Lesson A2–8

Understanding Plant Growth Regulators

Unit A. Horticultural Science

Problem Area 2. Plant Anatomy and Physiology

Lesson 8. Understanding Plant Growth Regulators

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: **I:** Apply principles of anatomy and physiology to produce and manage plants in both a domesticated and natural environment.

Benchmark: **I-A:** Analyze and evaluate nutritional requirements and environmental conditions to develop and implement a fertilization plan.

Performance Standard: **1.** Describe nutrient sources. **2.** Determine plant nutrient requirements for optimum growth. **3.** Identify function of plant nutrients in plants. **4.** Determine the environmental factors that influence and optimize plant growth. **5.** Apply nutrients to plants for economic growth. **6.** Describe nutrient application methods and appropriate practices.

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

1. Describe the work of plant growth regulators.
2. Explain the functions of several plant hormones.
3. List several commercial uses for plant growth regulators.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology,* Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003.

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2000.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet
2 Coleus or other small fast growing plants: one pinched, one not

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

Abscisic acid
Apical dominance
Auxins
Cytokinins
Ethylene
Gibberellins
Phototropism
Plant hormones
Thigmotropism

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.

Start a discussion on the obvious effects of human hormones. Ask what the students know about estrogen, testosterone, adrenaline, etc. Ask students to think about differences between little boys and men, between little girls and women. Reinforce the concepts that human hormones are very potent, have a lot of individual jobs, and are found in extremely small amounts. Now ask about plant hormones. Note the silence. Tell the students that plants do indeed have hormones and that they may cause even more dramatic changes in plants than humans go through.

Summary of Content and Teaching Strategies

Objective 1: Describe the work of plant growth regulators.

Anticipated Problem: What do plant growth regulators do?

I. Plant growth regulators are chemicals which affect the plant in many complex ways. As their name implies, they regulate plant growth. They can control such activities as cell division and differentiation, root and shoot growth, flowering, and ripening.

   A. Plant growth regulators that are made by the plant are called ***plant hormones***. Hormones are moved around the plant in extremely low concentrations.

   B. Some plant growth regulators are man-made or synthetic. These synthetic growth regulators can be applied to plants to get a myriad of changes. These changes often make the plant better or more saleable.

Use the recommended resources to enhance student understanding of the concepts.

Objective 2: Explain the functions of several plant hormones.

Anticipated Problem: What are the functions of several plant hormones?

II. Several hormones are made by tissues of the plant. These hormones make many changes in the plant occur. Each hormone has many different jobs. In that way, they are very much like human hormones.

   A. ***Auxins*** are growth hormones which are produced by the tip, or apical meristem of the stem. Auxins cause stem cells to elongate and divide. They also flow down from the tip of the stem, preventing lateral buds from sprouting.

      1. Auxins set up a situation in which the middle stem grows at a greater rate, suppressing the side growth. This is called ***apical dominance***. Apical dominance is why many conifers are pyramidal in shape. Apical dominance can be overcome by simply cutting off the dominant stem, losing the source of the auxin.

      2. Auxins are also responsible for allowing a plant stem to grow toward the sun, a behavior called ***phototropism***. Sunlight slowly breaks down Auxins. When the side with more auxin grows faster, the stem starts to bend toward the sun.

      3. Auxins allow a vine to grow around an object, a behavior called ***thigmotropism***. The repeated touch of an object causes less auxin to remain on that side of the stem. When the auxin side starts to grow at a greater rate, the plant grows toward the plant. This continues to happen until the plant is actually wound around the object.

   B. ***Cytokinins*** are hormones which are mostly responsible for cell division and differentiation. Cytokinins are produced in the root tips and in seeds. They tend to travel up the stem.

C. ***Ethylene*** is a gas that affects the plant like a hormone. Ethylene is produced by ripening fruit and dying plant materials. Ethylene stimulates flowering in some plants and causes other fruits and flowers to ripen more quickly and evenly.

1. Ethylene gas is why fruit will ripen faster in a paper bag, than out on a counter. The bag concentrates the ethylene gas.
2. Ethylene has a negative effect on cut flowers. It causes them to age more quickly, reducing their useful life.

D. ***Gibberellins*** are hormones which cause internodal elongation and cell division. Gibberellins are produced in stems, roots, and young leaves. Gibberellins are commonly used on commercially grown dessert grapes to spread the fruits out and cause them to be bigger.

E. ***Abscisic acid*** is a hormone which inhibits growth. It is found in seeds which are dormant and in dying leaves. It also appears to help a plant prepare its buds for the winter.

Use the recommended resources to strengthen student understanding of the concepts. Use TM: A2–8A to give visual aid and help students record information. Show the pinched and unpinched plants to the students. Discuss differences and similarities and discuss why the plants are different.

Objective 3: List several commercial uses for plant growth regulators.

Anticipated Problem: What are several commercial uses for plant growth regulators?

III. Synthetic growth regulators are very useful for commercial plant crops. They can save money, time and can lead to a better crop. These are some commercial uses for growth regulators.

A. Growth regulators are routinely sprayed on crops such as poinsettias, Easter lilies, and chrysanthemums to reduce size to make a shorter, bushier, and more attractive plants. Products such as A-rest, B-nine, Cycocel, and Florel are commonly used.

B. Growth regulators are commonly used to help plants root more completely. These are often sold in powder form under the names Rootone and Hormodin.

C. Ethylene gas is used commercially to ripen bananas once they get to market and to induce flowering in pineapple crops.

Use the recommended resources to enhance student understanding of the concepts. Take cuttings of plants in a flat of soil, treating half with Hormodin or Rootone, and half as a control.

Review/Summary. Use the student learning objectives to summarize the lesson. Ask students to explain the content associated with each objective. Student responses will tell which objectives need to be reviewed.

Application. Use LS: A2–8A to apply the objectives.

Evaluation. Evaluation should be based on student comprehension of the learning objectives. This can be determined using the attached sample written test.

Answers to Sample Test:

Part One: Matching

1. d 2. e 3. b 4. a 5. c

Part Two: Completion

1. thigmotropism
2. phototropism

Part Three: Short Answer

1. Apical dominance is the dominance of a central branch or leader. It leads to a pyramidal shape for the plant.
2. Apical dominance is caused by auxin which is produced in the apical meristem and flows down the stem, suppressing the lateral buds.

Sample Test Name _____

Test

Lesson A2–8: Understanding Plant Growth Regulators

Part One: Matching

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

a. Abscisic acid
b. Auxin
c. Cytokinins
d. Ethylene
e. Gibberellin

_____ 1. A hormone which helps fruit ripen.

_____ 2. A hormone which causes internodes to lengthen.

_____ 3. A hormone which causes apical dominance.

_____ 4. A hormone which actually hinders growth.

_____ 5. A hormone which is made mostly in the roots.

Part Two: Completion

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

1. Growth toward around an object is called _____.
2. Growth toward the sun is called _____.

Part Three: Short Answer

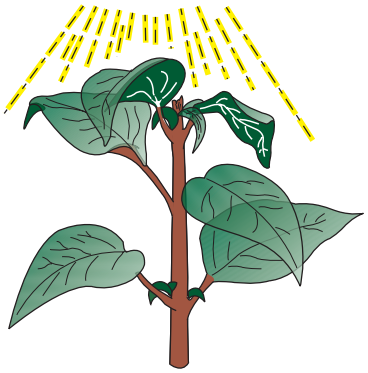
Instructions. Provide information to answer the following questions.

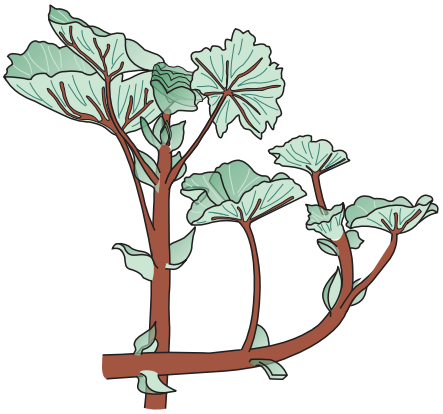
1. What is apical dominance?

2. What causes apical dominance?

Characteristics of Common Growth Substances

Group	Chemical Example	Description
Auxin	Indole-3-acetic acid (IAA)	A natural substance that promotes growth through cell division and elongation. Important in phototropism, geotropism, apical dominance, and root formation.
Gibberellin	Gibberellic Acid, GA_3 GA_1	Promotes stem elongation through cell division and cell elongation. Synthesized by young developing tissue and developing seeds.
Cytokinin	Zeaton®	Promotes cell division and delays leaf aging process. Synthesized in root tips and developing seeds. Used as a growth promoter in tissue culture.
Abscisic Acid	Single compound	Inhibitor of growth. It closes stomates of plants under water stress and counteracts the effects of auxins and gibberellins. Synthesized in mature leaves under stress.
Ethylene	Single compound	A gas that forms in tissue undergoing stress. It is important in fruit-ripening process and early petal drop of flowers.





Name _____

Lab Sheet

Get three small bunches of bananas. They should all be evenly green or greenish yellow.

1. Put the first bunch on a counter in the room.
2. Put the second bunch in a paper bag.
3. Put the third bunch in a paper bag with a couple of over-ripe apples.
4. Close the bags tightly and check ripeness each day.

Questions:

1. Which bananas ripened first?

2. Why did these ripen first?

3. Which bananas ripened last?

4. Why did these ripen last?

5. What difference did the apples make and why?

6. Would other fruits work as well as an apple?