

Unit C: Plant Physiology

Lesson 2: Understanding Light, Temperature, Air, and Water Effects on Plant Growth

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

1. Describe the effect of light on plants.
2. Describe a plant's temperature needs.
3. Explain how the quality of air affects plants.
4. Describe a plant's water needs.

Recommended Teaching Time: 2 hours

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

- A PowerPoint has also been developed with use of this lesson plan

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
10 to 15 small plants
Optical prism

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

- Day neutral plant (DNP)
- Foot-candles
- Hardiness
- Long day plant (LDP)
- Photoperiod
- Short day plant (SDP)
- Visible light spectrum
- Wilted

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Provide the class with 10 to 15 plants so they can set up their own experiments. This can be done by groups or by the whole class together. Tell the students they need to study the effects of light, temperature, air, and water on plants. For example, you might use four plants and put one in a bright window, one on the teacher's desk, one in a greenhouse or under a bright light, and one in a dark closet to study the effects of light. Allow students to be creative. Within a week you will start to see some serious differences. Students can check and measure the progress of the plants at the beginning of each class as a gathering and interest activity. You may ask students to draw conclusions from their data. This can take the form of a discussion, paper, or an oral presentation.

**** Use this activity to lead into the importance of light; have them use the knowledge they just gained from photosynthesis to add input into the discussion.**

Summary of Content and Teaching Strategies

Objective 1 Describe the effect of light on plants.

(PowerPoint Slide #3 and #4)

I. Plants have adapted, over millions of years, to use sunlight as their source of energy. As previously covered in the previous lesson, they do this using a pigment called chlorophyll to photosynthesize.

A. Plants use light in the **visible light spectrum**, a narrow band of radiant energy that we can see with our eyes.

(PowerPoint Slide #5)

Plants need mostly the colors blue and red to activate the chlorophyll. Other pigments collect other colors of light and pass that energy to the chlorophyll to make more sugar. The fact that plants need a lot of both blue and red light means that neither regular light bulbs nor regular fluorescent tubes provide adequate light for most plants. Light bulbs are deficient in blue and tubes are deficient in red.

(PowerPoint Slide #6)

Special grow-lights are made which have more of the correct wavelengths of light.

B. The intensity of the light matters a great deal to the plant. Light intensity is measured in **foot-candles**, the amount of light given off by a candle a foot away. Plants have adapted to a wide variety of light intensities. Many plants require full sun. Most plants that do well in a house can survive or even thrive in lower light intensities.

(PowerPoint Slide #7)

C. Plants also respond to the length of time they are exposed to light, or **photoperiod**. Plants can generally be separated into three groups by how they respond to photoperiod.

1. **Short day plants (SDP)** are plants that begin to flower when the nights are over 12 hours long.
2. **Long day plants (LDP)** are plants that begin to flower when the nights are under 12 hours long.
3. **Day neutral plants (DNP)** are plants whose flowering response is unaffected by photoperiod.

****Use TM: C2-1 as a visual aid to show the visible spectrum of light. If you have it available, a prism will break up the visible spectrum into its individual colors (red, orange, yellow, green, blue, indigo, and violet) for students to see. Go to a window and break up some light. If a light meter is available, measure differences of light intensity between light and darker areas in your room. Then, measure light intensities in your greenhouse or outside.**

Objective 2: Describe a plant's temperature needs.

(PowerPoint Slide #8)

II. Plants have adapted to a wide range of temperatures.

- A. There are plants which thrive within the Arctic Circle and others that can survive in the blazing sun of a desert. Plants tend to adapt for higher temperatures with smaller leaves in lighter colors with thicker cuticles. Plants adapt to low temperatures by growing lower to the ground with short life cycles and parabolic dish-shaped flowers to collect light and heat. Although plants can survive higher and lower extremes, plants don't really grow at temperatures below 0 degrees Celsius or above 37 degrees Celsius

(PowerPoint Slide #9)

- B. A plant's ability to withstand low temperatures is called its **hardiness**. A plant which is very hardy can survive in a cold climate. Hardiness is measured using a plant hardiness zone map. Each area of the world is assigned a zone numbered from one to thirteen. Hardiness zones are derived from the average coldest temperatures for the year.

(PowerPoint Slide #10)

The 13 hardiness zones are defined as followed:

- Zone 1: below -46 C (below -50 F)
- Zone 2: -46 to -40 C (-50 to -40 F)
- Zone 3: -40 to -34 C (-40 to -30 F)
- Zone 4: -34 to -29 C (-30 to -20 F)
- Zone 5: -29 to -23 C (-20 to -10 F)
- Zone 6: -23 to -18 C (-10 to 0 F)
- Zone 7: -18 to -12 C (0 to 10 F)
- Zone 8: -12 to -7 C (10 to 20 F)
- Zone 9: -7 to -1 C (20 to 30 F)
- Zone 10: -1 to 4 C (30 to 40 F)
- Zone 11: 4 to 10 C (40 to 50 F)
- Zone 12: 10 to 15 C (50 to 60 F)
- Zone 13: above 15 C (above 60 F).

**** Show students the hardiness zone map on TM: C2-2. Use the temperatures list for each zone to show the zone temperatures for your area.**

(PowerPoint Slide #11)

C. Plants have difficulties growing at extremely high temperatures. This usually has to do with the ability to pick up and move enough water to keep up with the higher rate of photosynthesis. When it gets too hot, the plant starts to lose water and become flat, a condition known as *wilted*. The guard cells also wilt, causing the stomata to close, thus effectively shutting the plant down.

****Show the students plants which have wilted or have been damaged by low temperatures. PowerPoint Slide #12 shows an example of a well watered plant and a plant that is wilting.**

Objective 3: Explain how the quality of air affects plants.

(PowerPoint Slide #13)

III. Air contains carbon dioxide and oxygen, both of which are necessary for plant growth.

A. Oxygen is necessary for cellular respiration to occur in a normal manner. Oxygen is picked up mainly by the roots of the plant.

B. Carbon dioxide is used for photosynthesis in very high amounts. Carbon dioxide usually enters the plant through the leaves via the stomata. In greenhouses, we often try to boost the level of carbon dioxide to speed up photosynthesis.

****Have students think about different ways people might experience air pollution. You can ask the following questions to lead into a discussion: How does it affect people? Does this affect plants the same way? How do plants help us?**

Objective 4: Describe a plant's water needs.

**** Before starting on this objective, have students recall what they remember about roots. Within a short amount of time, they should be able to tell you plants get most of their water through the roots. Use this information to talk about why this is so important.**

(PowerPoint Slide #14)

IV. Plants get most of their water through the root system. In some situations, plants can soak up water through their stems or take in water through their leaves.

A. One of the most difficult things about watering plants is that the roots need both water and oxygen. While some plants are very adept at removing the oxygen they need from the water, others drown in a very short time.

(PowerPoint Slide #15)

B. Plants should be watered all the way through the root zone to encourage even root growth.

C. Plants that are grown in pots should have pots with drainage holes, so the water can drain and allow oxygen into the root zone.

Review/Summary: Compile results from experiments designed in the interest approach. Have class discussion, presentations, or papers on the findings. Questions on PowerPoint Slides #16 and #17 can be used as review.

Application: Use experiment in the interest approach to apply the information.

Answers to Sample Test:

Part One: Matching

1. c
2. b
3. d
4. g
5. a
6. f
7. e

Part Two: Completion

1. Roots
2. Photoperiod.
3. Red, blue
4. 0°C, 37°C

Part Three: Short Answer

1. Drainage holes are necessary to allow the soil to get some oxygen in it.

Test

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Part One: Matching

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

- | | |
|---------------------------|----------------------|
| a. Visible light spectrum | e. Day neutral plant |
| b. Foot-candles | f. Hardiness |
| c. Short day plant | g. Wilting |
| d. Long day plant | |

- _____ 1. A plant which flowers when nights are longer than 12 hours.
- _____ 2. The unit of measure for light intensity.
- _____ 3. A plant which flowers when nights are shorter than 12 hours.
- _____ 4. What happens when a plant doesn't get enough water.
- _____ 5. Red, orange, yellow, green, blue, indigo and violet.
- _____ 6. The ability of a plant to withstand low temperatures.
- _____ 7. A plant which is unaffected by photoperiodism.

Part Two: Completion

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

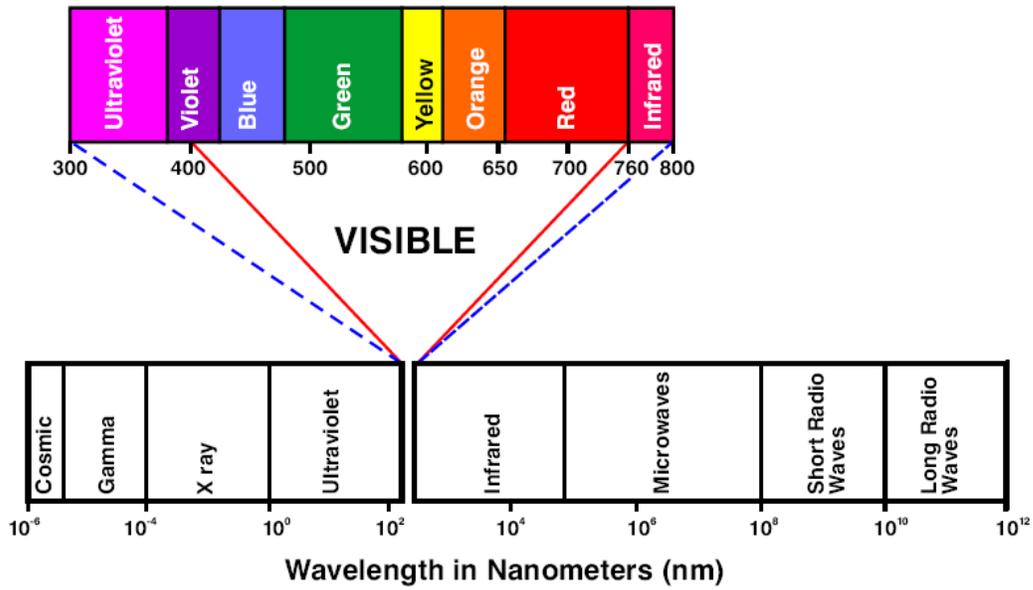
1. Plants usually get oxygen through their _____.
2. The length of the sunlight a plant gets is called a _____.
3. The colors of light that plants most often use are _____ and _____.
4. Plants usually do not grow well when the temperature is below _____ or above _____.

Part Three: Short Answer

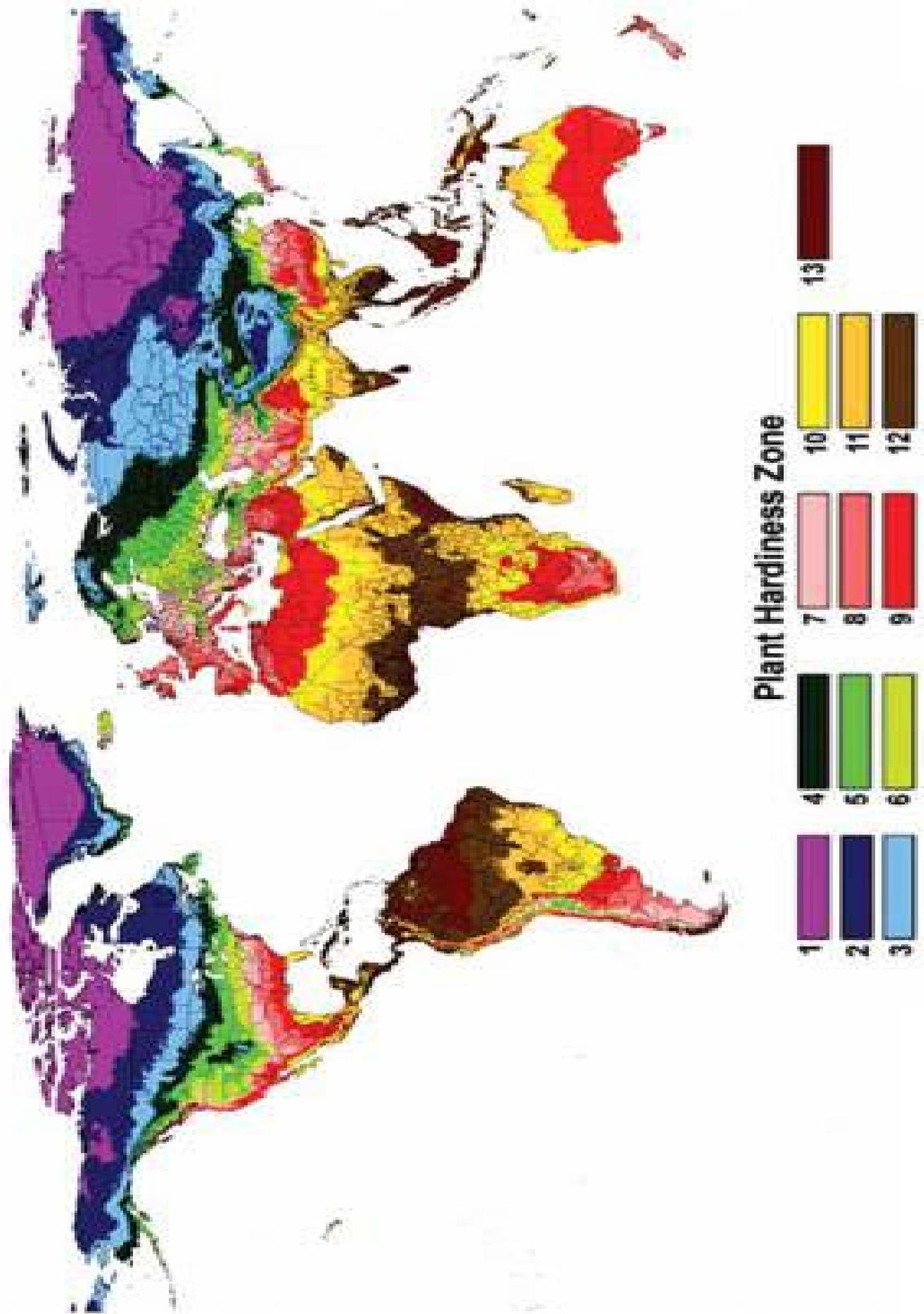
Instructions. Provide information to answer the following question.

1. Why do we put drainage holes in the bottom of pots?

THE LIGHT SPECTRUM



TM: C2-2



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