

Plant Hormones and Tropic Responses

Brief Description:

There are many hormones in plants and they all play different roles. In this lesson students will learn about hormones such as ethylene, gibberellins, cytokinin, abscisic acid and the application of hormones in commercial horticulture.

Tropic responses in plants are those responses to light, gravity and touch. In this lesson students will learn about the different tropic responses and set up experiments to demonstrate hormone effects and plant responses to stimulus. Data will be collected and summarized in tables and graphs.

Objective:

Students will be able to:

1. Grow a plant from a seed.
2. Identify parts of a plant and plant cells.
3. Understand the role plant hormones play in plant growth.
4. Understand what plant tropisms are.
5. Work in groups to design and conduct an experiment to demonstrate a plant hormone or tropic response.

Time:

Part I. Plant Structure

Introduction: 15 to 20 minutes

Activity 1: Up to three 50 minute class periods

Part II. Plant Hormones and Tropisms

Introduction: Up to one 50 minute class period

Activity 1: Up to four 50 minute class periods

Materials:

- Microscope(s)
- Iodine
- Onion skin
- Elodea (sometimes referred to as Anacharis) water plant
- Slides
- Cover slips, or prepared plant tissue slides
- Seeds (lima bean or cucumber)

- Potting soil
- Polystyrene cups
- Scissors
- Aluminum tray
- Fertilizer
- Water

Vocabulary:

apical bud, branch, cell, cell wall, cell membrane, chloroplast, flower, fruit, internode, lateral bud, leaf blade, nucleus node, organelle petiole, root, root cap, stem, tissue, vacuole, abscisic acid, auxin, cytokinin, ethylene, geotropic, gibberellin, hormone, phototropic, tropism and thigmotropic

Background:

Plant Tissues and Structure: Plants are composed of cells which together with other similar cells make tissues. Groups of tissues form plant organs such as roots, stems, leaves and flowers (if present).

Hormones and Tropisms: The distribution and concentration of plant hormones occur on a cellular level. The presence, absence, or balance of hormone in a tissue affects a tropism in the whole organ.

Tropisms are movements of a plant organ in response to an environmental stimulus, such as lights, gravity or touch.

Three Major Types of tropisms:

- Phototropism – Plant growth towards the sun or light.
- Geotropism or Gravitropism – Plant growth in response to gravity.
- Thigmotropism – Plant responses to touch.

Hormones are signaling molecules that are produced in small amounts and sent to other parts of the plant body, like tiny messengers running around. Plant hormones affect both plant growth as well as plant response to the environment. Plant growth and response may occur because a hormone is present, absent, or the balance between hormones is changed. Concen-

Florida Standards:

SC.7.N.1.1, SC.7.N.1.4, SC.7.L.17.3, SC.8.N.1.1, SC.8.N.1.2, SC.8.N.1.3, SC.8.N.1.4, SC.8.N.4.2, SC.912.L.14.1, SC.912.L.14.10, SC.912.L.14.2, SC.912.L.14.31, SC.912.L.14.7, SC.912.N.1.1, SC.912.N.1.6, SC.912.N.1.7, MAFS.7.RP.1.2, MAFS.7.SP.1.1, MAFS.7.SP.1.2, MAFS.8.SP.1.1, MAFS.8.SP.1.2, MAFS.8.F.2.5, MAFS.912.A-REI.1.1, MAFS.912.S-ID.1.1, MAFS.912.S-MD.2.5

trations of plant hormones cause regulation in the growth and metabolism of the plant as a whole.

Major Types of Plant Hormones:

- Auxins – Plant hormone produced in the stem tip that promotes cell elongation. Causes all tropisms by collecting in one side of the plant stem, causing the stem to bend. Auxin is used in rooting plant hormones. A stem that is cut and then dipped into powdered auxin will develop roots in as little as ten days. Auxin is also a source of apical dominance which causes the growing tip to continue to grow rather than the lateral buds.
- Cytokinins – Plant hormone that promotes mitosis (cell division) in the growing tip of the plant, as well as the roots. Without this hormone cells will not divide.
- Abscisic Acid – Plant hormone that slows down growth and water use when the environment is dry. Causes the stomata to close when the environment is dry to prevent water loss. Abscisic acid also promotes seed dormancy.
- Ethylene – Plant hormone that is released as a gas by ripened fruit. It will cause other fruit to ripen. Often fruit is picked unripe, shipped and then in the distribution warehouse it will be exposed to ethylene gas to ripen before going to the store.
- Gibberellins – Plant hormone that encourages seed growth and breaks the seed from dormancy. It increases stem growth and fruit size, as well as induces flowers.

Part I: Plant Structure

Introduction:

1. Review information on how to prepare wet mount versus stained mounted slides. If you have not already gone over this with students in class do it now.
2. It is important to understand the parts of plants for this lesson to understand how different responses are elicited.

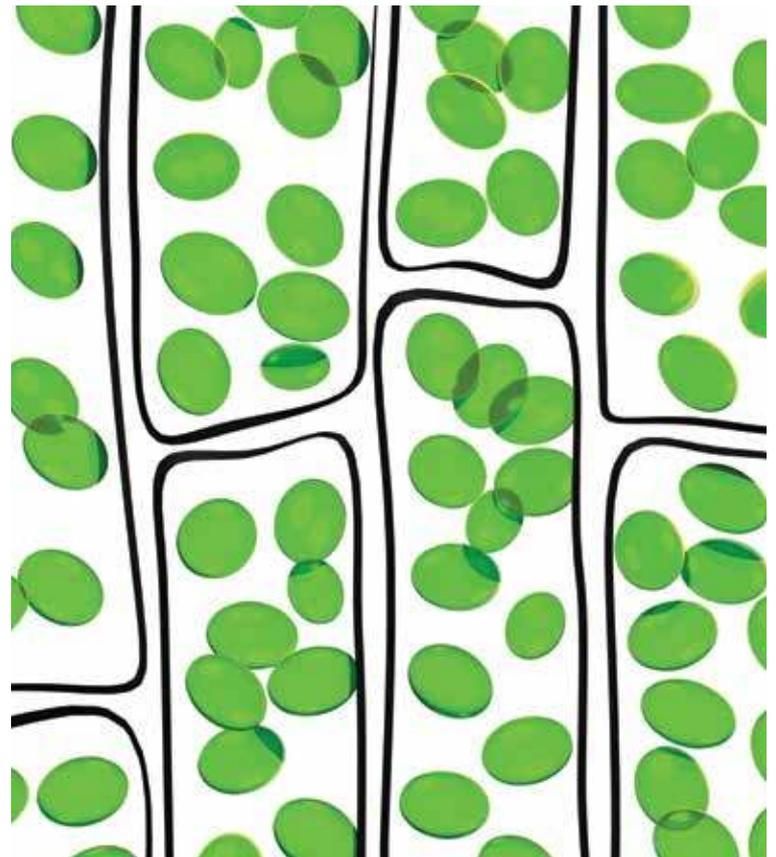
Activity 1:

1. Separate students into groups of three to four students.
2. Three weeks before starting the lesson each group will plant lima bean seeds into 10 Styrofoam cups.
 - a. Using scissors, make a slit on the cup bottom.
 - b. Cups should be filled with packed potting soil to one inch from top of 16 ounces Styrofoam cup (i.e. three groups = 30 plants).
 - c. Plant two seeds per cup, pressing them into the soil one inch.
 - d. Place plants in an aluminum tray.
 - e. Keep plants in an area of good light and water as needed.

- f. After seven days, or plant emergence, ask students to thin plants to one per cup by pinching off the weaker plant with fingers.
 - g. Using soluble fertilizer, fertilize and water plants at seven days.
 - h. Water plants as needed and on Fridays for the weekend.
 - i. At the end of two weeks of growth, have students each pick a “best grown” lima bean plant and use it for drawing and labeling of the plant parts.
3. Take students outside to show the different parts of landscape plants. Ask, “Do landscape plants have different parts than edible plants?” “How are the plants similar and how are they different?”
 4. Have students pick a plant and label the plant parts without damaging the plant or landscape.
 5. Have students prepare and look at slides of plant cells.
 - a. Prepare a wet mount of an elodea water plant leaf. Students can observe the cell membrane, chloroplast and vacuole space.
 - b. Prepare a stained slide of onion skin with a cover slip. Iodine is a safe, effective stain.

Evaluation:

1. Have students draw elodea and onion skin cells from microscope and label parts.
2. Have students retrieve one grown lima bean plant, remove the soil, and draw and label the plant parts.



Part II. Plant Hormones and Tropisms

Introduction:

1. Teach the PowerPoint (found at www.faitc.org/teachers/STEMming-Up) in class to ensure students understand the concept of hormones and tropisms and their relationship to plant growth.
2. Review the scientific method: Problem, Hypothesis, Procedure, Experiment, Results and Conclusion. Review the need for controls and three or more replications.

Activity 1:

1. Divide students into groups. There are nine tropic responses and hormones to experiment.
2. Assign each group a tropic response or plant hormone. Groups will research their hormone or tropism for more detailed information about function.
3. Students will design an experiment to demonstrate their plant's response. Teacher can choose to give students a list of materials available. Experiment and list of items needed must be presented to teacher for approval.
 - a. Controls should be used for comparison.
 - b. Measurements should be taken in metric units.
 - c. Ethylene is a gas, so an enclosed environment, such as a sealed bag or a large jar, will be required. Ethylene is produced by ripe and/or damaged fruit.
4. If students design experiments that use several concentrations of hormone, a mathematical model can be applied to the response curve (this would extend into an algebra lesson).

Evaluation: Plant Hormones and Tropisms

1. Students submit a lab report.

References:

Whiting, D., M. Roll and L. Vickerman, 2014. Colorado State University. Plant Growth Factors. Retrieved July 20, 2015 from <http://www.ext.colostate.edu/mg/gardennotes/145.html>

Shuster, et al., 2012. Biology for a Changing World, First Edition. W. H. Freeman & Co. and Sumanas, Inc. Retrieved July 20, 2015 from <http://www.sumanasinc.com/webcontent/animations/content/plantgrowth.html>

Plant Hormones and Tropic Responses

Sample Pre-Post Test Assessment

Directions: Answer each question to the best of your ability.

1. What are hormones?
2. What effects do hormones have on plants?
3. What is a tropic response in plants?
4. How does the agriculture industry use plant hormones?