

A. Twig Experiment: Stages of Development

1. Collect one cutting from several species of trees and shrubs. Label them.
Try to include a red maple among the stems collected. They are opposite branched, the buds are prominent, red and round. The red maples will flower before they break leaf bud. The flowers will be tinged with yellow if they are male and fully red if they are female.



Example: Red Maple twig

2. Place the cuttings in water. Be sure to trim the bottom of each stem weekly to ensure even water uptake.
3. Compare time required to break leaf bud or flower bud and observe the various stages of development. For each species, encourage students to consider:
 - Which comes first? Bud burst, flowering and leaf development.
 - When can you see the petiole (leaf stem)?
 - When does the leaf approach full size?
 - If the plant flowers, can you discern the sex?
 - Male flowers would have pollen.
 - How long is the period of time between flowering and leaf development?
 - Should you include conifers?
 - What developmental stages could we observe with them?

It might be interesting to include another classroom in your school. In Grand Rapids our classroom windows face north. We are going to invite another classroom with south facing windows to duplicate our experiment to see what effects aspect (orientation to the sun) has on outcomes. I would encourage you to take photographs each day as a way of documenting the experiment. Post them on Google Groups and we can all share the results. This will be a foundation for observing plant development in the spring. Can we have several schools doing the same experiment and compare the results? Begin in late January or early February.

Key Words:

Bud Burst: the first green lines that appear along the edges of a bud as it swells and prepares to open.

Petiole: The stem of a leaf.

Aspect: The orientation of an object to the sun.

B. Twig Experiment: Time from cutting to bud burst or flowering

1. Select one, two, or three species and gather a new branch *from the same tree* every two weeks.
2. Place them in similar containers; keep them moist and trim the ends each week.
3. Expose them to the same source of light.
4. Keep track of the timing to each stage of development. Are they similar or different? What do you think will happen? Why? This experiment could begin in mid-January and continue for 6 weeks.

This experiment will introduce the matter of cold exposure to the students. Some trees, notably the red maple, will break bud faster after a longer exposure to cold weather. This is an evolutionary adaptation to guard against the maple budding too early. In a warm spring, the maple might bud out, only to be burned by a late season frost. The important thing to notice in this experiment will be the time from initial cutting to bud break. In the case of the maples, it should decrease with longer exposure to cold weather. This may not be the case in other species. Careful observation will be important.

Phenophase Definitions

Breaking leaf buds

One or more breaking leaf buds are visible on the plant. A leaf bud is considered "breaking" once a green leaf tip is visible at the end of the bud, but before the first leaf from the bud has unfolded to expose the leaf stalk (petiole) or leaf base.

Leaves

One or more live, unfolded leaves are visible on the plant. A leaf is considered "unfolded" once its entire length has emerged from a breaking bud, stem node or growing stem tip, so that the leaf stalk (petiole) or leaf base is visible at its point of attachment to the stem. Do not include fully dried or dead leaves.

Increasing leaf size

A majority of leaves on the plant have not yet reached their full size and are still growing larger. Do not include new leaves that continue to emerge at the ends of elongating stems throughout the growing season.

Flowers or flower buds

One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds or inflorescences that are swelling or expanding, but do not include those that are tightly closed and not actively growing (dormant). Also do not include wilted or dried flowers. For *Populus tremuloides*, both the male and the female inflorescence is a catkin which is initially compact, but eventually unfolds to become longer and hang loosely from the branch. Once the flowers wilt, male catkins turn gray and dry up, and female catkins turn green and lengthen as the fruits develop.

Open flowers

One or more open, fresh flowers are visible on the plant. Flowers are considered "open" when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers. For *Populus tremuloides* (Quaking Aspen), the flowers will open once the initially compact catkin has unfolded and is hanging loosely.

Pollen release

One or more flowers on the plant release visible pollen grains when gently shaken or blown into your palm or onto a dark surface.

