Growing Pains

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Note: This lesson was originally published on an older version of The Learning Network; the link to the related Times article will take you to a page on the old site.

Overview of Lesson Plan: In this lesson, students compare common food items with the parts of a plant. They then grow their own plants to assess the difficulties in assisting a plant's growth and reproduction.

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Suggested Time Allowance: 1 hour

Objectives:
Students will:
1. Compare common edible items with the parts of a plant.
2. Learn about the importance of plant growth and reproduction for certain trees by reading and discussing the article "At Age 4,600-Plus, Methuselah Pine Tree Begets New Offspring."
3. Conduct a long-term investigation on the factors that affect a plant's growth and reproduction.
4. State their opinions on the policy to keep the location of the Methuselah tree secret.

Resources / Materials:
-student journals
-pens/pencils
-paper
-stapler
-classroom blackboard
-copies of "At Age 4,600-Plus, Methuselah Pine Tree Begets New Offspring" (one per student)
-resources about plants (computers with Internet access, almanacs, library resources, encyclopedias, etc.)
-peas
-apple
-radish
-spinach
-celery
-cauliflower
-plant seeds (enough for class; recommended: peas, basil, tomato, marigold, lettuce)
-soil (enough for class, non-fertilized)
-large cups with holes punched in bottom (one per pair)
-rulers (with millimeter markings, one per pair)

Activities / Procedures:
1. WARM-UP/DO NOW: Before class, find the following food items and display them in front of the classroom: peas, apple, radish, spinach, celery, cauliflower. Upon entering class, students respond to the following prompt in their journals (written on the board prior to class): "The five objects you see represent parts of a plant. Describe how each of the items helps a plant grow." After a few minutes, allow students to share their responses. Student replies should model these suggested answers: "The peas are seeds, which are tiny embryos. The apple is the fruit, which carries the seeds. The radish is a root, which anchors the plant and absorbs water and nutrients from the ground. The spinach is a leaf, which helps the plant make its own food through photosynthesis. The celery is a stem, which carries materials from the

roots to the leaves and provides support. The cauliflower is a flower, which carry the plant's reproductive parts."
Then discuss the following as a class: What are other examples of these plant parts? Why are plants important? Why are there more plants than animals? What factors might limit the growth of a plant? How do plants reproduce?
2. As a class, read and discuss the article "At Age 4,600-Plus, Methuselah Pine Tree Begets New Offspring," focusing on the following questions:
a. What is Methuselah? What is its "claim to fame"?
b. How did Methuselah reproduce?
c. Where is Methuselah's native setting?
d. What does it mean to have a "100 percent germination rate"?
e. Why will security be tight at the exhibition of the baby Methuselah?
f. What is the Champion Tree Project?
g. What does Christine Flanagan, public program director at the Botanic Garden, believe is the value of the Methuselah babies?
h. Why for plants, unlike humans, does "stress foster longevity"?
i. How long have bristlecones lived in their harsh environment?
j. How much do bristlecones grow in a "good" year?
k. Why might bristlecones that live in lush conditions be at risk?
l. What kills ancient bristlecones?
m. Where might older trees than the Methuselah be found?
3. Divide students into pairs. Explain to students that they have been charged with a daunting task. They will be given a seed taken from an imaginary plant that is believed to be the last of its species. They will be responsible for helping the seed grow and reproduce, thereby extending the longevity of the species. Each pair will keep a log book (several sheets of paper stapled together) in which they will make daily entries after observing their plant.
Assign each pair a particular type of seed, depending on availability. First students must research their assigned species type. Using available resources, students should create a species profile, listing the species name, type (perennial, annual, indoor, outdoor, etc.), native habitat, best growth conditions, planting/blooming season, optimum soil moisture and pH levels, foliage color, expected height growth, and plant uses. Students should record this profile in their log book.
Then allow students to set up their plant specimen. Give each pair one seed from their species type, a cup with holes punched in the bottom, and soil. Students should make comments in their log book regarding the depth of their planting and the condition and amount of the soil. Students should determine the amount and schedule of water to be given to the plant. Students should then select a location to place the plant, and record this location in their log book.
According to their pre-determined schedules, students should water their plants. Students should be allowed ten minutes each day over a period of a month (or longer, if desired) to observe their plant and write in their log book.
Each entry will consist of the following:
–date and time of observation
–weather observation (sunny, cloudy, rainy, etc.)
–height measurement of plant (in millimeters)
–evaluation of growth (is the plant growing well?)
–any changes made, if the plant is not growing well
Once the plant has reached a suitable height, students should consider strategies for assisting the plant in reproduction. Students might place the plant outdoors or near an open window to allow insects to pollinate it, cut off a leaf and attempt to sprout it another cup, split the plant near the roots and re-plant, or try other methods of their choosing. Any alterations made to the plant should be recorded in the log book.
At the end of the plant project, students should reflect back upon their entries in their log book and write a paper summarizing the study, focusing around the question: "What factors affect how a plant grows and reproduces?" In their papers, students should describe the purpose and findings of the experiment.
4. WRAP-UP/HOMEWORK: Each student should write an editorial on the following topic (written on the board for students to copy before they leave the class): "Do you agree with the measures to keep the location of the Methuselah tree a secret? Why or why not? How might knowledge of the tree's location or

photographs of the tree help or hinder its conservation?" In a future class, students should share their editorials with their peers.

Further Questions for Discussion:
–How is a plant different from an animal?
–Why do plants have cell walls?
–Why do trees have rings?
–What is photosynthesis?

Evaluation / Assessment:
Students will be evaluated based on initial journal responses, thoughtful participation in class discussions, cooperation in pairs, detail in keeping accurate plant log books, accuracy of papers summarizing their plant experiments, and editorials on their agreement with the policy to keep the location of the Methuselah tree secret.

Vocabulary:
sprout, medium, borne, offspring, eerie, germination, reforestation, pollinate, lineage, faulty, genome, fosters, longevity, thrived, retain, shrinkage, lusher, susceptible, pathogens, abrupt, arboretums

Extension Activities:
1. Diagram the processes involved in plant reproduction. In your diagrams, differentiate between sexual and asexual (self) pollination. Also explain how the difference between male and female pine cones in conifer reproduction (as in the case of Methuselah). What are angiosperms? What are gymnosperms? Use your diagrams to write a chapter on plants for a children's science textbook. Begin your research at http://scitec.uwichill.edu.bb/bcs/bl14apl/gym3.htm.
2. Dendrochronology is the science of studying tree rings to decode seasonal conditions of the past or incidences of catastrophe like fires. Scientists use a method of cross-dating different tree rings to understand the climate and environmental conditions of the past. Learn about the principles of dendrochronology at the University of Arizona Web site at http://www.ltrr.arizona.edu/dendrochronology.html. Then test yourself by using the examples from http://web.utk.edu/~grissino/gallery.htm to determine if your dendrochronological skills need improving!
3. Walk outdoors and collect a variety of flowers, fruit, seeds, or pinecones. Once indoors, dissect them carefully and use science resources to identify the different parts. If possible, preserve the parts and mount them. If not, diagram the parts and compare the different items.
4. Research to determine what is a considered a "champion tree." Then organize a debate about whether cloning should be used for reforestation of the 800-plus tree species found in the United States, a goal of the Champion Tree Project (http://www.msue.msu.edu/msue/imp/modpb/12129717.html). Both sides should conduct research from encyclopedic, media and academic resources and conduct interviews (where possible) to support their case.
5. Visit a botanical garden and interview an employee. Find out where their trees are taken from, how they are cared for, how so many varieties can be housed together, and how the reproduction of the plants is addressed. Summarize the interview in the form of an invitation for your peers to visit the garden.
6. Select a tree in your local park or garden and determine, using your own strategies, what species it is from and its approximate age. What identifying characteristics might you be able to locate in a guide book? How might measuring the diameter of the tree be helpful? Once you have made your guess, contact, if possible, a park ranger or gardener who might confirm your guess.

Interdisciplinary Connections:
Fine Arts- Collect a variety of leaves and do rubbings of them. Compare the rubbings and write the introduction for a "Leaf Guide," explaining general differences between different types of leaves.
Geography- On what types of land do plants grow? Produce a television show parody where plants show their "homes" to viewers. Suggested environments where plants interestingly grow are in lava flows, on rock cliffs, around metal fences, and underwater.
Global Studies- Who was Methuselah, the namesake of the tree? Why is the name appropriate for such an old species? Create a name placard for the Methuselah tree on which you explain the significance of

its name. The Catholic Encyclopedia offers an entry on the name at http://www.newadvent.org/cathen/10048b.htm.

Other Information on the Web:
NOVA Online: Methuselah Tree (http://www.pbs.org/wgbh/nova/methuselah/) explores the life cycle of the world's oldest living thing: the bristlecone pine of California's White Mountains.
The United States Forest Service (http://www.fs.fed.us/) manages public lands in national forests and grasslands.
The United States Botanic Garden (http://www.usbg.gov/) is a beautiful and fascinating living plant museum on the Nation's Mall at the foot of the U.S. Capitol.
The Champion Tree Project (http://www.championtreeproject.org/) promotes urban and community environmental sustainability by protecting, propagating, and planting a living legacy of our champion trees.

Academic Content Standards:
Grades 6-8
Science Standard 4- Knows about the diversity and unity that characterize life. Benchmarks: Knows ways in which living things can be classified; Knows that animals and plants have a great variety of body plans and internal structures that serve specific functions for survival; Knows evidence that supports the idea that there is unity among organisms despite the fact that some species look very different
(CTSS – 'science', '6-8', '4')
Science Standard 5- Understands the genetic basis for the transfer of biological characteristics from one generation to the next. Benchmarks: Knows that reproduction is a characteristic of all living things and is essential to the continuation of a species; Knows that the characteristics of an organism can be described in terms of a combination of traits; Knows that hereditary information is contained in genes, each of which carries a single unit of information; an inherited trait of an individual can be determined by either one or many genes, and a single gene can influence more than one trait; Knows how dominant and recessive traits contribute to genetic variation within a species
(CTSS – 'science', '6-8', '5')
Science Standard 7- Understands how species depend on one another and on the environment for survival. Benchmarks: Knows how an organism's ability to regulate its internal environment enables the organism to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment; Knows factors that affect the number and types of organisms an ecosystem can support; Knows relationships that exist among organisms in food chains and food webs
(CTSS – 'science', '6-8', '7')
Science Standard 16- Understands the scientific enterprise. Benchmarks: Knows that people of all backgrounds and with diverse interests, talents, qualities, and motivations engage in fields of science and engineering; Knows various settings in which scientists and engineers may work; Understands ethics associated with scientific study; Knows ways in which science and society influence one another
(CTSS – 'science', '6-8', '16')
Grades 9-12
Science Standard 4- Knows about the diversity and unity that characterize life. Benchmarks: Knows how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships; Knows how variation of organisms within a species increases the chance of survival of the species, and how the great diversity of species on Earth increases the chance of survival of life in the event of major global changes
(CTSS – 'science', '9-12', '4')
Science Standard 5- Understands the genetic basis for the transfer of biological characteristics from one generation to the next. Benchmarks: Knows the chemical and structural properties of DNA and its role in specifying the characteristics of an organism; Knows that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells, while other changes in an organism cannot be passed on
(CTSS – 'science', '9-12', '5')
Science Standard 7- Understands how species depend on one another and on the environment for

survival. Benchmarks: Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years; Knows ways in which humans can modify ecosystems and cause irreversible effects
(CTSS – 'science', '9-12', '7')
Science Standard 16- Understands the scientific enterprise. Benchmarks: Understands that individuals and teams contribute to science and engineering at different levels of complexity; Understands the ethical traditions associated with the scientific enterprise and that scientists who violate these traditions are censored by their peers; Understands that science involves different types of work in many different disciplines
(CTSS – 'science', '9-12', '16')