more expensive than traditional systems that rely on fossil fuels. As our technology on alternative energy systems improve, its cost should be reduced. It is also difficult for many alternative energy fuels or systems to be installed into existing buildings and machines. A good time to integrate alternative energy systems into our lives is when we build new homes, remodel old ones, or buy new appliances or machines. So by conserving energy now, we will have more time to develop alternative energy sources and integrate them into our lives.

- Energy is expensive. By reducing energy costs we keep American industry more competitive with other industries throughout the world. By conserving energy in our homes, we increase our disposable income. This gives a family more money to spend on items other than heating costs, electricity, and gasoline.

Teaching Note: *Explain the following information about solar angles to the class.*

SOLAR ANGLES

Lecture Note: Use overhead # 2 (Solar Angles)

- The angle of the sun changes with the time of day, season, and latitude.

Lecture Note: Use overhead # 3 (Earth's Rotation)

- The earth rotates on an axis that passes through the north and south poles. The earth completes a full 360^0 rotation every 24 hours. This rotation gives the sun the appearance of moving across the sky by rising in the east and setting in the west.

Lecture Note: Use overhead # 4 (Earth's Orbit)

- The earth has an elliptical orbit around the sun, because the earth's polar axis is tilted 23.5^0. This causes sunlight to strike the northern hemisphere of the earth more directly in the summertime, since it is tilting toward the sun. This makes the days longer & the sun appear at a higher altitude. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower altitude. This makes the winter daylight hours shorter and colder and the shadows longer than they are in the summer.

- Geographic location also effects solar angle. For example, the sun at 37^0 North latitude (Southern Illinois) appears higher in the sky than at 42^0 North (Northern Illinois). This is why a roof overhang on a building shades more of a south wall in Southern Illinois than Northern Illinois.

Teaching Note: ***Assign Work Sheet A and Student Information Guide on Energy Conservation. Students can complete Work Sheet A either individually or in small groups during class time.***

STUDENT INFORMATION GUIDE

ENERGY CONSERVATION

Energy conservation is the careful use of our energy resources. Many Americans have focused their attention on using energy more efficiently since the energy crisis of the mid-1970's. Two reasons for the interest in energy conservation are the high economic cost of energy and the fear that some day it will not be available for us to use.

Our major sources of energy are fossil fuels. Fossil fuels are the remains of organisms that lived millions of years ago which release energy when they are burned. Some examples of fossil fuels are coal, oil, and natural gas. All of our major energy sources are non-renewable. Energy sources that are used up at a much faster rate than at which they are formed are classified as non-renewable. Once these resources have been used up, they cannot be replaced. Although scientists do not agree on when our fossil fuels will be depleted, most scientists agree that our fossil fuels will eventually run out and we will need different energy sources to heat our homes, run our cars, and keep our industry producing goods. By conserving energy, we can reduce the amount of fossil fuels we consume. The more energy we save now, the longer our current supply of fossil fuels will last.

Research and time is still needed to switch to alternative energy sources. Alternative energy resources are being researched and developed. They include energy that is derived from any sources other than fossil fuels. Some examples of alternative energy sources are sun, wind, and water. Many alternative energy systems are still more expensive than traditional systems that rely on fossil fuels. As our technology on alternative energy systems improve, its cost should be reduced. It is also difficult for many alternative energy fuels or systems to be installed into existing buildings and machines. A good time to integrate alternative energy systems into our lives is when we build new homes, remodel old ones, or buy new appliances or machines. So by conserving energy now, we will have more time to develop alternative energy sources and integrate them into our lives.

Energy is expensive. By reducing energy costs we keep American industry more competitive with other industries throughout the world. By conserving energy in our homes, we increase our disposable income. This gives a family more money to spend on items other than heating costs, electricity, and gasoline.

SOLAR ANGLE

The angle of the sun changes with the time of day, season, and latitude. The earth rotates on an axis that passes through the north and south poles. The earth completes a full 360^0 rotation every 24 hours. This rotation gives the sun the appearance of moving across the sky by rising in the east and setting in the west.

The earth has an elliptical orbit around the sun, because the earth's polar axis is tilted 23.5^0. This causes sunlight to strike the northern hemisphere of the earth more directly in the summertime, since it is tilting toward the sun. This makes the days longer & the sun appear at a higher altitude. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower altitude. This makes the winter daylight hours shorter and colder and the shadows longer than they are in the summer.

Geographic location also effects solar angle. For example, the sun at 37^0 North latitude (Southern Illinois) appears higher in the sky than at 42^0 North (Northern Illinois). This is why a roof overhang on a building shades more of a south wall in Southern Illinois than Northern Illinois.

LANDSCAPING YOUR HOME FOR ENERGY EFFICIENCY

Landscaping is the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment. For most people, this means planting trees, shrubs, flowers, grass, and groundcovers around their home to make it more attractive.

An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed. Besides reducing your home heating and cooling costs, landscaping can have other advantages. Landscaping can be done on both existing and new homes. It can increase the value of your home and add beauty or privacy to it.

WHICH DIRECTION DOES YOUR HOUSE FACE?

<u>WINTER</u>

The side of the house that faces south will receive the most sunlight in the winter. Windows and/or solar collectors, devices that collect solar energy, that are placed on the south side of the house will allow sunlight to enter and heat the house. If winter heating is important to your situation, sunlight needs to reach southern windows or solar collectors.

East and west windows receive some sunlight in the winter. In very cold climates, the sunlight that shines on the east & west wall should be used to heat the house in the winter. However, in Illinois the sun that strikes the east and west walls also causes major heat buildup in the summer.

The North side receives the least amount of sunlight of any side of a house. It receives only indirect sunlight in the winter, so providing solar access on the north side of the house in the winter is unimportant. Protection from the winter wind on the North side of the house may be very important.

SUMMER

East and west windows and walls receive the most summer sun. They receive more summer sun than south windows and the south wall. Overheating occurs when excessive amounts of heat are allowed to build up. If east and west windows are unshaded, they are a major cause of overheating the house in the summer. Generally in Illinois, it is more important to shade the east and west side from the summer sun than maintain solar access during the winter.

The south windows and walls of a house receive sunlight in the summer. However, the need for solar access during the winter is also important. Solar access, or the allowance of sunlight to reach solar collectors and windows without obstruction, generally takes priority over summer shade.

The north windows and walls of the house receive the least amount of direct sunlight in the summer. Windows on the north side of the house may be very important for ventilation by utilizing summer breezes.

CHOOSE A STRATEGY

Generally you should decide which problem you want to solve--winter heating or summer cooling. You must determine if it is more important to landscape to aid in summer cooling or landscape to reduce the costs of winter heating of your home. Summer cooling and winter heating costs can both be reduced by landscaping. However, they are two different problems and are treated very differently. Whichever problem you tackle, make sure strategies that are aimed to keep your house cooler in the summer don't also keep it cooler in the winter and vices versa. You don't want to save money on summer cooling just so you can pay more money for winter heating.

When developing your landscape strategy, make sure you have a good understanding of your climate and the microclimate around you home. Climate is the general character of temperature, humidity, wind, precipitation, and solar radiation over a large geographic area. Information about climate including average temperatures during winter and summer are usually available from your power company. Microclimate is the character of temperature, humidity, wind, precipitation, and solar radiation in a

localized area. Your microclimate can be assessed by examining your home for any conditions or features that will change the outside temperature around your home from your neighbors. A few features that can change the microclimate around your house are listed below:
1. elevation (house on a hill verses a house in a valley)
2. Proximity to a stream, pond, lake, or ocean
3. Type of ground covers found around the house (concrete, asphalt, rock, grass)
4. Distance house is from other buildings
5. Distance house is from existing trees and shrubs around the home

SUMMER COOLING BY LANDSCAPING
When landscaping a home to aid in summer cooling, use a combination of the following 3 principles:

1. Shade your house from the sun. Protect east and west windows, walls and roof areas from the sun.

2. Use groundcovers, low growing plants that cover the soil, to reduce the amount of sunlight absorbed by the ground near the house or reflected through the windows of the house.

3. Keep natural summer breezes free from obstacles. Channel summer breezes to the house if possible.

APPLYING SUMMER COOLING PRINCIPLES
Shade the west windows and wall and the east windows and wall of your house from the sun. First, plant deciduous trees, shrubs, or vines on the west side of the house to provide afternoon shade. Deciduous plants lose all their leaves after the growing season, usually in the fall. By planting deciduous plants on the west and east side of the house, shade is provided in the summer when it is needed and yet the area will still get sunlight in the winter when the warmth of the winter sun is needed. In the summer, afternoon shade is usually more important than morning shade because the outside temperature is hotter, the sun is more intense, the house has already heated up during the day, and generally more people are at home. After deciduous trees, shrubs, or vines have been planted on the west side of the house, plant them on the east side. Plant trees so they shade windows. It is more important to shade windows than insulated walls. Shading a window can provide 50 - 80 times as much energy savings as shading an insulated wall.

Shade the yard, driveways, and patios that surround your house. Light colored concrete or gravel can reflect light back into your house and raise temperatures inside of your house. When asphalt and soil are left unshaded in the summer, they absorb heat. By shading these areas, you can cool them so it is comfortable to be outside or so cooler air can be used to ventilate your house.

Shade your roof. Plant deciduous trees that grow tall and have a wide canopy on top. The canopy of a tree is formed by its branches to make the portion of the tree which provides shade. These trees should not have many branches or undergrowth below the canopy. By choosing tall, deciduous trees with wide canopies, you are allowing sunlight to strike the house in the winter when the sun is low in the sky, yet shading the roof of the house in the summer when the sun is high in the sky.

Plant ground covers, turf, low shrubs, or vines, around your house wherever possible. Avoid concrete, asphalt, and brick near the house and shade them when they are used.

Use summer breezes to cool your house and yard. If you live near a lake or on a hill, you may be able to determine a prevailing wind direction and take advantage of summer breezes. If you cannot determine a prevailing wind direction you will want to take advantage of any breezes.

WINTER WARMING BY LANDSCAPING
When landscaping a home to aid in winter warming, use the following two principles:

1. Provide solar access on the south side of the house.
2. Protect the house from winter winds.

APPLYING WINTER WARMING PRINCIPLES
Provide solar access on the south side of the house. Avoid shading south windows and solar collectors. Avoid planting trees, even deciduous trees, in front of windows and solar devices that face south. Even deciduous trees can block as much as 60% of winter sunlight.

Plant windbreaks if you are in an area where winter winds are strong (greater than 10 mph) and consistently from the same direction. Windbreaks are used to break the force of the wind. Evergreen trees can be planted to form a windbreak. Plant windbreaks on the windward (the direction the wind is coming from) side of the house, without blocking summer breezes.

Design the windbreak so it is as tall or taller than the house. This way air currents will be deflected up and over the house.

Locate the windbreak so it is 1 - 3 times its height away from the house. Windbreaks that are planted far from the house must be taller and wider than windbreaks planted near the house.

The windbreak should be dense but not solid. It should allow 25% to 60% of air to flow through. Foliage should extend from the ground to the top.

Plant evergreen trees and shrubs on the north side of your house because they retain their foliage during the whole year and will block more wind than deciduous trees and shrubs.

WORK SHEET A

DIRECTIONS: Complete the following questions.

1. *Energy conservation* is the careful use of our energy resources.

2. Two reasons for the interest in energy conservation are the high *economic cost* of energy and the fear that some day it will not be available for us to use.

3. All of our major energy sources are *non-renewable*.

4. The more energy we save now, the longer our current supply of *fossil fuels* will last.

5. Many *alternative* energy systems are still more expensive than traditional systems that rely on fossil fuels.

6. It is *difficult* for many alternative energy fuels or systems to be installed into existing buildings and machines.

7. By conserving energy in our homes, we increase our *disposable income*.

8. The *angle* of the sun changes with the time of day, season, and latitude.

9. The *rotation* of the earth gives the sun the appearance of moving across the sky by rising in the east and setting in the west.

10. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower *altitude* than in the summer.

Teaching Note: *Explain the following terms to the class and then assign Work Sheet B. The Students can find the definitions for these terms in the Student Information Guide. Students can complete Work sheet B during class or as homework.*

GLOSSARY OF SCIENTIFIC TERMS:

alternative energy sources - energy derived from sources other than fossil fuels; such as sun, wind, and water

canopy - the shade portion of a deciduous tree which is formed by its branches

climate - the general character of temperature, humidity, wind, precipitation, and solar radiation over a large geographic area

deciduous - trees, shrubs, and other plants which lose all of their leaves after the growing season, usually in the fall

energy conservation - the careful use of our energy resources

evergreen - trees, shrubs, and other plants which retain leaves throughout the four seasons, including winter

fossil fuels - the remains of organisms which lived millions of years ago which release energy when they are burned (Ex. coal, oil & natural gas)

groundcovers - low growing plants that cover the soil

landscaping -	the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment.
microclimate -	the character of temperature, humidity, wind, precipitation, and solar radiation in a localized area
non-renewable resources -	energy sources that are used up at a much faster rate than at which they are formed
overheating -	allowing excessive amounts of heat to build up
solar access -	allowing sunlight to reach solar collectors and windows without obstruction
solar collectors -	windows or devises that collect solar energy
windward -	the direction the wind is coming from
windbreak -	something, like evergreen trees, used to break the force of the wind

WORK SHEET B

Directions:

The answers to the following fill-in-the blank questions are terms which have something to do with energy conservation. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

alternative energy sources
canopy
climate
deciduous
energy conservation
evergreen
fossil fuels
groundcovers
landscaping
microclimate
non-renewable resources
overheating
solar access
solar collectors
windward
windbreak

Fill-in-the blank:

1. Windows or devises that collect solar energy are called *solar collectors*.

2. *Energy conservation* is the careful use of our energy resources.

3. Energy derived from the sun, wind, water, or other energy sources other than fossil fuels are known as *alternative energy sources.*

4. The remains of organisms which lived millions of years ago which release energy when they are burned are called *fossil fuels.*

5. *Non-renewable resources* are energy sources that are used up at a much faster rate than at which they are formed.

6. The general character of temperature, humidity, wind, precipitation, and solar radiation over a large geographic area is known as *climate.*

7. The character of temperature, humidity, wind, precipitation, and solar radiation for a localized area is called the *microclimate* for that area.

8. The *canopy* of a deciduous tree is formed by its branches and provides shade to an area.

9. *Landscaping* is the art of arranging land, plants, and buildings together for human use and enjoyment.

10. To achieve *solar access*, sunlight must be allowed to reach solar collectors and windows without obstruction.

11. *Overheating* occurs when excessive amounts of heat are allowed to build up.

12. *Deciduous* plants lose their leaves at the end of the growing season, generally in the fall.

13. Low growing plants that cover the soil are called *groundcovers.*

14. *Evergreen* plants keep their leaves throughout the four seasons, including winter.

15. A *windbreak* is something that is used to break the force of the wind.

16. The *windward* direction is the direction the wind is coming from.

Teaching Note: *The students may use the Energy Conservation Study Guide Computer Program for individual study and review for this lesson.*

Day 2:

Teaching Note: *Discuss the Scientific Terms Work Sheet (Work Sheet B) with the class.*

Teaching Note: *Demonstrate "Observing Shade Patterns throughout the Day" activity. Students can take notes and record them on the Student Activity Sheet during the teacher demonstration. The steps and procedures are found in the Student Activity - 1 Information Sheet, "Observing Shade Patterns throughout the Day". The activity and demonstration steps are summarized below.*

Activity Summary: *Its best to do this activity on a sunny day. In this activity, students are required to observe an object such as a tree or roof overhang, that casts a shadow at three different times during the school day. The best times to observe the change in solar angles are 9:00 - 10:00 a.m., Noon, and 3:00 p.m. Since it may not be possible to observe shade patterns at these times due to conflicts within the school schedule, suggested observation times may include before school, lunch, after school, and/or during class time. Ideally, the students will do the activity during class time before performing other observations on their own. Students can work in groups of 2 - 5 students. Have students select an object usually found in the home landscape that casts a shadow for this activity. Some feasible objects include fences, shrubs, trees, roof overhangs, and buildings. Each group should use a different object. Students will measure or trace the shade patterns of the object on the ground at three different times during the day. Chalk can be used to trace shade patterns on asphalt or concrete. If it is not feasible to measure the shade patterns, then estimate measurements. Distances can be "stepped off" to estimate length. Students should complete Student Activity - 1 Record Sheet during the activity.*

Teaching Note: *Assign and discuss Student Activity - 1 Information Sheet, "Observing Shade Patterns throughout the Day". Provide the students with supplies for the student activity and answer any questions. Coordinate the Student Activity.*

STUDENT ACTIVITY NOTE SHEET

List steps to follow:

1. Observe shade patterns of object

2. Measure shade patterns of object

3. Trace landscape design

4. Landscape for summer cooling

5. Landscape for winter warming

STUDENT ACTIVITY - 1
INFORMATION SHEET

OBSERVING SHADE PATTERNS THROUGHOUT THE DAY

a. **Introduction:** Solar angles are effected by time of the day, season, and latitude. This activity will encourage you to observe the solar angle of the sun during the day and the shade patterns of objects in the landscape. Everyday the sun appears to rise in the Northeast in the morning and set in the Northwest in the evening. As the sun travels across the sky, the angle of the sun striking the earth changes, too. This causes shade patterns to change during the day also. People can use information about shade patterns to aid in cooling their homes in the summer and maintaining solar access during the winter.

b. **Purpose:** to understand how the time of day effects the angle of the sun and shade patterns

c. **What each group of students need:**
chalk
yardstick or tape measure

d. **Here's How:**

1. Work in your assigned group.

2. Select an object that is usually found in the home landscape that casts a shadow.(Some feasible objects include fences, shrubs, trees, roof overhangs, and buildings.) Each group should use a different object.

3. Complete Part A: Predictions of the Student Activity - 1 Record Sheet.

4. Observe the object. Measure or trace the shade patterns of the object on the ground. Chalk can be used to trace shade patterns on asphalt or concrete. If it is not feasible to measure the shade patterns, then estimate measurements.

5. Record your observations in Part B: Data of the Student Activity - 1 Record Sheet.

6. Repeat observations two more times during the day. Record observation in Part B: Data of the Student Activity - 1 Record Sheet.

7. Complete Part C: Conclusions of the Student Activity - 1 Record Sheet.

STUDENT ACTIVITY - 1
RECORD SHEET

A. Predictions:

1. At what time a day will your object's shadow be the longest?

   Answers will vary.

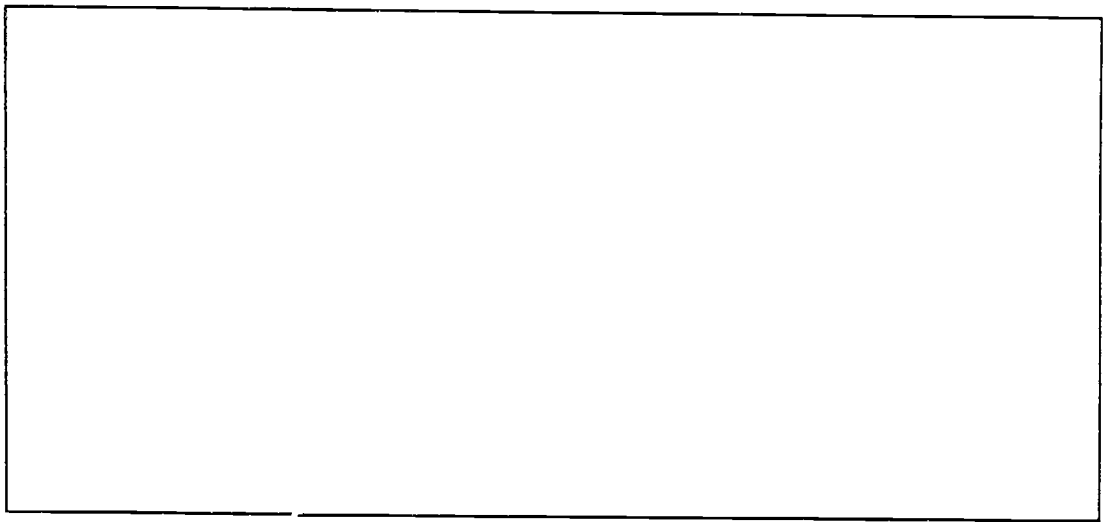
2. At what time a day will your object's shadow be the shortest?

   Answers will vary.

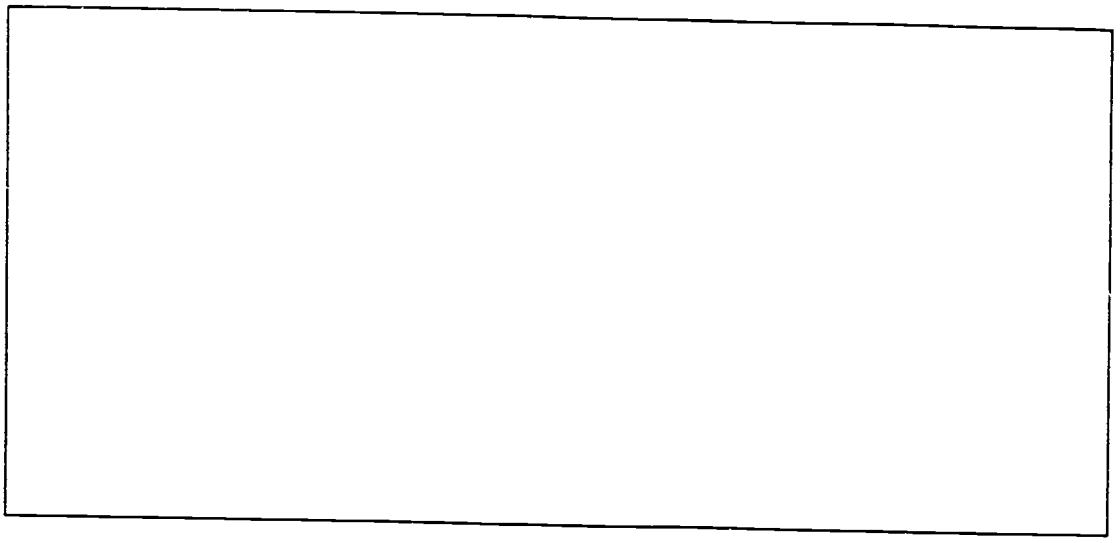
3. Sketch where the sun is in the sky, your object, and its anticipated shade patterns in the boxes below. Indicate orientation (which direction North is) on your sketch.

   Answers will vary, but should show varying shade patterns and orientation.

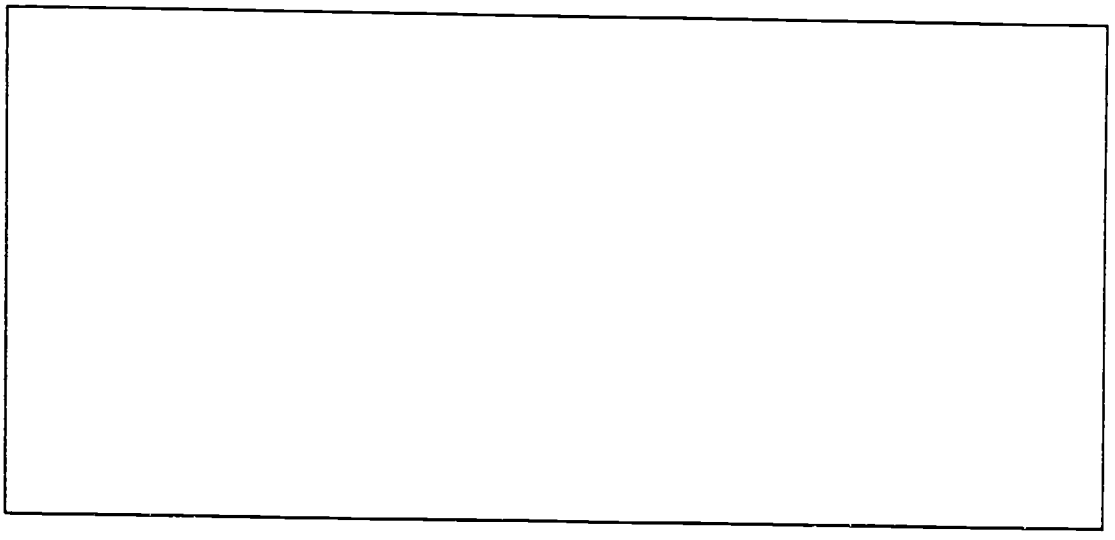
   Morning:



Noon:



Afternoon:



B. Data:

MORNING

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

   Morning:

NOON

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

   Noon:

AFTERNOON

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

   Afternoon:

C. Conclusions:

1. At what time of day was the shadow the longest?

   Answers will vary, but shadows will be the longest early in the day or late in the day.

2. At what time of day was the shadow the shortest?

   Answers will vary, but shadows will be the shortest at noon.

3. Where was the shadow in relationship to the object in the morning, noon, and afternoon?

   Answers will vary according to season and orientation.

4. What was the path of the sun as it traveled across the sky?

   Answers will vary according to season, but generally should state the sun rose in the northeast and traveled across the sky and set in the northwest.

5. How did the angle of the sun change during the day?

   Answers will vary, but should indicate the sun was high in the sky at midday and lower in the sky at other times.

Teaching Note: *The students may use the Energy Conservation Study Guide Computer Program for individual study and review of this lesson.*

Day 3

Teaching Note: *Discuss data and conclusions from Student Activity - 1 "Observing Shade Patterns throughout the Day " with the class.*

Teaching Note: *Explain the following method of energy conservation to the class.*

LANDSCAPING YOUR HOME FOR ENERGY EFFICIENCY

Lecture Note: *Use overhead #5 (Landscaping).*

- Landscaping is the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment. For most people, this means planting trees, shrubs, flowers, grass, and groundcovers around their home to make it more attractive.

Lecture Note: *Use overhead #6 (Energy Efficient Landscape).*

- An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed. Besides reducing home heating and cooling costs, landscaping can have other advantages. Landscaping can be done on both existing and new homes. It can increase the value of your home and add beauty or privacy to it.

- Landscaping can also reduce the heating and cooling costs of buildings other than homes. Some examples of other buildings which use landscaping to cut energy costs are: office buildings, livestock production facilities such as farrowing houses, storage facilities for equipment, and machine shops. Greenhouses and nurseries often use windbreaks for winter climate control.

WHICH DIRECTION DOES YOUR HOUSE FACE?

Lecture Note: *Use overhead #7 (Orientation of House in Winter).*

WINTER

- No matter which direction your house is turned, the side that faces south will receive the most sunlight in the winter. Windows and/or solar collectors placed on the south side of the house will allow sunlight to enter and heat the house. If winter heating is important to your situation, sunlight needs to reach southern windows or solar collectors.

- East and west windows receive some sunlight in the winter. In very cool climates, this sunlight that shines on the east & west wall should be used to heat the house in the winter. However, in Illinois the sun that strikes the east and west walls also causes major heat buildup in the summer.

- The North side receives the least amount of sunlight of any side of a house. It receives only indirect sunlight in the winter, so providing solar access on the north side of the house in the winter is unimportant. Protection from the winter wind on the North side of the house may be very important.

Lecture Note: *Use overhead #8 (Orientation of House in Summer).*

SUMMER

- East and west windows and walls receive the most summer sun. They receive more summer sun than south windows and the south wall. If east and west windows are unshaded, they are a major cause of overheating the house in the summer. Generally in Illinois, it is more important to shade the east and west side from the summer sun than maintain solar access during the winter.

- The south windows and walls of a house receive sunlight in the summer. However, the need for solar access during the winter generally takes priority over summer shade.

- The north windows and walls of the house receive the least amount of direct sunlight in the summer. Windows on the north side of the house may be very important for ventilation by utilizing summer breezes.

Lecture Note: *Use overhead #9 (Choose a Strategy).*

CHOOSE A STRATEGY

- Generally you should decide which problem you want to solve. Either solve winter heating problems or summer cooling problems. You must determine if it is more important to landscape to aid in summer cooling or landscape to reduce the costs of winter heating of your home. Summer cooling and winter heating costs can both be reduced by landscaping. However, they are two different problems and are treated very differently. Whichever problem you tackle, make sure strategies that are aimed to keep your house cooler in the summer don't also keep it cooler in the winter and vices versa. You don't want to save money on summer cooling just so you can pay more money for winter heating.

- When developing your landscape strategy, make sure you have a good understanding of your climate and the microclimate around you home. Information about average temperatures during winter and summer are usually available from your power company. Your microclimate can be assessed by examining your home for any conditions or features that will change the outside temperature around your home from your neighbors. A few features that can change the microclimate around your house are listed below:
    1. elevation (house on a hill verses a house in a valley)
    2. Proximity to a stream, pond, lake, or ocean
    3. Type of ground covers found around the house (concrete, asphalt, rock, grass)
    4. Distance house is from other buildings
    5. Distance house is from existing trees and shrubs around the home

SUMMER COOLING BY LANDSCAPING

Lecture Note: *Use overhead #10 (Principles to Aid in Summer Cooling).*

- When landscaping a home to aid in summer cooling, use a combination of the following 3 principles:

    1. Shade your house from the sun. Protect east and west windows, walls and roof areas from the sun.

    2. Use groundcovers and low growing plants to reduce the amount of sunlight absorbed by the ground near the house or reflected through the windows of the house.

    3. Keep natural summer breezes free from obstacles. Channel summer breezes to the house if possible.

APPLYING SUMMER COOLING PRINCIPLES

- Shade the west windows and wall and the east windows and wall of your house from the sun. First, plant deciduous trees, shrubs, or vines on the west side of the house to provide afternoon shade. Afternoon shade is usually more important than morning shade because the outside temperature is hotter, the sun is more intense, the house has already heated up during the day, and generally more people are at home. After deciduous trees, shrubs, or vines have been planted on the west side of the house, plant them on the east side. Plant trees so they shade windows. It is more important to shade windows than insulated walls. Shading a window can provide 50 - 80 times as much energy savings as shading an insulated wall.

- Shade the yard, driveways, and patios that surround your house. Light colored concrete or gravel can reflect light back into your house and raise temperatures inside of your house. When asphalt and soil are left unshaded in the summer, they absorb heat. By shading these areas, you can cool them so it is comfortable to be outside or so cooler air can be used to ventilate your house.

- Shade your roof. Plant deciduous trees that grow tall and have a wide canopy on top. These trees should not have many branches or undergrowth below the canopy. By choosing tall, deciduous trees with wide canopies, you are allowing sunlight to strike the house in the winter when the sun is low in the sky, yet shading the roof of the house in the summer when the sun is high in the sky.

- Plant ground covers, turf, low shrubs, or vines, around your house wherever possible. Avoid concrete, asphalt, and brick near the house and shade them when they are used.

- Use summer breezes to cool your house and yard. If you live near a lake or on a hill, you may be able to determine a prevailing wind direction and take advantage of summer breezes. If you cannot determine a prevailing wind direction your will want to take advantage of any breezes.

WINTER WARMING BY LANDSCAPING

Lecture Note: *Use overhead #11 (Principles to Aid in Winter Warming).*

- When landscaping a home to aid in winter warming, use the following two principles:

  1. Provide solar access on the south side of the house.

  2. Protect the house from winter winds.

APPLYING WINTER WARMING PRINCIPLES

- Provide solar access on the south side of the house. Avoid shading south windows and solar collectors. Avoid planting trees, even deciduous trees, in front of windows and solar devices that face south. Even deciduous trees can block as much as 60% of winter sunlight.

- Plant windbreaks if you are in an area where winter winds are strong (greater than 10 mph) and consistently from the same direction. Plant windbreaks on the windward side of the house, without blocking summer breezes.

- Design the windbreak so it is as tall or taller than the house. This way air currents will be deflected up and over the house.

- Locate the windbreak so it is 1 - 3 times its height away from the house. Windbreaks that are planted far from the house must be taller and wider than windbreaks planted near the house.

- The windbreak should be dense but not solid. It should allow 25 to 60% of air to flow through. Foliage should extend from the ground to the top.

- Plant evergreen trees and shrubs on the north side of your house because they retain their foliage and block more wind.

WORK SHEET C

DIRECTIONS: Complete the following questions.

A. Fill-in-the Blank:

1. An energy efficient landscape uses *sunlight* and *wind* when they are needed and reduces their intensities when they are not needed.

2. No matter which direction your house is turned, the side that faces *south* will receive the most sunlight in the winter.

3. *East* and *west* windows and walls receive the most summer sun.

4. Summer cooling and winter heating costs can both be reduced by landscaping, but they are done quite *differently*.

5. When developing your landscape strategy, make sure you have a good understanding of your climate and the *microclimate* around you home.

6. Plant deciduous trees, shrubs, or vines on the *west* side of the house to provide afternoon shade in the summer.

7. In the summer, it is more important to shade *windows* than insulated walls.

8. Light colored concrete or gravel can reflect light back into your house and *raise* temperatures inside of your house.

9. Plant deciduous trees that grow tall and have wide canopies at their top, so they shade the *roof* of your house in the summer.

10. Tall deciduous trees planted near the house, allow sunlight to strike the house in the winter when the sun is *low* in the sky, yet shade the roof of the house in the summer when the sun is *high* in the sky.

11. Provide solar access on the *south* side of the house to aid in winter warming.

12. Plant evergreen trees and shrubs on the *north* side of your house because they retain their foliage and block more wind in the winter.

13. Locate windbreaks so they are *1 - 3* times their height away from the house.

B. Short Answer:

1. List 3 landscape principles that can be used to aid in summer cooling.

   1. *Shade your house from the sun.*

   2. *Use ground covers around your house.*

   3. *Keep natural summer breezes unobstructed.*

2. List 2 landscape principles that can be used to aid in winter warming.

   1. *Provide solar access on the south side of the house.*

   2. *Protect the house from winter winds.*

Teaching Note: *The students may use the Energy Conservation Study Guide Computer Program for individual study and review for this lesson.*

Day 4

Teaching Note: *Demonstrate "Landscaping for Energy Efficiency" activity. Students can take notes and record them on the Student Activity Sheet during the teacher demonstration. The steps and procedures are found in the Student Activity - 2 Information Sheet, "Landscaping for Energy Efficiency". House plan and landscape symbols are found on the following pages. These pages can be duplicated for student use. The activity and demonstration steps are summarized below:*

Activity Summary: *In this activity, students are required to trace a landscape plan onto tracing paper and design a landscape plan for energy efficiency. Students can work in groups of 2 - 5 students. The instructor can change the orientation of the house to add variety to the landscape plans. This can be done by just changing which direction North is on the plan. The landscape plan should be drawn to scale. A template can be used to draw landscape symbols onto the plan or onto construction paper. Landscape symbols cut from green construction paper could represent evergreen plants, while symbols cut from brown construction paper could represent deciduous plants. The symbols can be cut out and glued or taped to the design. At the completion of the activity, have students explain their landscape plantings to the class.*

Teaching Note: *Assign and discuss Student Activity - 2 Information Sheet, "Landscaping for Energy Efficiency". Provide the students with supplies for the student activity and answer any questions. Their landscape plans should reflect landscape principles. Coordinate the Student Activity.*

STUDENT ACTIVITY - 2
INFORMATION SHEET

Landscaping for Energy Efficiency

a. **Purpose:** to design landscape plantings that will modify temperatures in the home.

c. **What Each Group of Students Needs:**

houseplan
tracing paper
pencil
scissors
glue or tape
construction paper

c. **Here's How:**

1. Work in your assigned groups.

2. Trace houseplan onto tracing paper using orientation assigned to you by your instructor. Use a pencil to do this.

3. Determine a landscape strategy for winter warming and summer cooling for the house.

4. Draw landscape symbols on construction paper to be in scale with your houseplan.

5. Add symbols to the houseplan using glue or tape to show where plants should be located to increase energy efficiency.

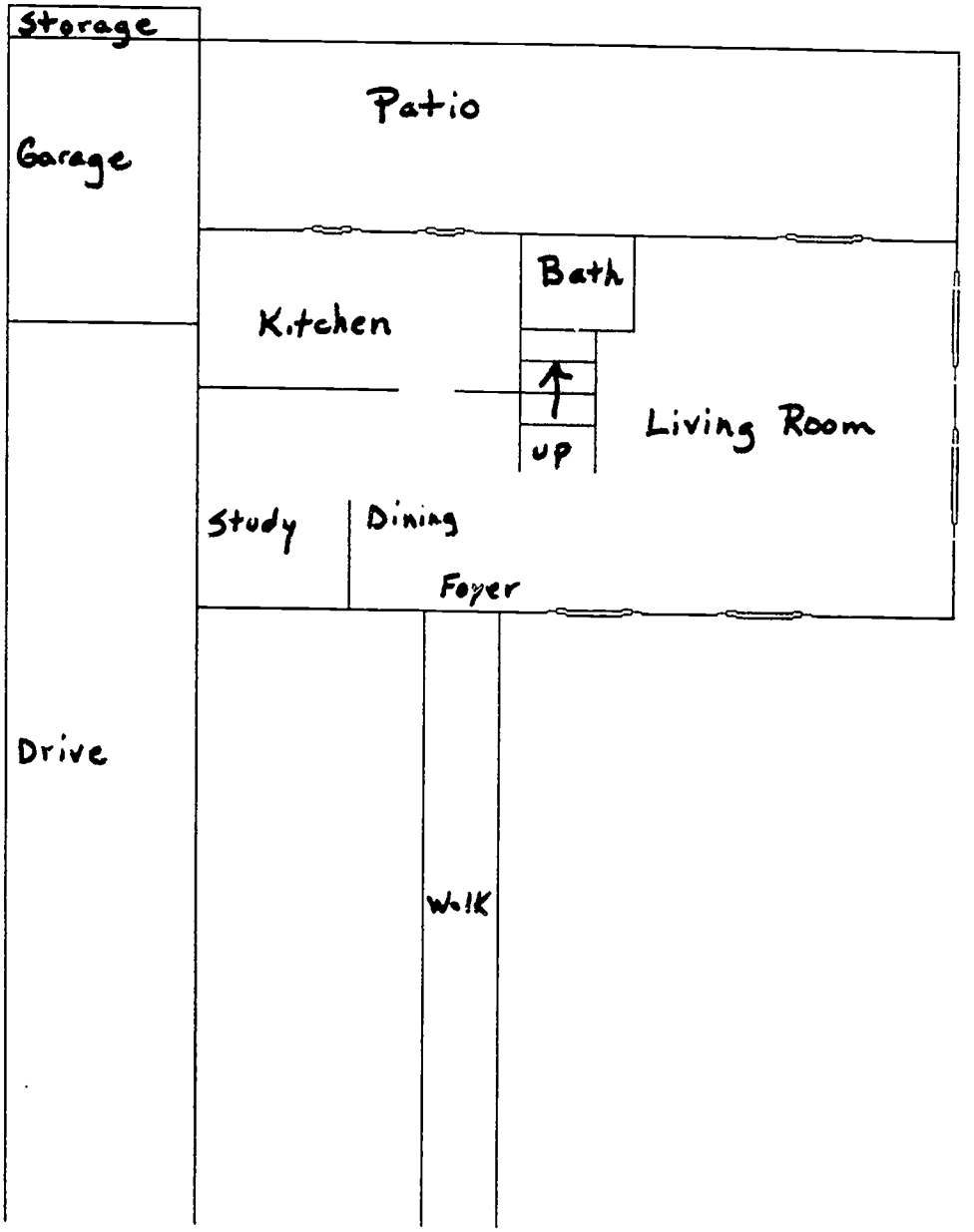
6. Clean up your work area.

7. Defend your rationale to your instructor and classmates.

Sample Houseplan

NORTH -->

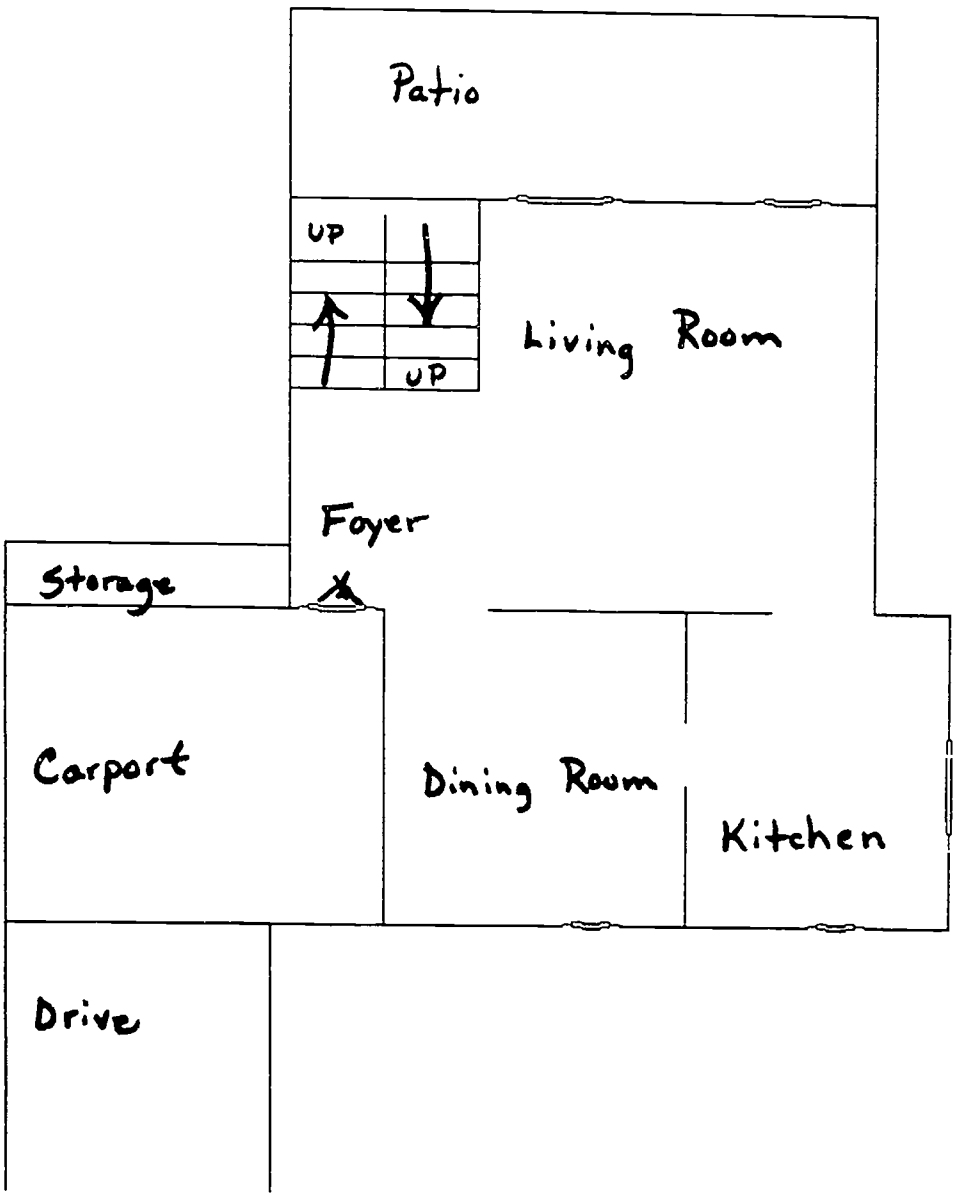
SCALE: 1/4" = 4'



Sample Houseplan

NORTH -->

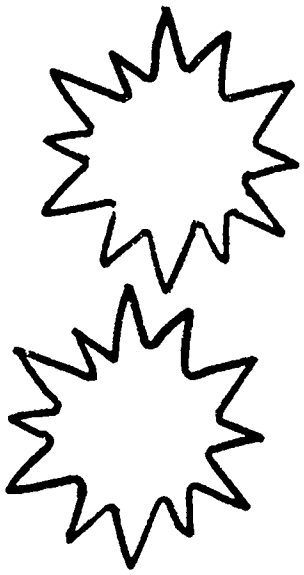
Scale: 1/4" = 4'



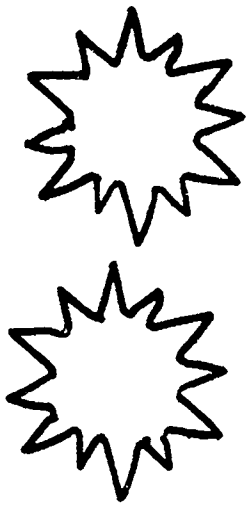
Sample Landscape Symbols

Evergreen Trees or Shrubs
Scale: 1/4" = 4'
(If larger symbols are desired, they may be drawn free hand.)

24 feet

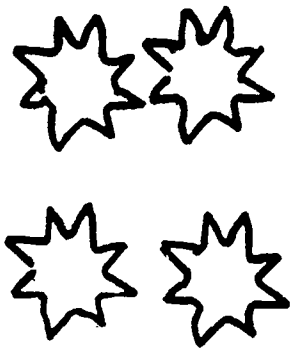


20 feet

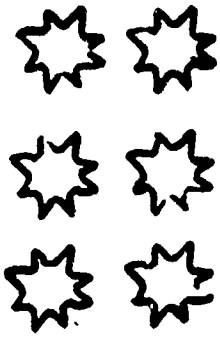


16 feet

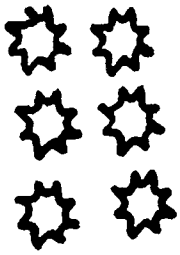
12 feet



8 feet

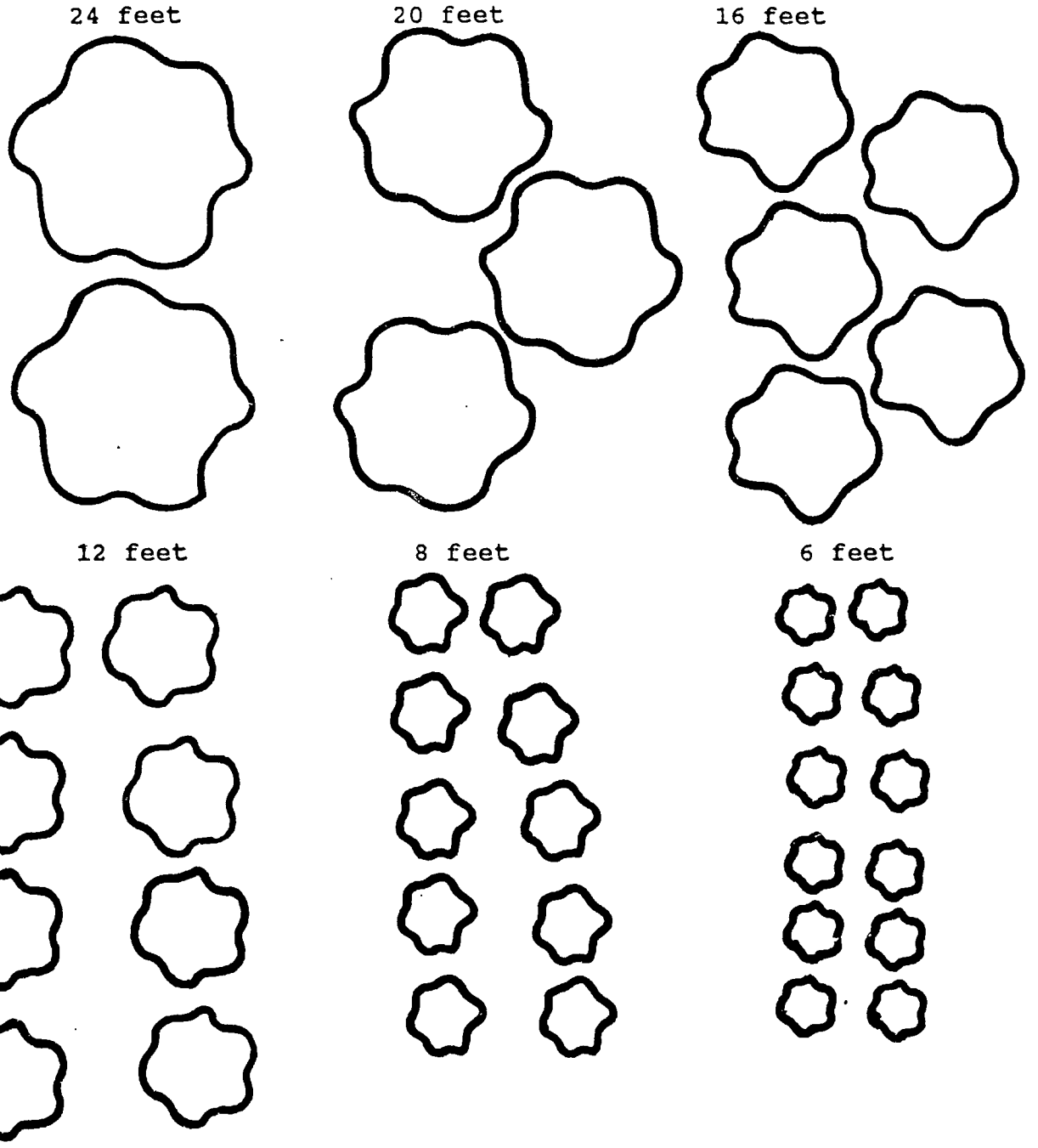


6 feet



Sample Landscape Symbols

Deciduous Trees or Shrubs
Scale: 1/4" = 4'
(If larger symbols are desired, they may be drawn free hand.)



Teaching Note: *Discuss results of Student Activity - 2 "Designing an Energy Efficient Landscape" with the class.*

Teaching Note: *The students may use the Energy Conservation Computer Quiz for individual evaluation.*

Day 5:

Teaching Note: *Review information about Energy Conservation, Solar Angles, and Landscaping your home for energy efficiency with students. Some key facts are listed below:*

Teacher Review:

- Energy conservation is the careful use of our energy resources. Two reasons for the interest in energy conservation are the high economic cost of energy and the fear that some day it will not be available for us to use.
- All of our major energy sources are fossil fuels and are non-renewable. The more energy we save now, the longer our current supply of fossil fuels will last.
- Research and time is still needed to switch to alternative energy sources.

SOLAR ANGLES

- The angle of the sun changes with the time of day, season, and latitude.
- The earth has an elliptical orbit around the sun. This causes sunlight to strike the northern hemisphere of the earth more directly in the summer than in the winter. This makes the days in the summer longer & the sun appear at a higher altitude than in the winter.
- Geographic location also effects solar angle. The sun in Southern Illinois appears higher in the sky than Northern Illinois.
- Landscaping is the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment. For most people, this means planting trees, shrubs, flowers, grass, and groundcovers around their home to make it more attractive.

- An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed.

WHICH DIRECTION DOES YOUR HOUSE FACE?

WINTER

- No matter which direction your house is turned, the side that faces south will receive the most sunlight in the winter.

- East and west windows receive some sunlight in the winter. However, in Illinois the sun that strikes the east and west walls causes major heat buildup in the summer.

- The North side receives only indirect sunlight in the winter, so providing solar access on the north side of the house in the winter is unimportant. Protection from the winter wind on the North side of the house may be very important.

SUMMER

- East and west windows and walls receive the most summer sun. They receive more summer sun than south windows and the south wall. If east and west windows are unshaded, they are a major cause of overheating the house in the summer.

- The south windows and walls of a house receive sunlight in the summer. However, the need for solar access during the winter generally takes priority over summer shade.

- The north windows and walls of the house receive the least amount of direct sunlight in the summer. Windows on the north side of the house may be very important for ventilation by utilizing summer breezes.

CHOOSE A STRATEGY

- Generally you should decide which problem you want to solve: either winter heating or summer cooling. When developing your landscape strategy, make sure you have a good understanding of your climate and the microclimate around you home.

SUMMER COOLING BY LANDSCAPING

- When landscaping a home to aid in summer cooling, use a combination of the following 3 principles:

  1. Shade your house from the sun. Protect east and west windows, walls and roof areas from the sun.

  2. Use groundcovers and low growing plants to reduce the amount of sunlight absorbed by the ground near the house or reflected through the windows of the house.

  3. Keep natural summer breezes free from obstacles. Channel summer breezes to the house if possible.

WINTER WARMING BY LANDSCAPING

- When landscaping a home to aid in winter warming, use the following two principles:

  1. Provide solar access on the south side of the house.

  2. Protect the house from winter winds.

Teaching Note: *Students should complete Work Sheet D: Student Review during class time.*

WORK SHEET D: STUDENT REVIEW

1. List two reasons why energy conservation is important?

   Energy conservation is important because of the high economic cost of energy and the fear that some day it will not be available for us to use.

2. Explain how the angle of the sun changes with seasons in the Northern hemisphere.

   The sun strikes the northern hemisphere of the earth more directly in the summer than in the winter. This makes the days in the summer longer & the sun appear at a higher altitude than in the winter. In the winter, the days are shorter, the sun appears lower in the sky, and shadows are longer.

3. Explain how the angle of the sun changes with geographic latitude in the Northern hemisphere.

   Geographic location affects the solar angle. The sun in southern part of the Northern hemisphere appears higher in the sky than that of the northern part of the Northern hemisphere.

4. Describe how an energy efficient landscape modifies temperatures inside and around the house.

   An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed.

5. Why is it important to maintain solar access on the south side of a house in Illinois?

   The south side receives the most sunlight in the winter. Windows and/or solar collectors placed on the south side of the house will allow sunlight to enter and heat the house. If winter heating is important to your situation, sunlight needs to reach southern windows or solar collectors.

6. Why is it important to shade the west and east side of a house?

East and west windows and walls receive the most summer sun. They receive more summer sun than south windows and the south wall. If east and west windows are unshaded, they are a major cause of overheating the house in the summer.

7. List the 3 landscape principles used to in reduce cooling costs in the summer.

   1. *Shade your house from the sun. Protect east and west windows, walls and roof areas from the sun.*

   2. *Use groundcovers and low growing plants to reduce the amount of sunlight absorbed by the ground near the house or reflected through the windows of the house.*

   3. *Keep natural summer breezes free from obstacles. Channel summer breezes to the house if possible.*

8. List the two landscape principles used to reduce heating costs in the winter.

   1. *Provide solar access on the south side of the house.*

   2. *Protect the house from winter winds.*

Teaching Note: *The students may use the Energy Conservation Computer Quiz for individual evaluation.*

Teaching Note: *Quiz 1 can be used to evaluate student's knowledge of Energy Conservation.*

QUIZ 1

A: MATCHING:

__g__1.alternative energy sources

__f__2.landscaping

__e__3.deciduous

__c__4.evergreen

__b__5.energy conservation

__d__6.microclimate

__a__7.solar access

a. allowing sunlight to reach solar collectors and windows without obstruction
b. the careful use of our energy resources
c. trees, shrubs, and other plants which retain leaves throughout the four seasons, including winter
d. the character of temperature, humidity, wind, precipitation, and solar radiation in a localized area
e. trees, shrubs, and other plants which lose all of their leaves after the growing season, usually in the fall
f. the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment.
g. energy derived from sources other than fossil fuels; such as sun, wind, and water

B: TRUE OR FALSE:

False 8. All of our major energy sources are renewable.

True 9. The angle of the sun changes with the time of day, season, and latitude.

True 10. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower altitude than in the summer.

True 11. An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed.

False 12. No matter which direction your house is turned, the side that faces south will receive the most sunlight in the summer.

C: FILL-IN-THE BLANK:

13. _East_ and _west_ windows and walls receive the most summer sun.

14. Plant deciduous trees, shrubs, or vines on the _west_ side of the house to provide afternoon shade in the summer.

15. Tall deciduous trees planted near the house, allow sunlight to strike the house in the winter when the sun is _low_ in the sky, yet shade the roof of the house in the summer when the sun is _high_ in the sky.

16. Provide solar access on the _south_ side of the house to aid in winter warming.

17. Plant evergreen trees and shrubs on the _north_ side of your house because they retain their foliage and block more wind in the winter.

18. Locate windbreaks so they are _1-3_ times their height away from the house.

D: SHORT ANSWER:

19. How can you landscape your home to aid in cooling it in the summer?

Shade your house from the sun. Use ground covers around your house. Keep natural summer breezes.

20. How can you landscape your home to aid in warming it in the winter?

Provide solar access on the south side of the house. Protect the house from winter winds.

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E: AUDIO VISUAL MATERIALS:

OH1. IMPORTANCE OF ENERGY CONSERVATION

OH2. SOLAR ANGLES

OH3. EARTH'S ROTATION

OH4. EARTH'S ORBIT

OH5. LANDSCAPING

OH6. ENERGY EFFICIENT LANDSCAPE

OH7. ORIENTATION OF HOUSE IN WINTER

OH8. ORIENTATION OF HOUSE IN SUMMER

OH9. CHOOSE A STRATEGY

OH10. PRINCIPLES TO AID IN SUMMER COOLING

OH11. PRINCIPLES TO AID IN WINTER WARMING

OH1

IMPORTANCE OF ENERGY CONSERVATION

1. HIGH COST OF ENERGY

2. FEAR CURRENT ENERGY SOURCES WILL BE DEPLETED

OH2

SOLAR ANGLES CHANGE WITH:

1. TIME OF DAY

2. SEASON

3. LATITUDE

OH3

EARTH'S ROTATION

1. EARTH COMPLETES FULL 360° ROTATION EVERY 24 HOURS

2. THE EARTH'S ROTATION GIVES SUN THE APPEARANCE OF RISING IN EAST AND SETTING IN THE WEST

OH4

EARTH'S ORBIT

EARTH'S POLAR AXIS IS TILTED 23.5° MAKING EARTH'S ORBIT ELLIPTICAL.

DURING THE SUMMER IN THE NORTHERN HEMISPHERE:

1. SUN STRIKES EARTH MORE DIRECTLY
2. DAYS ARE LONGER
3. SUN APPEARS AT HIGHER ALTITUDE
4. SHADOWS ARE SHORTER

OH5

WHAT IS LANDSCAPING?

LANDSCAPING IS THE ART OF ARRANGING & FITTING TOGETHER OF LAND, PLANTS, & BUILDINGS

HOW DO MOST PEOPLE LANDSCAPE?

PLANT TREES
PLANT SHRUBS
PLANT FLOWERS
PLANT GROUNDCOVERS

OH6

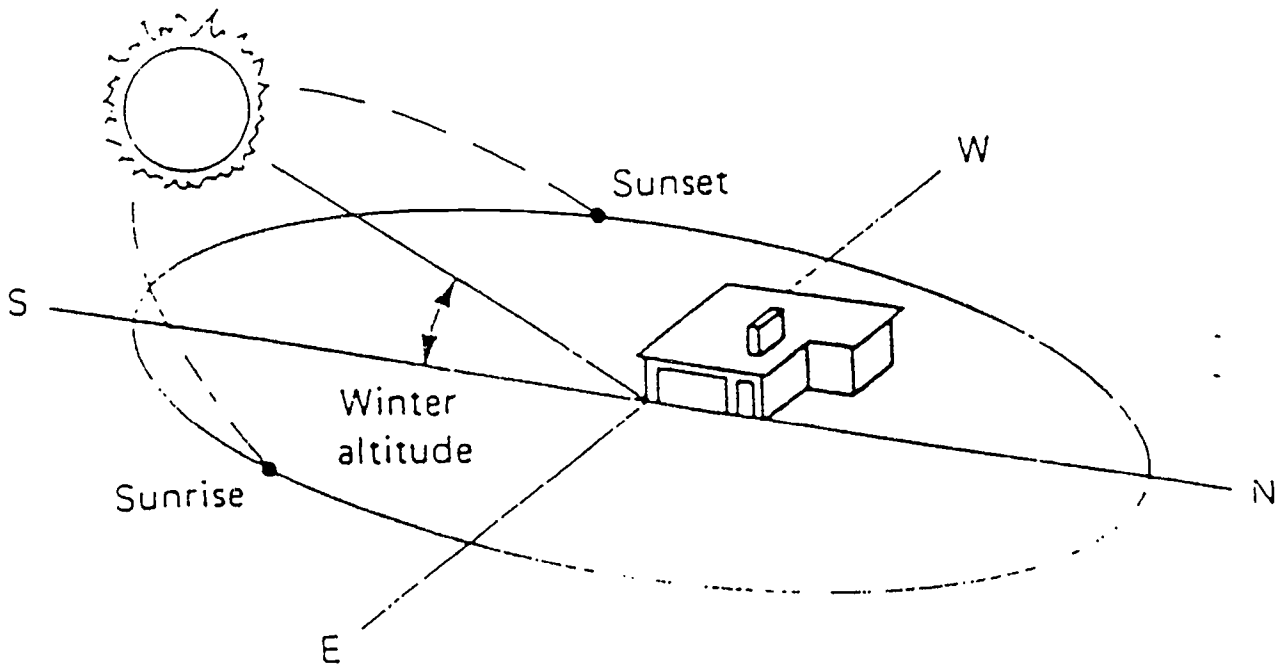
ENERGY EFFICIENT LANDSCAPE

1. USES SUNLIGHT AND WIND WHEN THEY ARE NEEDED

2. REDUCES SUNLIGHT & WIND INTENSITIES WHEN THEY ARE NOT NEEDED

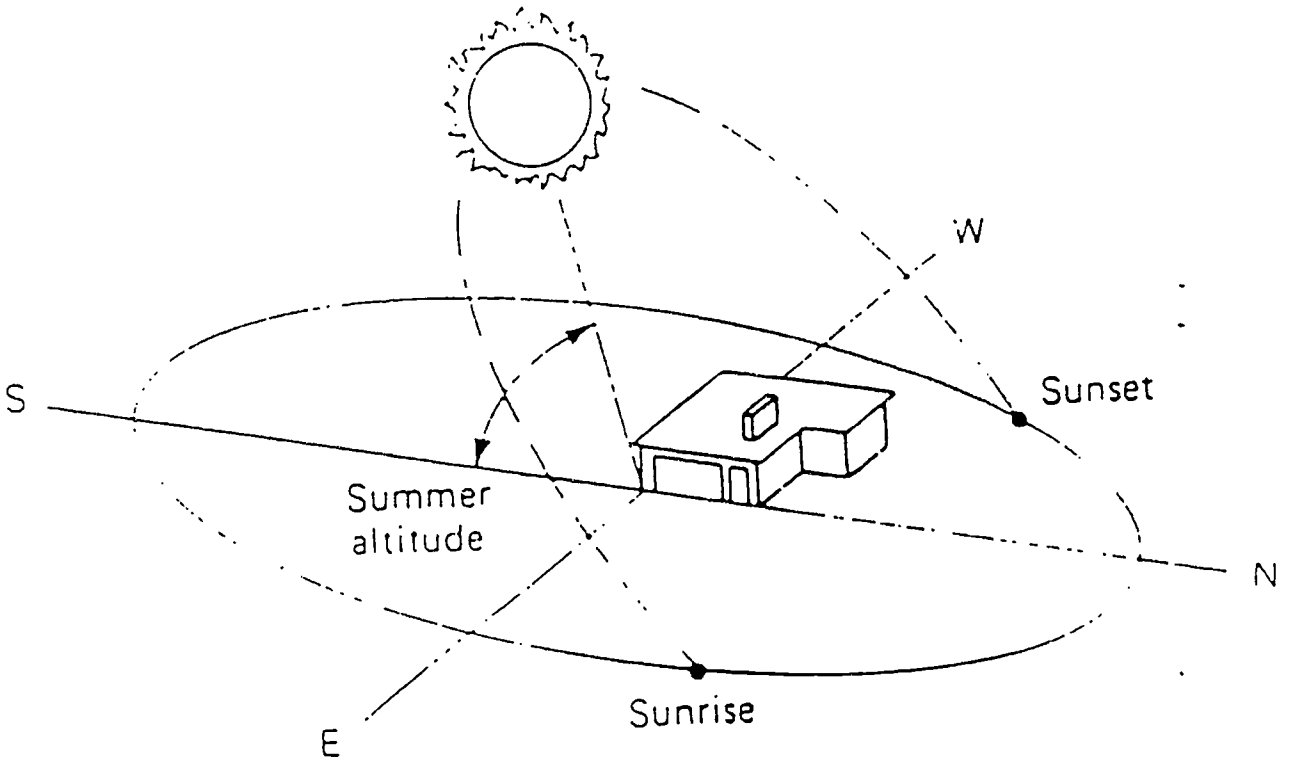
OH7

ORIENTATION OF HOUSE IN THE WINTER



OH8

ORIENTATION OF HOUSE IN THE SUMMER



CHOOSE A STRATEGY

1. SOLVE WINTER HEATING PROBLEMS

OR

2. SOLVE SUMMER COOLING PROBLEMS

OH10

PRINCIPLES TO AID IN SUMMER COOLING

1. SHADE YOUR HOUSE FROM THE SUN.

2. USE GROUND COVERS AROUND YOUR HOUSE.

3. KEEP NATURAL SUMMER BREEZES.

PRINCIPLES TO AID IN WINTER WARMING

1. PROVIDE SOLAR ACCESS ON THE SOUTH SIDE OF THE HOUSE

2. PROTECT THE HOUSE FROM WINTER WINDS

F. STUDENT HANDOUTS AND QUIZ

Student Information Guide

Work Sheet A

Work Sheet B

Work Sheet C

Work Sheet D

Student Activity Note Sheet

Student Activity - 1 Information Sheet

Student Activity - 1 Record Sheet

Student Activity - 2 Information Sheet

Student Activity - 2 Houseplans

Student Activity - 2 Landscape Symbols

Quiz 1

STUDENT INFORMATION GUIDE

ENERGY CONSERVATION

Energy conservation is the careful use of our energy resources. Many Americans have focused their attention on using energy more efficiently since the energy crisis of the mid-1970's. Two reasons for the interest in energy conservation are the high economic cost of energy and the fear that some day it will not be available for us to use.

Our major sources of energy are fossil fuels. Fossil fuels are the remains of organisms that lived millions of years ago which release energy when they are burned. Some examples of fossil fuels are coal, oil, and natural gas. All of our major energy sources are non-renewable. Energy sources that are used up at a much faster rate than at which they are formed are classified as non-renewable. Once these resources have been used up, they cannot be replaced. Although scientists do not agree on when our fossil fuels will be depleted, most scientists agree that our fossil fuels will eventually run out and we will need different energy sources to heat our homes, run our cars, and keep our industry producing goods. By conserving energy, we can reduce the amount of fossil fuels we consume. The more energy we save now, the longer our current supply of fossil fuels will last.

Research and time is still needed to switch to alternative energy sources. Alternative energy resources are being researched and developed. They include energy that is derived from any sources other than fossil fuels. Some examples of alternative energy sources are sun, wind, and water. Many alternative energy systems are still more expensive than traditional systems that rely on fossil fuels. As our technology on alternative energy systems improve, its cost should be reduced. It is also difficult for many alternative energy fuels or systems to be installed into existing buildings and machines. A good time to integrate alternative energy systems into our lives is when we build new homes, remodel old ones, or buy new appliances or machines. So by conserving energy now, we will have more time to develop alternative energy sources and integrate them into our lives.

Energy is expensive. By reducing energy costs we keep American industry more competitive with other industries throughout the world. By conserving energy in our homes, we increase our disposable income. This gives a family more money to spend on items other than heating costs, electricity, and gasoline.

SOLAR ANGLE

The angle of the sun changes with the time of day, season, and latitude. The earth rotates on an axis that passes through the north and south poles. The earth completes a full 360^0 rotation every 24 hours. This rotation gives the sun the appearance of moving across the sky by rising in the east and setting in the west.

The earth has an elliptical orbit around the sun, because the earth's polar axis is tilted 23.5^0. This causes sunlight to strike the northern hemisphere of the earth more directly in the summertime, since it is tilting toward the sun. This makes the days longer & the sun appear at a higher altitude. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower altitude. This makes the winter daylight hours shorter and colder and the shadows longer than they are in the summer.

Geographic location also effects solar angle. For example, the sun at 37^0 North latitude (Southern Illinois) appears higher in the sky than at 42^0 North (Northern Illinois). This is why a roof overhang on a building shades more of a south wall in Southern Illinois than Northern Illinois.

LANDSCAPING YOUR HOME FOR ENERGY EFFICIENCY

Landscaping is the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment. For most people, this means planting trees, shrubs, flowers, grass, and groundcovers around their home to make it more attractive.

An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed. Besides reducing your home heating and cooling costs, landscaping can have other advantages. Landscaping can be done on both existing and new homes. It can increase the value of your home and add beauty or privacy to it.

WHICH DIRECTION DOES YOUR HOUSE FACE?

<u>WINTER</u>

The side of the house that faces south will receive the most sunlight in the winter. Windows and/or solar collectors, devices that collect solar energy, that are placed on the south side of the house will allow sunlight to enter and heat the house. If winter heating is important to your situation, sunlight needs to reach southern windows or solar collectors.

East and west windows receive some sunlight in the winter. In very cold climates, the sunlight that shines on the east & west wall should be used to heat the house in the winter. However, in Illinois the sun that strikes the east and west walls also causes major heat buildup in the summer.

The North side receives the least amount of sunlight of any side of a house. It receives only indirect sunlight in the winter, so providing solar access on the north side of the house in the winter is unimportant. Protection on the North side of the house from the winter wind may be very important.

SUMMER

East and west windows and walls receive the most summer sun. They receive more summer sun than south windows and the south wall. Overheating occurs when excessive amounts of heat are allowed to build up. If east and west windows are unshaded, they are a major cause of overheating the house in the summer. Generally in Illinois, it is more important to shade the east and west side from the summer sun than maintain solar access during the winter.

The south windows and walls of a house receive sunlight in the summer. However, the need for solar access during the winter is also important. Solar access, or the allowance of sunlight to reach solar collectors and windows without obstruction, generally takes priority over summer shade.

The north windows and walls of the house receive the least amount of direct sunlight in the summer. Windows on the north side of the house may be very important for ventilation by utilizing summer breezes.

CHOOSE A STRATEGY

Generally you should decide which problem you want to solve--winter heating or summer cooling. You must determine if it is more important to landscape to aid in summer cooling or landscape to reduce the costs of winter heating of your home. Summer cooling and winter heating costs can both be reduced by landscaping. However, they are two different problems and are treated very differently. Whichever problem you tackle, make sure strategies that are aimed to keep your house cooler in the summer don't also keep it cooler in the winter and vices versa. You don't want to save money on summer cooling just so you can pay more money for winter heating.

When developing your landscape strategy, make sure you have a good understanding of your climate and the microclimate around you home. Climate is the general character of temperature, humidity, wind, precipitation, and solar radiation over a large geographic area. Information about climate including average temperatures during winter and summer are usually available from your power company. Microclimate is the character of temperature, humidity, wind, precipitation, and solar radiation in a

localized area. Your microclimate can be assessed by examining your home for any conditions or features that will change the outside temperature around your home from your neighbors. A few features that can change the microclimate around your house are listed below:
1. elevation (house on a hill verses a house in a valley)
2. Proximity to a stream, pond, lake, or ocean
3. Type of ground covers found around the house (concrete, asphalt, rock, grass)
4. Distance house is from other buildings
5. Distance house is from existing trees and shrubs around the home

SUMMER COOLING BY LANDSCAPING
When landscaping a home to aid in summer cooling, use a combination of the following 3 principles:

1. Shade your house from the sun. Protect east and west windows, walls and roof areas from the sun.

2. Use groundcovers, low growing plants that cover the soil, to reduce the amount of sunlight absorbed by the ground near the house or reflected through the windows of the house.

3. Keep natural summer breezes free from obstacles. Channel summer breezes to the house if possible.

APPLYING SUMMER COOLING PRINCIPLES
Shade the west windows and wall and the east windows and wall of your house from the sun. First, plant deciduous trees, shrubs, or vines on the west side of the house to provide afternoon shade. Deciduous plants lose all their leaves after the growing season, usually in the fall. By planting deciduous plants on the west and east side of the house, shade is provided in the summer when it is needed and yet the area will still get sunlight in the winter when the warmth of the winter sun is needed. In the summer, afternoon shade is usually more important than morning shade because the outside temperature is hotter, the sun is more intense, the house has already heated up during the day, and generally more people are at home. After deciduous trees, shrubs, or vines have been planted on the west side of the house, plant them on the east side. Plant trees so they shade windows. It is more important to shade windows than insulated walls. Shading a window can provide 50 - 80 times as much energy savings as shading an insulated wall.

Shade the yard, driveways, and patios that surround your house. Light colored concrete or gravel can reflect light back into your house and raise temperatures inside of your house. When asphalt and soil are left unshaded in the summer, they absorb heat. By shading these areas, you can cool them so it is comfortable to be outside or so cooler air can be used to ventilate your house.

Shade your roof. Plant deciduous trees that grow tall and have a wide canopy on top. The canopy of a tree is formed by its branches to make the portion of the tree which provides shade. These trees should not have many branches or undergrowth below the canopy. By choosing tall, deciduous trees with wide canopies, you are allowing sunlight to strike the house in the winter when the sun is low in the sky, yet shading the roof of the house in the summer when the sun is high in the sky.

Plant ground covers, turf, low shrubs, or vines, around your house wherever possible. Avoid concrete, asphalt, and brick near the house and shade them when they are used.

Use summer breezes to cool your house and yard. If you live near a lake or on a hill, you may be able to determine a prevailing wind direction and take advantage of summer breezes. If you cannot determine a prevailing wind direction you will want to take advantage of any breezes.

WINTER WARMING BY LANDSCAPING
When landscaping a home to aid in winter warming, use the following two principles:

1. Provide solar access on the south side of the house.
2. Protect the house from winter winds.

APPLYING WINTER WARMING PRINCIPLES
Provide solar access on the south side of the house.

Avoid shading south windows and solar collectors. Avoid planting trees, even deciduous trees, in front of windows and solar devices that face south. Even deciduous trees can block as much as 60% of winter sunlight.

Plant windbreaks if you are in an area where winter winds are strong (greater than 10 mph) and consistently from the same direction. Windbreaks are used to break the force of the wind. Evergreen trees can be planted to form a windbreak. Plant windbreaks on the windward (the direction the wind is coming from) side of the house, without blocking summer breezes.

Design the windbreak so it is as tall or taller than the house. This way air currents will be deflected up and over the house.

Locate the windbreak so it is 1 - 3 times its height away from the house. Windbreaks that are planted far from the house must be taller and wider than windbreaks planted near the house.

The windbreak should be dense but not solid. It should allow 25% to 60% of air to flow through. Foliage should extend from the ground to the top.

Plant evergreen trees and shrubs on the north side of your house because they retain their foliage during the whole year and will block more wind than deciduous trees and shrubs.

WORK SHEET A

DIRECTIONS: Complete the following questions.

1. _____ is the careful use of our energy resources.

2. Two reasons for the interest in energy conservation are the high _____ of energy and the fear that some day it will not be available for us to use.

3. All of our major energy sources are _____.

4. The more energy we save now, the longer our current supply of _____ will last.

5. Many _____ energy systems are still more expensive than traditional systems that rely on fossil fuels.

6. It is _____ for many alternative energy fuels or systems to be installed into existing buildings and machines.

7. By conserving energy in our homes, we increase our _____.

8. The _____ of the sun changes with the time of day, season, and latitude.

9. The _____ of the earth gives the sun the appearance of moving across the sky by rising in the east and setting in the west.

10. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower _____ than in the summer.

WORK SHEET B

Directions:

The answers to the following fill-in-the blank questions are terms which have something to do with energy conservation. Choose the term from the word list below that best answers each question. Each term may be used only once.

Word List:

alternative energy sources
canopy
climate
deciduous
energy conservation
evergreen
fossil fuels
groundcovers
landscaping
microclimate
non-renewable resources
overheating
solar access
solar collectors
windward
windbreak

Fill-in-the blank:

1. Windows or devises that collect solar energy are called _____.

2. _____ is the careful use of our energy resources.

3. Energy derived from the sun, wind, water, or other energy sources other than fossil fuels are known as _____.

4. The remains of organisms which lived millions of years ago which release energy when they are burned are called _____.

5. _____ are energy sources that are used up at a much faster rate than at which they are formed.

6. The general character of temperature, humidity, wind, precipitation, and solar radiation over a large geographic area is known as _____.

7. The character of temperature, humidity, wind, precipitation, and solar radiation for a localized area is called the _____ _____ for that area.

8. The _____ of a deciduous tree is formed by its branches and provides shade to an area.

9. _____ is the art of arranging land, plants, and buildings together for human use and enjoyment.

10. To achieve _____, sunlight must be allowed to reach solar collectors and windows without obstruction.

11. _____ occurs when excessive amounts of heat are allowed to build up.

12. _____ plants lose their leaves at the end of the growing season, generally in the fall.

13. Low growing plants that cover the soil are called _____.

14. _____ plants keep their leaves throughout the four seasons, including winter.

15. A _____ is something that is used to break the force of the wind.

16. The _____ direction is the direction the wind is coming from.

WORK SHEET C

DIRECTIONS: Complete the following questions.

A. Fill - in - the Blank:

1. An energy efficient landscape uses _____ and _____ when they are needed and reduces their intensities when they are not needed.

2. No matter which direction your house is turned, the side that faces _____ will receive the most sunlight in the winter.

3. _____ and _____ windows and walls receive the most summer sun.

4. Summer cooling and winter heating costs can both be reduced by landscaping, but they are done quite _____.

5. When developing your landscape strategy, make sure you have a good understanding of your climate and the _____ around you home.

6. Plant deciduous trees, shrubs, or vines on the _____ side of the house to provide afternoon shade in the summer.

7. In the summer, it is more important to shade _____ than insulated walls.

8. Light colored concrete or gravel can reflect light back into your house and _____ temperatures inside of your house.

9. Plant deciduous trees that grow tall and have wide canopies at their top, so they shade the _____ of your house in the summer.

10. Tall deciduous trees planted near the house, allow sunlight to strike the house in the winter when the sun is _____ in the sky, yet shade the roof of the house in the summer when the sun is _____ in the sky.

11. Provide solar access on the _____ side of the house to aid in winter warming.

12. Plant evergreen trees and shrubs on the _____ side of your house because they retain their foliage and block more wind in the winter.

13. Locate windbreaks so they are _____ times their height away from the house.

B. Short Answer:

1. List 3 landscape principles that can be used to aid in summer cooling.

   1.

   2.

   3.

2. List 2 landscape principles that can be used to aid in winter warming.

   1.

   2.

WORK SHEET D: STUDENT REVIEW

1. List two reasons why energy conservation is important?

2. Explain how the angle of the sun changes with seasons in the Northern hemisphere.

3. Explain how the angle of the sun changes with geographic latitude in the Northern hemisphere.

4. Describe how an energy efficient landscape modify temperatures inside and around the house.

5. Why is it important to maintain solar access on the south side of a house in Illinois?

6. Why is it important to shade the west and east side of a house?

7. List the 3 landscape principles used to in reduce cooling costs in the summer.

8. List the two landscape principles used to reduce heating costs in the winter.

STUDENT ACTIVITY - 1
INFORMATION SHEET

OBSERVING SHADE PATTERNS THROUGHOUT THE DAY

a. **Introduction:** Solar angles are effected by time of the day, season, and latitude. This activity will encourage you to observe the solar angle of the sun during the day and the shade patterns of objects in the landscape. Everyday the sun appears to rise in the Northeast in the morning and set in the Northwest in the evening. As the sun travels across the sky, the angle of the sun striking the earth changes, too. This causes shade patterns to change during the day also. People can use information about shade patterns to aid in cooling their homes in the summer and maintaining solar access during the winter.

b. **Purpose:** to understand how the time of day effects the angle of the sun and shade patterns

c. **What each group of students need:**
chalk
yardstick or tape measure

d. **Here's How:**

1. Work in your assigned group.

2. Select an object that is usually found in the home landscape that casts a shadow.(Some feasible objects include fences, shrubs, trees, roof overhangs, and buildings.) Each group should use a different object.

3. Complete Part A: Predictions of the Student Activity - 1 Record Sheet.

4. Observe the object. Measure or trace the shade patterns of the object on the ground. Chalk can be used to trace shade patterns on asphalt or concrete. If it is not feasible to measure the shade patterns, then estimate measurements.

5. Record your observations in Part B: Data of the Student Activity - 1 Record Sheet.

6. Repeat observations two more times during the day. Record observation in Part B: Data of the Student Activity - 1 Record Sheet.

7. Complete Part C: Conclusions of the Student Activity - 1 Record Sheet.

STUDENT ACTIVITY - 1
RECORD SHEET

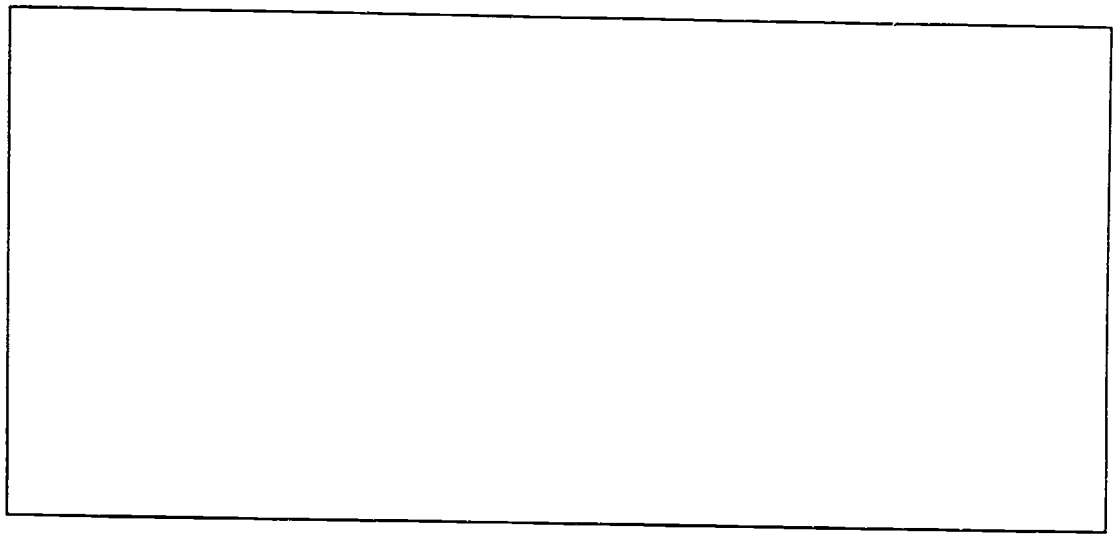
A. Predictions:

1. At what time a day will your object's shadow be the longest?

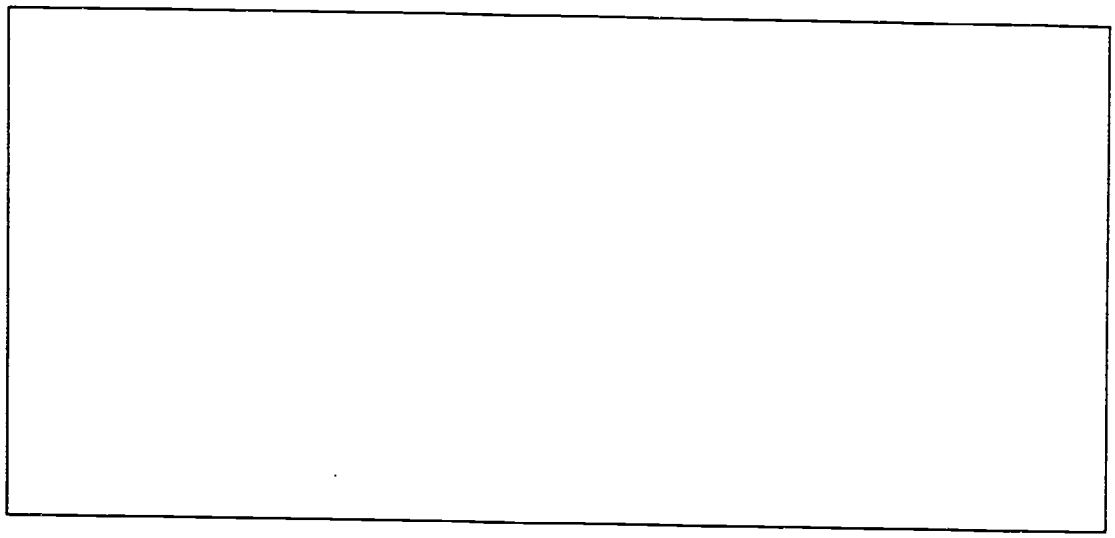
2. At what time a day will your object's shadow be the shortest?

3. Sketch where the sun is in the sky, your object, and its anticipated shade patterns in the boxes below. Indicate orientation (which direction North is) on your sketch.

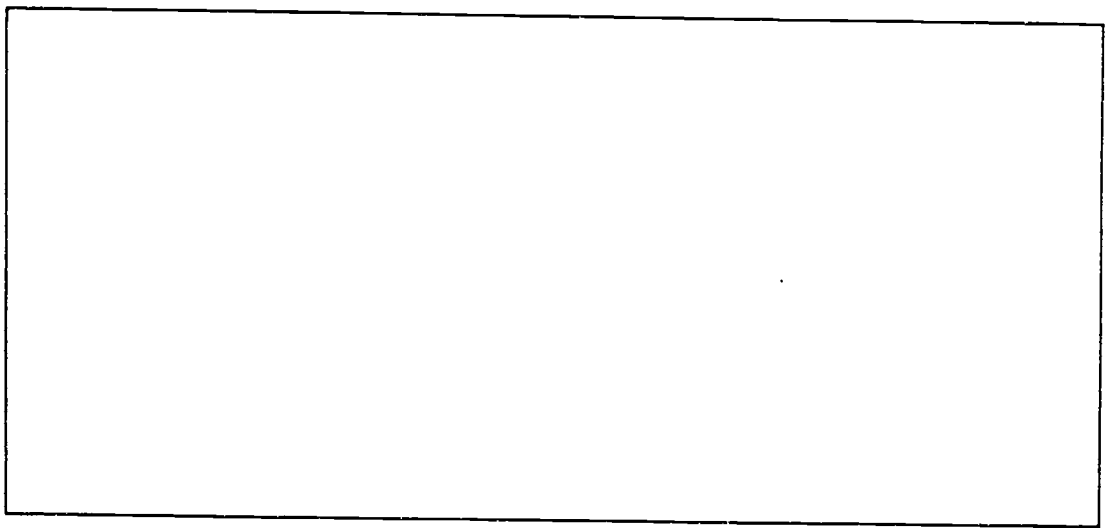
Morning:



Noon:



Afternoon:



B. Data:

MORNING

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

   Morning:

NOON

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

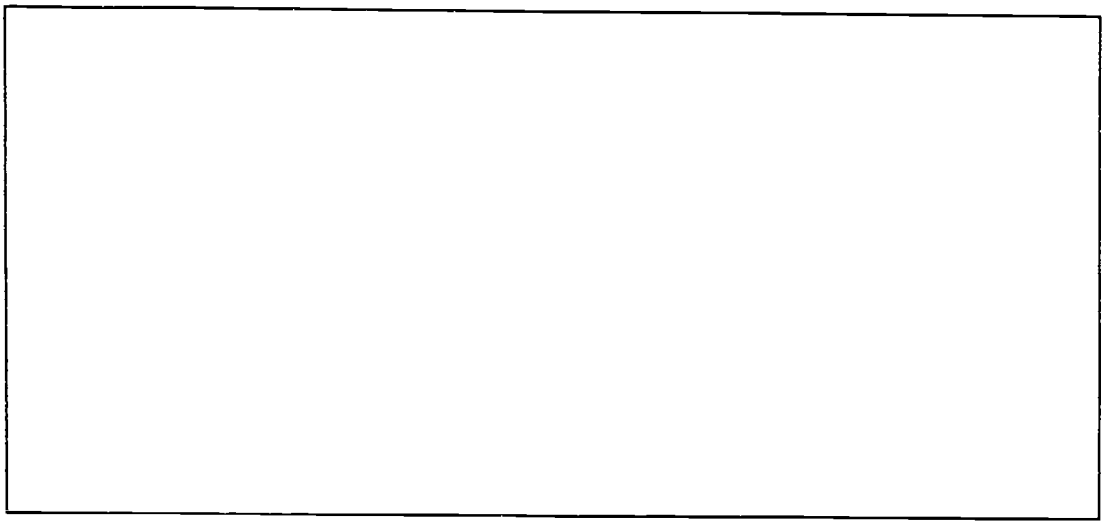
4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

Noon:



AFTERNOON

1. What object are you observing?

2. Describe weather in relationship to cloud cover at the time of observation.

3. What is the exact time of day?

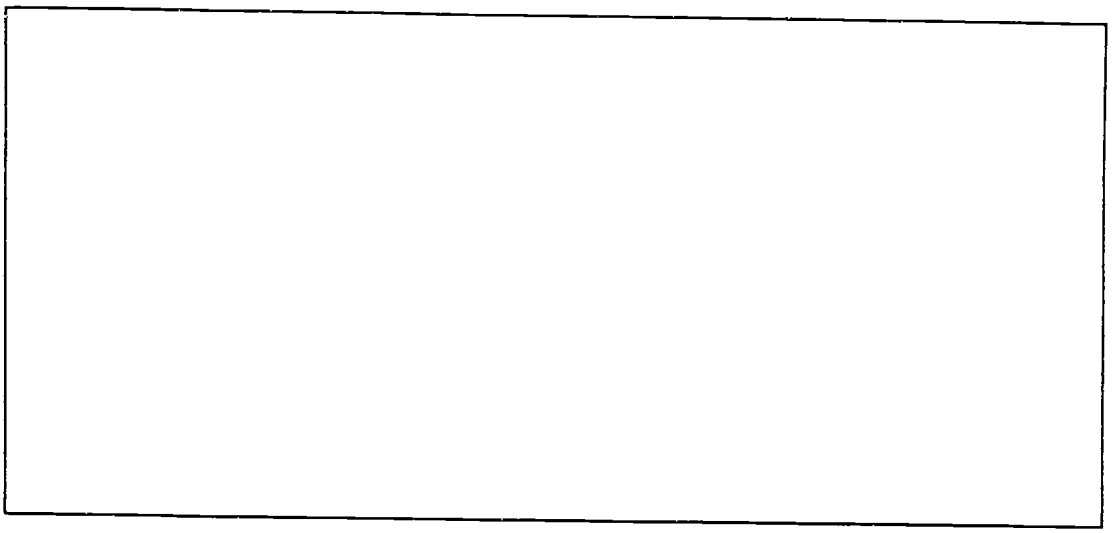
4. Where is the sun located in the sky?

5. Where is the shadow in relationship to the object?

6. Record the height of the object and the length of the shadow. (If it is not feasible to measure the object and the length of the shadow, use estimates.)

7. Sketch where the sun is in the sky, your object, and its shade pattern in the box below. Indicate orientation (which direction North is) on your sketch.

   Afternoon:



C. Conclusions:

1. At what time of day was the shadow the longest?

2. At what time of day was the shadow the shortest?

3. Where was the shadow in relationship to the object in the morning, noon, and afternoon?

4. What was the path of the sun as it traveled across the sky?

5. How did the angle of the sun change during the day?

STUDENT ACTIVITY - 2
INFORMATION SHEET

Landscaping for Energy Efficiency

a. **Purpose:** to design landscape plantings that will modify temperatures in the home.

c. **What Each Group of Students Needs:**

houseplan
tracing paper
pencil
scissors
glue or tape
construction paper

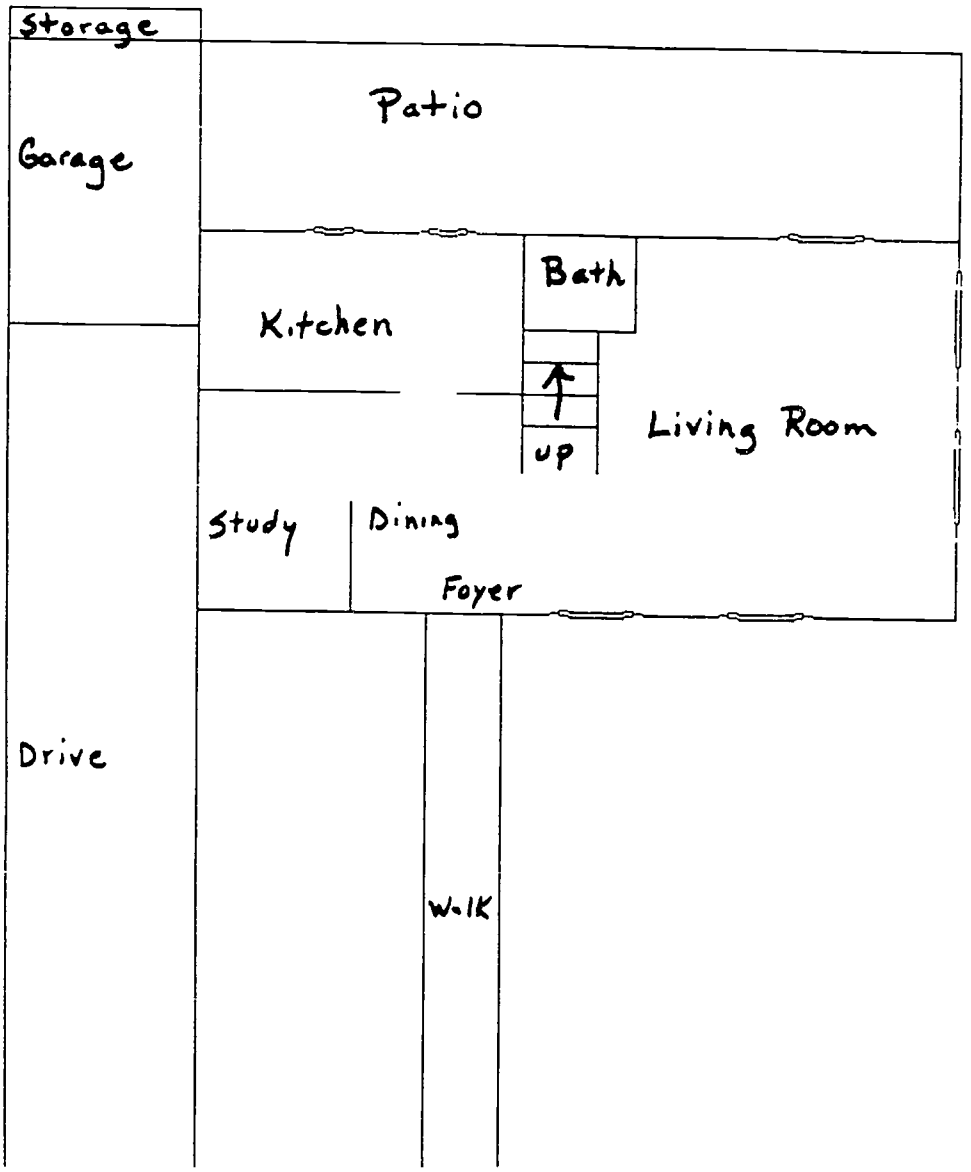
c. **Here's How:**

1. Work in your assigned groups.
2. Trace houseplan onto tracing paper using orientation assigned to you by your instructor. Use a pencil to do this.
3. Determine a landscape strategy for winter warming and summer cooling for the house.
4. Draw landscape symbols on construction paper to be in scale with your houseplan.
5. Add symbols to the houseplan using glue or tape to show where plants should be located to increase energy efficiency.
6. Clean up your work area.
7. Defend your rationale to your instructor and classmates.

Sample Houseplan

NORTH -->

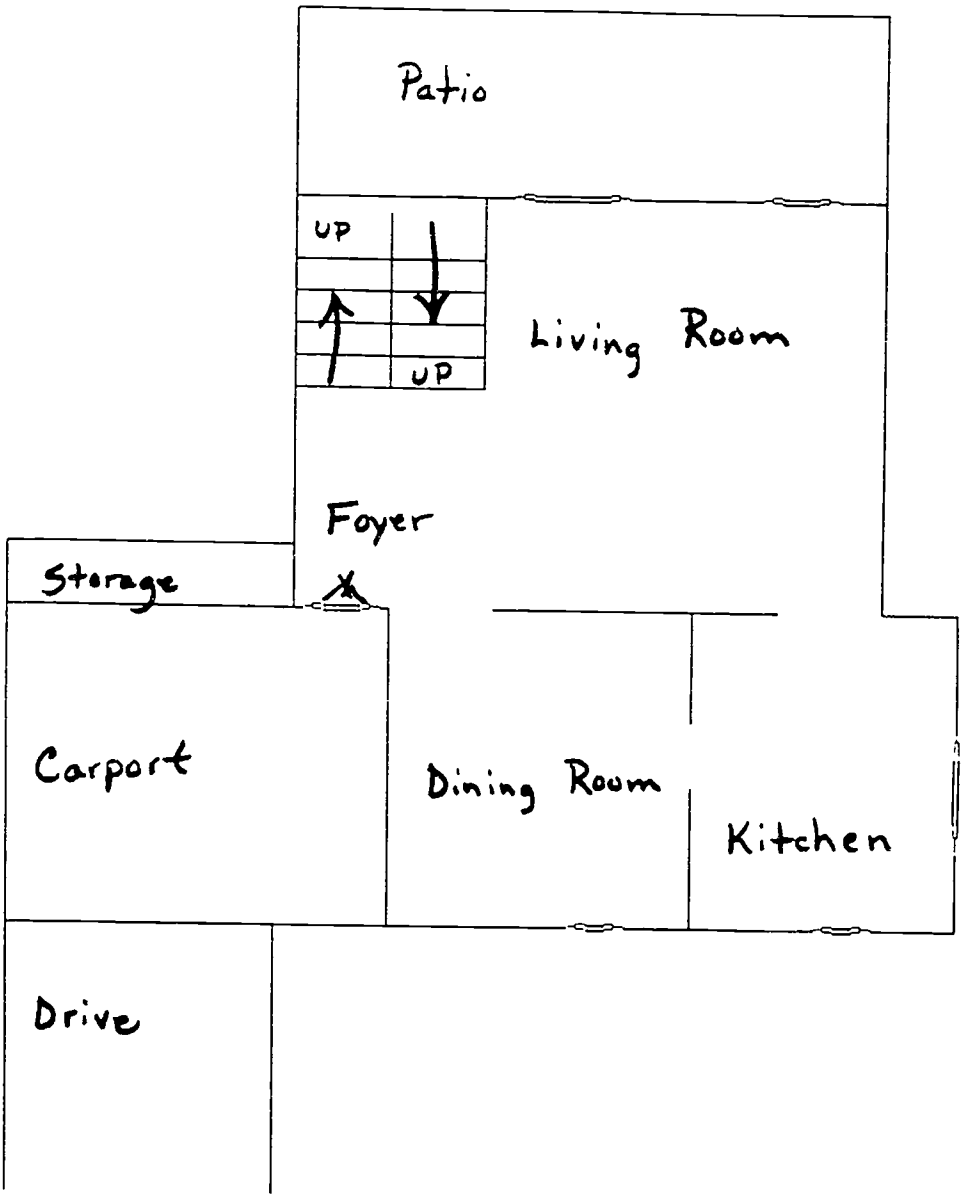
SCALE: 1/4" = 4'



Sample Houseplan

NORTH -->

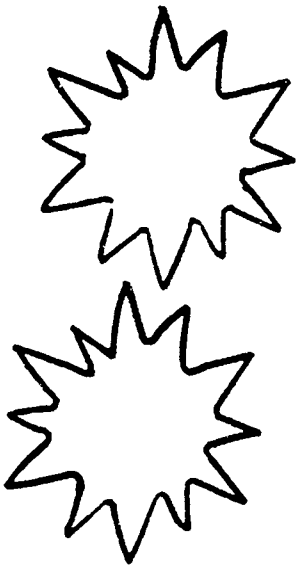
Scale: 1/4" = 4'



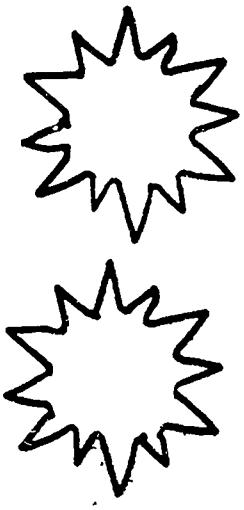
Sample Landscape Symbols

Evergreen Trees or Shrubs
Scale: 1/4" = 4'
(If larger symbols are desired, they may be drawn free hand.)

24 feet

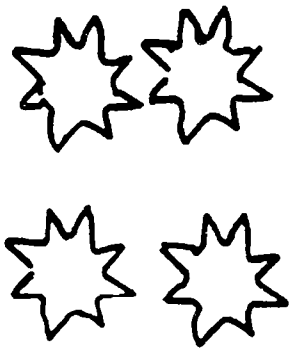


20 feet

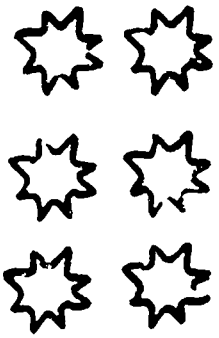


16 feet

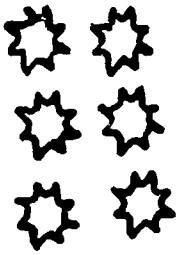
12 feet



8 feet



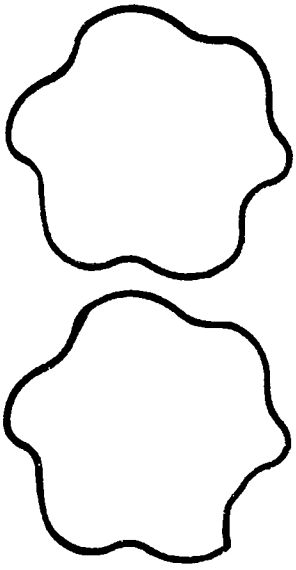
6 feet



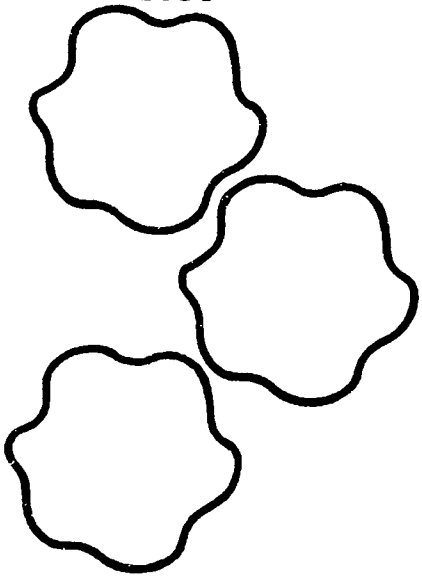
Sample Landscape Symbols

Deciduous Trees or Shrubs
Scale: 1/4" = 4'
(If larger symbols are desired, they may be drawn free hand.)

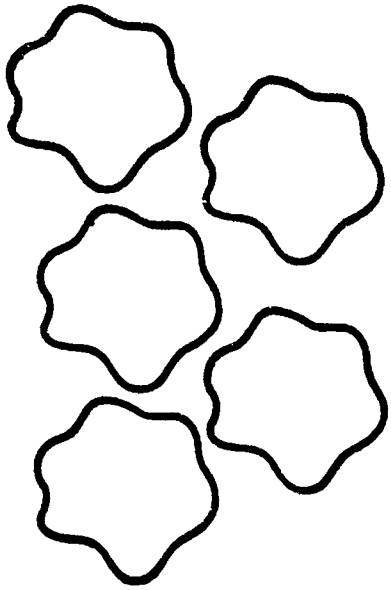
24 feet



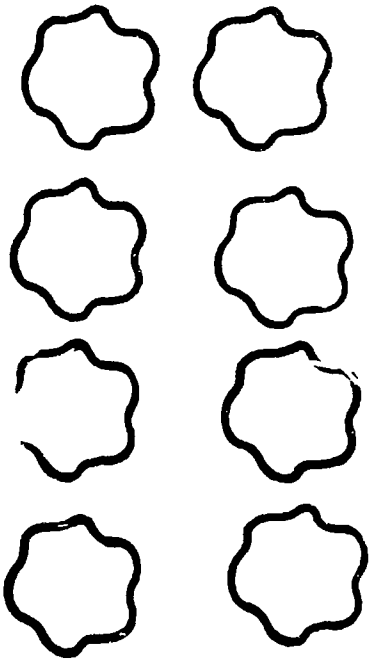
20 feet



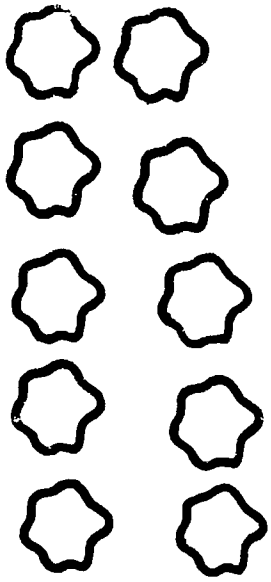
16 feet



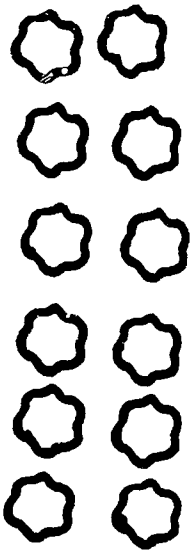
12 feet



8 feet



6 feet



QUIZ 1

A: MATCHING:

_____1.alternative energy sources

_____2.landscaping

_____3.deciduous

_____4.evergreen

_____5.energy conservation

_____6.microclimate

_____7.solar access

a. allowing sunlight to reach solar collectors and windows without obstruction

b. the careful use of our energy resources

c. trees, shrubs, and other plants which retain leaves throughout the four seasons, including winter

d. the character of temperature, humidity, wind, precipitation, and solar radiation in a localized area

e. trees, shrubs, and other plants which lose all of their leaves after the growing season, usually in the fall

f. the art of arranging and fitting together of land, plants, and buildings for human use and enjoyment.

g. energy derived from sources other than fossil fuels; such as sun, wind, and water

B: TRUE OR FALSE:

_____ 1. All of our major energy sources are renewable.

_____ 2. The angle of the sun changes with the time of day, season, and latitude.

_____ 3. In winter when the Northern hemisphere is tilting away from the sun, the sun appears at a lower altitude than in the summer.

_____ 4. An energy efficient landscape uses sunlight and wind when they are needed and reduces their intensities when they are not needed.

_____ 5. No matter which direction your house is turned, the side that faces south will receive the most sunlight in the summer.

C: FILL-IN-THE BLANK:

13. _____ and _____ windows and walls receive the most summer sun.

14. Plant deciduous trees, shrubs, or vines on the _____ side of the house to provide afternoon shade in the summer.

15. Tall deciduous trees planted near the house, allow sunlight to strike the house in the winter when the sun is _____ in the sky, yet shade the roof of the house in the summer when the sun is _____ in the sky.

16. Provide solar access on the _____ side of the house to aid in winter warming.

17. Plant evergreen trees and shrubs on the _____ side of your house because they retain their foliage and block more wind in the winter.

18. Locate windbreaks so they are _____ times their height away from the house.

D: SHORT ANSWER:

19. How can you landscape your home to aid in cooling it in the summer?

20. How can you landscape your home to aid in warming it in the winter?