

# Elaborate: A Leaf Off the Ol' Phylogenetic Tree

## BACKGROUND INFO

Sometimes historians and genealogists will construct a family tree showing all the descendants of a famous person like George Washington or King Henry VIII. Such a tree is handy for listing all the descendants and for showing their relationships to each other. A **phylogenetic tree** in biology is a similar device used to show all the groups and species that have evolved from a common ancestor organism and how closely they're all related to each other.

Plants are multicellular living organisms with chlorophyll (the pigment that lets them do photosynthesis) in their cells. Scientists believe the original precursor to plants was green algae. A series of mutations and adaptations led to the variety of plants you see around you every day. One of the first adaptations that occurred was a waxy outer layer called a cuticle. This enabled plants to survive on land without drying out as easily. *Bryophytes* (mosses and liverworts) were some of the first plants which had this adaptation. For a plant to grow larger than moss, the plant needs a way to get water from the ground to all the parts of the plant. This requires a vascular system. Such an adaptation allows seedless vascular plants like *ferns* to grow much larger than mosses.

Mosses and ferns both reproduce using spores. Part of this reproduction requires water, so ferns and mosses tend to be limited to cool, moist areas. For plants to spread to other areas, they need a reproductive strategy (*pollen*) that doesn't rely on moisture for fertilization and a reproductive structure (*seeds*) that can last through drier spells. Gymnosperms (which include the *conifers* - cone bearing plants) were some of the first plants to use these adaptations. To extend their reach even more, plants needed adaptations that would help get pollen further than just how far the wind might carry it (*flowers* to attract pollinators) and would help seeds spread further than just dropping from the tree (*fruit* to encourage animals to take the seeds elsewhere). *Angiosperms* are flowering plants and many types bear fruit or other special adaptations on their seeds to help their seeds spread. *Dicots* and *monocots* are two types of angiosperms your teacher will tell you about.

## PROCESS AND PROCEDURES

### **Making and using a phylogenetic tree**

1. Your teacher will draw a phylogenetic tree for plants on the whiteboard summarizing the background information listed above. In the "Elaborate" section of your notebook, use one page to copy this tree down. Reserve the opposite page for questions from the Analysis section.
2. Using a 1 quart plastic bag with your name on it (or other container) collect specimens (a leaf, seed, berry, fruit, etc.) from as many different types of plants as you can. If you get a flower or fruit, be sure to try and include a leaf with it to aid in identification of the specimen. Try to obtain specimens from each of the groups listed in your phylogenetic tree.
3. Lay your specimens out on your table or desk, and organize them into the groups listed above: bryophytes, ferns, gymnosperms, monocots, and dicots. Your teacher will assist you in grouping specimens you're not sure of. Use two pages in your Elaborate section to draw sketches of your specimens and be sure to group them and label them in your sketches.

## **PROCESS AND PROCEDURES** (cont.)

### **Six kingdoms**

4. One of the highest levels of classification used in phylogenetic trees and taxonomy is the “kingdom”. Different books and different scientists use anywhere from 5 kingdoms to 8 kingdoms, however, the six kingdom system is used and accepted by many books and scientists. Your teacher will fill in the information for the Six Kingdom Worksheet on the board at the front of the room. Be sure to put all that information into your notebook to refer to as you answer the Analysis questions.

## **ANALYSIS**

**Answer the following questions in your notebook using complete sentences.**

1. There weren't any scientists around taking records as plants were evolving into mosses, ferns, and all the various other types, so how do you think scientists constructed a phylogenetic tree for plants? What information do you think they used?
2. Which plant groups listed in your tree have flowers? Which ones have a vascular system? Which groups have a waxy cuticle?
3. Flowers, a vascular system, and a waxy cuticle are all adaptations that occurred in plants at some time in the past. What order do you think these adaptations occurred in? What evidence do you have that supports the order you listed?
4. You find an organism in the forest that is multicellular and the cells have nuclei. The organism has no chlorophyll (so it's not autotrophic). Which kingdom(s) could this belong to?
5. You and a friend find another organism in the forest that is multicellular and has no nuclei. Your friend gets very excited and says you should call a biologist at a university. Why?