



Bend, Reach & Touch: Investigating Tropisms in Plants

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Great Falls, Montana
Summer 2002

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Bend, Reach & Touch: Investigating Tropism in Plants

Teacher Section

Purpose	The purpose of this activity is to allow students to investigate plant responses to environmental stimuli (tropisms) and the physiology involved in these responses.
Objectives	The student will be able to: <ol style="list-style-type: none">1. Conduct and design a controlled experiment.2. Summarize and present results of experiment in a scientific poster.3. Differentiate between plant responses (phototropism, gravitropism, and thigmotropism) to environmental stimuli.4. Predict plant response to external stimulus.5. Identify and apply plant hormones to their functions in plant responses to environmental stimuli.6. Appreciate a living (active) response of plants to their environment.
Grade Level	This activity is geared for 9-12 th grade Biology students working in cooperative groups of two.
National Science Education Standards Alignment	K-12: <u>Unifying Concepts and Processes:</u> Change, constancy, and measurement Form and function Grades 9-12: <u>Science as Inquiry:</u> Abilities necessary to do scientific inquiry Understandings about scientific inquiry <u>Life Science:</u> Behavior of organisms <u>Science and Technology:</u> Understanding about science and technology <u>Science in Personal and Social Perspectives:</u> Natural resources
Time Required	This activity should take one class period to set-up but will be monitored for 2-4 weeks depending on plant types.
Prior Knowledge	This activity is designed as part of a unit on botany that includes: plant classification, cells, tissues and organs, growth and transport, life cycles and plant physiology.

Teacher Section

Including All Students	<ol style="list-style-type: none">1. Let students choose their own partner, or allow students to work by themselves.2. Assignments or the poster can be modified to accommodate student needs.3. Identify important contributions made by minority and/or women scientists to the study of use of plants in agriculture.4. Use of native seeds as examples of ties to cultural use of plants.
Safety	Normal laboratory safety precautions should be followed.
Materials	Students may add to supplies as their experimental designs vary. Seeds: wheat, lentils, beans, sweet peas, oats, grasses, Wisconsin fast seeds Plant hormones: Auxin Lights: Fluorescent grow lights, colored bulbs Plant materials: soil, fertilizers, pots, and film canisters
Questions to Ask Along the Way	<ol style="list-style-type: none">1. What is a disadvantage to being anchored in the ground if you are alive? Advantages?2. How can plants respond to changes in their environment? Can they move?3. What types of stimuli in the environment would affect a plant?4. Can we observe tropisms outside in the environment? In your neighborhood?5. Why would the response to gravity be important for plants?6. Why would the response to contact and light be important for plants?7. What are some other responses that plants have that are not responses towards the environment? (Nastic movements)8. How have plant responses helped plants to evolve and develop into the land plants we see today?9. How do we use plant responses to our advantage in agriculture?10. What might be an advantage of negative tropisms?

Teacher Section

Preparation and Procedure

- 1. Engage:** Plants will be grown throughout the year in the classroom in order to demonstrate responses to their environment and to generate student interest. The Engage activity will be a lab investigating gravitropism from activities with Fast Plants, <http://www.fastplants.org/> teaching resources. I will use either “The Crucifer Cross: Gravitropism Revisited,” or “Plants Know the Way to Grow,” activities found under the topic Plant Physiology at the Fast Plants web site.
- 2. Explore:** With the results from the engage activity above we will explore possible plant responses to their environment. A KWL activity will be used to first identify what we know about how plants respond to their environment and then to identify further questions. Questions should be generated on phototropism, gravitropism and thigmotropism.
Attached Handout: Tropisms in your Neighborhood
- 3. Explain:** A web quest has been developed for this activity in order to answer questions identified in the KWL in the explore activity. Students will be directed to also look for possible questions/problems they can investigate through experimentation.
Attached Handout: Web Quest on Tropisms
- 4. Elaborate:** Students will design an experiment around one of the questions they raised in the Explore and Explain activities. Topics should be centered on phototropism, gravitropism, or thigmotropisms. Students will be handed a grant proposal outline to fill out including question, hypothesis, materials needed and planned procedure. Proposals must be approved by the teacher before experimentation begins and materials are granted. A detailed lab notebook will be required throughout experimentation for notes and observations.
Attached Handout: Grant Proposal for Tropism Project
- 5. Evaluate:** Students will perform experiments throughout this unit on Botany. Experiments will be summarized in a poster format using software programs Microsoft Word and Excel. The final poster symposium will be held so that all students can evaluate each other’s work.

Teacher Section

Suggestions for Assessment

1. KWL Activity
2. Engage Lab Report
3. Lab Notebook (Rubric)
4. Grant proposal
5. Poster Presentation (Rubric)
6. Peer Evaluation (Rubric)
7. Tropisms in Your Neighborhood (Worksheet)

Extensions

1. Students may be able to bring in plants from home to perform experiments.
2. Investigate an agriculturally important plant and research companies that perform research on these plants.
3. Design an advertisement for plant movies based on movement.
4. Design a cartoon or “Far Side” comic based on plant movements.
5. Research an important scientist in studies of plants.

References & Resources

Seeds: <http://www.fastplants.org>, <http://www.nativeseeds.org/>

Hormones: <http://www3.carolina.com>

Please see attached handout for websites with information on tropisms.

Movies (to generate interest): Little Shop of Horrors, Attack of the Killer Tomatoes (1978), Killer Tomatoes Strike Back (1990), Killer Tomatoes Eat France (1991).

The Private Life of Plants (1995), NOVA.

Books: Bruce Capon. 1994. Plant Survival, Adapting to a Hostile World. Timber Press.

Student Section

Tropisms in Your Neighborhood

Name: _____

The following are tropisms that you might be able to observe in your neighborhood:

- Phototropism:** response to light
- Thigmotropism:** response to contact
- Hydrotropism:** response to water
- Gravitropism:** response to the pull of gravity
- Chemotropism:** response to chemicals

Directions: Spend some time outside in a park, or around your home and neighborhood. Look for plants that show a response (positively or negatively) to an environmental stimulus. Look in areas that are shady, sunny, and moist, around fences or poles. Make sure to look at both tall trees and small plants. Look for new growth this spring season as opposed to old winter growth from last year.

Plant Name	Date	Location	Type of Tropism	Sketch or Describe Tropism

Student Section

Name: _____

Tropism in Plants

Web Site Info Search: What are they?

This web search will help you find information about the response of plants to their environment. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also consider who wrote the site, what their purpose is in writing it, and if you think the information is accurate.

Site	http://encarta.msn.com/encnet/features/reference.aspx
Who created this website?	
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure
What did you learn?	What is tropism? What causes tropisms to occur? What are some examples of tropisms in plants?

Web Site Info Search: What are tropisms?

Site	http://www.infoplease.com/ce6/sci/A0849494.html
Who created this website?	
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure
What did you learn?	<p>What is a negative tropism? What is a positive tropism?</p> <p>What types of stimuli affect tropisms?</p> <p>What is Auxin?</p> <p>What is a nastic movement? How does it differ from a tropism?</p>

Site	http://www.infoplease.com/ce6/sci/A0805426.html
Who created this website?	
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure
What did you learn?	<p>What is the function of Auxin in plants?</p> <p>What processes does Auxin affect?</p> <p>How do Auxins work in phototropism?</p> <p>How are Auxins used commercially?</p>

Web Site Info Search: What are tropisms?

Site	http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/T/Tropisms.html
Who created this website?	
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure
What did you learn?	<p>Why might a tropism response be advantageous for a plant?</p> <p>According to Darwin's experiment, where was phototropism detected at in a grass seedling?</p> <p>How did they discover Auxin transport was responsible for tropism response?</p> <p>Does Auxin promote or inhibit cell growth? Where does it accumulate? What does that mean for the tropism response?</p>

Web Site Info Search: What are tropisms?

Site	http://www.tiscali.co.uk/reference/encyclopedia/hutchinson/m0007087.html
Who created this website?	
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure
What did you learn?	<p>What is Geotropism? What does it cause the root and stem to do?</p> <p>What part of the plant exhibits positive phototropism?</p> <p>What is thigmotropism? What types of plants exhibit thigmotropism?</p>

Site	http://www.geocities.com/centennial3d/ecology/tropisms.html																		
Who created this website?																			
Why did they create it? (check all that apply)	<input type="checkbox"/> To provide factual info <input type="checkbox"/> To influence the reader's opinion <input type="checkbox"/> To sell a product or service <input type="checkbox"/> I'm not sure																		
How accurate do you think the info is? (check all that apply)	<input type="checkbox"/> Very accurate <input type="checkbox"/> Somewhat accurate <input type="checkbox"/> Not very accurate <input type="checkbox"/> I'm not sure																		
What did you learn?	<p>Fill in the responses for the following tropisms using the data table provided at this web site.</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Tropisms</th> <th style="text-align: center;">Stem Response</th> <th style="text-align: center;">Root Response</th> </tr> </thead> <tbody> <tr> <td>Phototropism</td> <td></td> <td></td> </tr> <tr> <td>Geotropism</td> <td></td> <td></td> </tr> <tr> <td>Thigmotropism</td> <td></td> <td></td> </tr> <tr> <td>Hydrotropism</td> <td></td> <td></td> </tr> <tr> <td>Chemotropism</td> <td></td> <td></td> </tr> </tbody> </table>	Tropisms	Stem Response	Root Response	Phototropism			Geotropism			Thigmotropism			Hydrotropism			Chemotropism		
Tropisms	Stem Response	Root Response																	
Phototropism																			
Geotropism																			
Thigmotropism																			
Hydrotropism																			
Chemotropism																			

Student Section

Grant Proposal

Tropism Project

Name of Project Partners: _____

Name of Project Seeking Funding:

Brief Description of Project: The description must include the question(s) being addressed in the project including a brief description of the procedure to be followed and the approximate length of time needed for the experiment.

List of Materials needed:

Quantity	Materials
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Proposal Approval:

_____ OK'd _____ Needs more development
before approval.