BLOOM WHERE YOU'RE PLANTED?

Subject Matter: Life Science
Grade Levels: 9-12
Time Allotment: Four 60-minute class sessions
Master Teacher: Sharon Porter

Overview

Plants are alive and changing all around us. Their growth is often overlooked because change is slow. In this lesson, students will learn the elements and conditions for optimal plant growth and the structure and functions of plant cells that enable plants to thrive. Students will develop a hypothesis, design experiments and conduct experiments using an online virtual plant lab. Results will be charted and a conclusion will be prepared for compilation in a class hypermedia presentation.

Learning Objectives

Students will be able to:

- Identify plant structure organelles and the processes of plant growth.
- Develop a hypothesis and identify factors and variables in a plant growth experiment.
- Conduct an experiment in an online laboratory.
- Produce spreadsheets of data supporting or denying a stated hypothesis.
- Prepare experiment conclusions for a group hypermedia presentation.

Oregon Standards Available at:

http://www.ode.state.or.us/cifs

Science – Life Science

Understand the structure, functions and interactions of living organisms and the environment.

Organisms
- Describe, explain and compare the structure and functions of cells in organisms.

Science – Scientific Inquiry

Use interrelated processes to pose questions and investigate the physical and living world.

Forming the Question/Hypothesis

- Based on observations and scientific concepts, ask questions or form hypotheses that can be answered or tested through scientific investigations.

Designing the Investigation
- Design a scientific investigation that provides sufficient data to answer a question or test a hypothesis.

Collecting and Presenting Data
- Collect, organize and display sufficient data to facilitate scientific analysis and interpretation.

Analyzing and Interpreting Results
- Summarize and analyze data, evaluating sources of error or bias. Propose explanations that are supported by data and knowledge of scientific terminology.

Media Components

Video

Check the link at http://www.opb.org/edmedia/trs/ to find access to the video(s) from unitedstreaming™ referenced in this lesson plan.

- "Life Science: Plants" (20:00)
  - **Clip:** "The Survival of Plants: Reproduction and Change" (03:48)

- "Elements of Biology: The Cell: Structure and Function" (20:00)
  - **Clip:** "Plant and Animal Cells" (04:30)

Web

- **Virtual Plant Lab**
  A computer simulation model that allows experimentation with different plant types growing in different climates.
  http://cycas.cornell.edu/ebp/projects/laststraw/ise/frm.lab.html

- **Plant Growth Movies**
  Arranged by concept, Indiana University presents this collection of movies.
  http://sunflower.bio.indiana.edu/~rhangart/plantmotion/starthere.html

- **Flower Play**
  Artistic "stage-setter" for creative response to plant growth and structures.
  http://sunflower.bio.indiana.edu/~rhangart/plantmotion/art/art.html

- **Comparing a Cell to a Factory**
  Use this chart for an overhead transparency for students to compare parts of a cell to processes and structures in a factory.
  http://www.sciencenetlinks.com/pdfs/cellsystem_actsheet.pdf

- **Plant Facts**
  This Ohio State University Web site features FAQs, images and a Web search engine specializing in plants.
  http://plantfacts.osu.edu/

- **The Great Plant Escape - Case #1**
  A general explanation of the structure of plants and their functions.
  http://www.urbanext.uiuc.edu/gpe/case1/c1brief.html

- **Some Plant Hypotheses**
  Indicating independent and dependent variables, this site provides sample hypotheses.
  http://www.accessexcellence.org/21st/TL/filson/biol.html

- **Creative Movie**
  Creative movie using time-lapse photography of seed germination.
  http://207.148.237.252/lowlife/craigweb1.swf

- **Labeling a Plant Cell**
  Cell labeling diagram.
  http://www.borg.com/~lubehawk/cell.htm

- **Interactive Plant Cell Model**
  Parts of a plant cell are identified and described.
  http://www.cellsalive.com/cells/plntcell.htm

- **Hyperlinked Plant Cell Model**
  A plant cell identified with hyperlinks to descriptions.
  http://waynesword.palomar.edu/lmexer1a.htm#plant

Materials

Per Student:

- Pencil
- Handout: Bloom Where You're Planted - Introductory Activity Response Sheet (located at end of lesson plan)
- Handout: Label the Plant Cell (located at end of lesson plan)

- Handout: Research and Experiment Gathering Sheet (located at end of lesson plan)
- Handout: Which Way Did They Grow? (located at end of lesson plan)
- Handout: Plant Adaptation Video Clips Focus (located at end of lesson plan)
- Handout: Scoring Guide found at http://www.iusd.k12.ca.us/ra/rsjdocs/analytic/eirubric.htm

Per Class:

- Access to a shared folder on a server or floppy disks to transfer data from student work to compile for group presentation
- Access to a color printer (Black and white will work, though.)
- Computer with network connectivity, Java-enabled browser installed, QuickTime (Macintosh) or Windows Media Player installed
- Spreadsheet software installed on computers
- Hyperstudio, Microsoft PowerPoint or other hypermedia software installed
- Demonstration computer with Internet connectivity with projection screen for whole group instruction
- Overhead transparency of "Comparing a Cell to a Factory" found at: http://www.sciencenetlinks.com/pdfs/cellsystem_actsheet.pdf

Prep for Teachers

When using media, provide students with a **Focus for Media Interaction**, a specific task to complete and/or information to identify during or after viewing of video, Web sites or other multimedia elements.

Session 1: Bookmark all Web sites and download video clips. Preview them for specific points you will use to teach students about plant structure and growth processes. Schedule the computer lab or mobile lab and allow one computer per student. Check to see if QuickTime or Windows Media Player is installed on the demonstration computer you will use for instruction. Make sure that this computer can be connected to a projector or a large-screen monitor for large-group instruction. Make a copy of Bloom Where You're Planted - Introductory Activity Response Sheet handout for each student.

Session 2: Prepare an overhead transparency of "Comparing a Cell to a Factory" from http://www.sciencenetlinks.com/pdfs/cellsystem_actsheet.pdf and copy the Which Way Did They Grow?, Plant Adaptation Video Clips Focus and Label the Plant Cell handouts for each student.

Session 3: Practice using the virtual plant lab found at: http://cycas.cornell.edu/ebp/projects/laststraw/ise/frm.lab.html. Be familiar with the process of screen capture for the computer platform you are using. Practice how to paste the data into PowerPoint. Have individual floppy disks or some scheme to save student work in PowerPoint to a folder for assembling into one class presentation. Review saving data with the students, if

necessary. Make a copy of the scoring guide found at: http://www.iusd.k12.ca.us/ra/rsjdocs/analytic/eirubric.htm and the Research and Experiment Gathering Sheet handout for each student.

Introductory Activity

Step 1: As the students enter the room, give them copies of the handout Bloom Where You're Planted? and have the movie found at http://207.148.237.252/lowlife/craigweb1.swf playing in the background. When students are settled into the classroom/lab/AV auditorium, begin the class by viewing "Flower Play" from the Web site, http://sunflower.bio.indiana.edu/~rhangart/plantmotion/art/art.html, following the navigation menu: Plants & Art--Plant Art--Flower Play. The movie begins by crossing your mouse over the viewing area. For the **Focus for Media Interaction**, have students respond to the movies by answering the questions on the handout while listening and watching the images.

Step 2: After viewing the video clip, have students share answers from the handout. (Possible answers from the first film are: seeing aliens dancing, plant seeds are growing, time-lapse photography, claymation. For the second film, possible answers are: to decorate, for medicine, to represent a country — ex: the cedar tree on the flag of Lebanon, for employment of farmers, for celebration — ex. the Potato Festival in Michigan. Examples of commercial movies include "Invasion of the Body Snatchers," "Little Shop of Horrors," "Day of the Triffids" and the "Killer Tomato" series — these films emphasize rapid growth and meat-eating species. Answers will vary for the rest of the questions but look for leads to the next teaching activity that highlight growth and conditions for growth.)

Learning Activities

Session 1

Step 1: **Play** the video clip, "The Survival of Plants: Reproduction and Change" (03:48), from the video, "Life Science: Plants" (20:00). As a **Focus for Media Interaction**, review the top half of the Plant Adaptation Film Video Clips Focus handout and ask students to fill in answers.

Step 2: Share answers. (Answers may vary but look for light energy to chemical energy through photosynthesis and is possible through the stems and leaves using chlorophyll; Wagner's definition of biology is "study of plants and their parasites"; two specialties are reproduction and change — some changes are climate, volcanoes, rainfall change and new kinds of organisms; plants can't move — that is why they have to adapt to survive; bees, insects and birds move pollen around, and the wind and animals move seeds from place to place; the Dutchman's Pipe captures a bee until the time he is loaded with pollen and then releases him by relaxing the downward pointed hairs in the "belly" of the plant.)

Session 2

Step 1: View the video clip, "Plant and Animal Cells" (04:30), from the video, "Elements of Biology: The Cell: Structure and Function" (20:00), and as a **Focus for Media Interaction**, fill in the parts of a plant cell mentioned in the video clip on the Label the Plant Cell handout. Ask the students about an environmental issue referred to in the video in which plants process more carbon dioxide than their numbers can handle (greenhouse effect).

Step 2: Have the students finish labeling the parts of the cell by visiting http://waynesword.palomar.edu/lmexer1a.htm#plant and/or http://www.cellsalive.com/cells/plntcell.htm.

Ask the students if they find the analogy of the cell as a factory a valid analogy. Why or why not? Use the overhead transparency to compare the cell organelles and their functions to factory processes. (See overhead master "Comparing a Cell to a Factory.")

Step 3: As a **Focus for Media Interaction**, have the students use the handout Which Way Did They Grow? (located at end of lesson plan) to match the growth process description with the action seen while watching the video clips below.

Watch the following QuickTime movies:
Sunflowers (germination)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/earlygrowth/germination/germ.html

Sunflowers – in dark and in light (photomorphogenesis)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/earlygrowth/photomorph/photomorph.html

Coleus (negative gravitropism)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/movements/tropism/tropisms.html

Venus flytrap (nastic movements)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/movements/nastic/nastic.html

Shamrock plant (circadian response)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/movements/leafmovements/clocks.html

Root and root hair growth (growth)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/vegetative/veg.html

Morning Glory (flowering)
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/flowers/flower.html

Step 4: Share answers in class. Assure that answers are reinforced by naming variables. Example: "What are the variables in the dark and light conditions for growth of the sunflowers?"

Session 3

Step 1: As a **Focus for Media Interaction**, using the Research and Experiment Gathering Sheet handout, students will follow the steps necessary to create an online experiment in plant growth. The steps follow:

Step 2: Proceed to http://cycas.cornell.edu/ebp/projects/laststraw/ise/frm.lab.html.
Read the directions on the first page of this Web site until you are ready to click on the button "Open model window."

Note: First screen is the "Help" menu and well worth your time exploring. Pay particular attention to the buttons, "How do I collect the results?" and "How do I graph the results?"

Step 3: When you are confident that you know what you are looking for, click on the "Plant" tab at the top of the Help screen. Choose your plants for comparison. Keep in mind which variables you are concentrating on.

Step 4: Choose the climates using the "Climate" tab.

Step 5: Next, click on the "Grow" tab and watch your plants grow under the conditions and climate you chose.

Step 6: On the left side of the screen, choose the measurement element you are using as a point of comparison. Pull the probe down with your mouse and notice the readings change in the top of the screen to reflect the data represented in your choices. Don't forget that time may be one of your variables and days are managed by the slide bar in the upper left-hand of the screen.

Note: At this point, you need to note your data on the bottom of this paper for safekeeping. Once you leave the computer, your data is gone.

Step 7: Choose the "Graph" tab. You will see your graph produced on the screen. To copy it to the computer Clipboard for pasting into PowerPoint, hold down the Alt button and Print Screen button at the same time on a Windows computer to place your active window of your graph to the computer's Clipboard. On a Macintosh, hold down the Control, Shift, Command and the 4 key all at once to capture a part of your computer screen. Drag the selection tool over your graph to capture it to the computer Clipboard.

Note: Do not use the "Export to Clipboard" button at the bottom of your graph. It will create more mess than you need!

Step 8: Open up PowerPoint and choose the template that has a picture and one headline. Paste your graph in the open space of the slide by choosing "Paste" from the Edit menu. Save your work to the server or floppy disk (whatever is the protocol in your school). If you need help with PowerPoint, visit http://www.learningelectric.com/powerpoint.htm.

Step 9: Gather all the individual slides from the students (whether they are on the server in a folder or on individual floppies) and assemble them into one class presentation.

Culminating Activity

Have the students organize their topics into some order for a table of contents by organizing their research question from the Research and Experiment Gathering Sheet handout. Generate general topics about plant growth and write them on the blackboard. Some students may prefer growth strategies as a way to organize the topics (phototropism, circadian cycles), while others may prefer conditions for growth (light, water, soil) as ways to organize. Write student names with corresponding research question under the main headings as you view the whole class presentation build from the individual slides. Have students defend their reason for putting their own research questions under the umbrella of a topic.

Cross-Curricular Extensions

English/Language Arts

- Students can research famous poems about plants, flowers and trees (example: Kilmer's "Trees" or Wordsworth's "The Daffodils"). A collage of poetry and poems may be created. The poetry can be analyzed for scientific elements.

Civics

- The students can investigate legislation about air emission standards in the United States compared to other industrialized countries.

Music

- Students can perform or compose music to accompany video clips of time-lapse photography of plant growth.

Art

- Students can create accurate depictions of plant life with labels identifying the different parts of a plant.

Community Connections

- Invite regional climatologists to speak to the students about the effects of greenhouse gases on the planet.
- Invite botanists or gardeners to share specific plant adaptations to the region where you live. What plants live here and why? What environmental conditions make them thrive?

Bloom Where You're Planted?

Introductory Activity Response Sheet

Your Name_____

Time Block _____

While watching the first video, reflect on these questions:

- What are you seeing?

- What process captured this movement?

- Why is this process important?

While viewing the second video, reflect on these thoughts:

- What do plants provide for human life? (Write at least 6 *different* uses of plants - food being the obvious one.)

1.
2.
3.
4.
5.
6.

- Can you think of any commercial movies where plants have been a main "character"?

- What made the plants in the movie remarkable?

- Do you notice plants much as you travel along?

    - If you do not notice, why don't we notice plants very much compared to their value on the planet?
    - If you do notice plants as you go along, what accounts for that?

Plant Adaptation Video Clips Focus

Name_____ Time Block_____

Fill in the answers as we watch the video clip "Plants: Reproduction and Change."

1. Plants capture light energy and change it to _____ energy through a process called _____ through _____ found in stems and leaves of plants.

2. Warren Wagner, the biologist in the film clip, defines biology in a unique way. What is his definition?

3. Plants require two specialties to survive:

a.

b.

4. What can happen to make plants adapt? Name at least three change agents.

5. What aspect of being a plant complicates its adaptation in its environment?

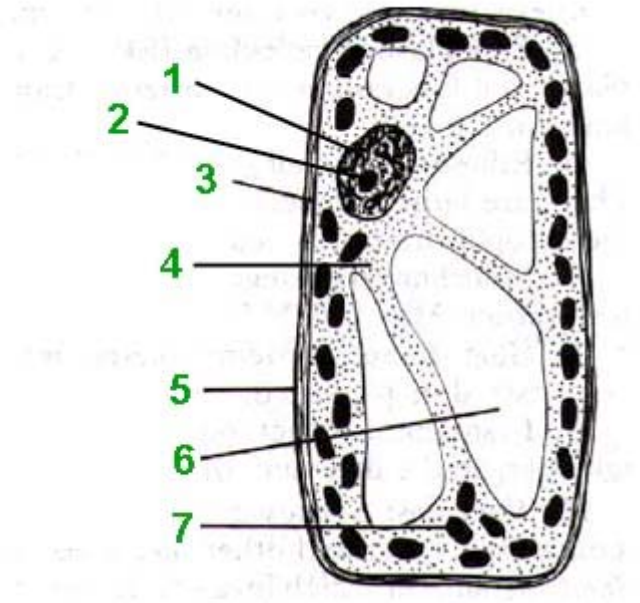
6. What moves pollen and seed from a plant to another place? Be specific.

7. What is the unique way that the Dutchman's Pipe plant moves its pollen? Be specific.

Label the Plant Cell

Name
Time Block

Word Bank
cell wall
chloroplast
cytoplasm
nucleolus
nucleus
plasma membrane
vacuole (large)



Which Way Did They Grow?

Plant Growth Processes

Name_____ Time Block _____
As we watch several segments of plant growth processes, match up the video clip with the growth process it illustrates. Draw lines from the flower to the process you watched in the video segments.

Sunflowers	negative gravitropism - directional movement responses that occur in response to a directional stimulus
Sunflowers - in dark and in light	circadian response - biological clocks that allow plants to respond to changes in time
Coleus	flowering - is the reproductive structure and is essential for completion of the plant's life cycle
Venus flytrap	germination - starts when a seed is provided with water as long as the temperature is appropriate
Shamrock plant	photomorphogenesis - the process by which plant development is controlled by light
Root and root hair growth	nastic movements - movements that occur in response to environmental stimuli
Morning Glory	growth - the period between germination and flowering

We have all observed examples of plant growth processes. Name two plant growth processes you have observed in daily life. From the processes we watched in the video clips, what processes do they represent?

1.

2.

Research and Experiment Gathering Sheet

Name_____ Time Block _____

Research Sources:
Visit at least three Web sites and gather information about plant growth and plant structure. To get you started, here are some ideas:
http://plantfacts.osu.edu/ The Ohio State University Plant Facts
http://www.urbanext.uiuc.edu/gpe/case1/c1brief.html The Great Plant Escape, Case #1
http://sunflower.bio.indiana.edu/~rhangart/plantmotion/starthere.html Plant processes
Record your research in the following form and table:

Research Source #1
Author (if any)_____
Title of the Web page_____
Type of resource (movie, article in a database, Web page) _____
Publisher or organization_____
Date visited _____
URL _____

Direct quote from the Web page	State the quote in YOUR own words

Use the back of the paper if necessary to add more information.

Research Source #2
Author (if any)_____
Title of the Web page_____
Type of resource (movie, article in a database, Web page) _____
Publisher or organization_____
Date visited _____
URL _____

Direct quote from the Web page	State the quote in YOUR own words

Use the back of the paper if necessary to add more information.

Research Source #3
Author (if any)_____
Title of the Web page_____
Type of resource (movie, article in a database, Web page) _____
Publisher or organization_____
Date visited _____
URL _____

Direct quote from the Web page	State the quote in YOUR own words

Use the back of the paper if necessary to add more information.

Hypothesis:

1. List as many factors as you can that affect plant growth.

2. Choose one question that you would like to test:_____
   _____
   If you need help identifying a hypothesis, try getting some ideas at this Web site: http://www.accessexcellence.org/21st/TL/filson/biol.html

3. Identify the controlled and dependent variables for your experiment. A definition of these terms is found at http://ei.cornell.edu/student/exptdesign.asp

The Experiment
* Proceed to http://cycas.cornell.edu/ebp/projects/laststraw/ise/frm.lab.html.

* Read the directions on the first page of this Web site until you are ready to click on the button "Open model window."

* The first screen is the "Help" menu and well worth your time exploring. Pay particular attention to the buttons, "How do I collect the results?" and "How do I graph the results?"

* When you are confident that you know what you are looking for, click on the "Plant" tab at the top of the Help screen. Choose your plants for comparison. Keep in mind which variables you are concentrating on.

* Now, choose your climates using the "Climate" tab.

* Next, click on the "Grow" tab and watch your plants grow under the conditions and climate you chose.

* On the left side of the screen, choose the measurement element you are using as a point of comparison. Pull the probe down with your mouse and notice the readings change in the top of the screen to reflect the data represented in your choices. **Note:** Don't forget that time may be one of your variables and days are managed by the slide bar in the upper left-hand of the screen.

Note: At this point, you need to note your data on the bottom of this paper for safekeeping. Once you leave the computer, your data is gone.

* Choose the "Graph" tab. You will see your graph produced on the screen. To copy it to the computer Clipboard for pasting into PowerPoint, hold down the Alt button and Print Screen button at the same time on a Windows computer to place your active window of your graph to the computer's Clipboard. On a Macintosh, hold down the Control, Shift, Command and the 4 key all at once to capture a part of your computer screen. Drag the selection tool over your graph to capture it to the computer Clipboard. **Note:** Do not use the "Export to Clipboard" button that looks so easy to use!

* Open up PowerPoint and choose the template that has a picture and one headline. Paste your graph in the open space of the slide by choosing "Paste" from the Edit menu. Save your work to _____. If you need help with PowerPoint, visit http://www.learningelectric.com/powerpoint.htm

To help you organize your data and headlines, use the space below:

Hypothesis:
Variables:
Data:

* Add a headline that describes your data and your hypothesis. Save again.

We will compile all the data slides into one group presentation.