

Adopt-a-Bud Project: An Exercise in Observation of a Tree Bud from Winter until Sprout Completion



RECOMMENDATION

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ABSTRACT

Students observe a tree bud from late winter until it sprouts. They learn to use dichotomous keys to identify their tree. The activity is inquiry-based; students predict when their bud will open and what it will become. Student drawings, quotes, and data are included to exemplify the process. The activity can be used to teach plant vocabulary and differentiation as well. It can be adapted to any grade level – from elementary school to college.

Key Words: Inquiry; bud; plant growth; conservation; projects.

When we were first assigned the bud project, I'm not going to lie, I wasn't too thrilled about it. I didn't think I would actually observe any significant changes, but it was indeed growing. When the bud started to open I started to get intrigued. I thought it was kind of interesting. I've never seen the phases of the bud opening on a tree before. It originally just looked like a 3 parted bump on the end of a twig and it was very small and almost unnoticeable if you didn't know it was a bud. In the end it grew to a size of 34 by 26 mm! (Patrick Littel, Class of 2010)

[Students] appreciate how it forces them to take the time to observe something so simple and beautiful that they had taken for granted.

James Wandersee and Elisabeth Schussler announced their campaign to “prevent plant blindness” in *The American Biology Teacher* (February 1999) to illustrate how society overlooks the effects of plants on ecosystems. They acknowledged that plants are often omitted or underemphasized in introductory biology classes even by knowledgeable teachers. Like many others, the student quoted above did not take much notice of plants before performing the bud observation activity described here. Easy and affordable, this activity can be adapted for use with students at any level, from elementary to college. During spring in the Midwest, students and teachers alike rush outdoors to enjoy the warmth of the sun and erase the memories of the harsh winter. Students plead to take their

lessons outside. They want to experience the greening of the environment, yet they are unaware of the amazing process of burgeoning buds sprouting into blades of foliage and bursts of blossoms. Additionally, many students and parents do not know the specific names of the trees growing in their yards. With the modern biology curriculum placing so much emphasis on molecular, cellular, and evolutionary studies, and with teachers using examples from the generally more familiar animal kingdom, botany is frequently skipped altogether or squeezed into a 2- or 3-week unit in many American schools. At our high school we have chosen to do a study of a tree bud as part of our plant unit – a long-term scientific study. The project can be a paradox. Students frequently report that it is frustrating to watch a bud for so long, yet they appreciate how it forces them to take the time to observe something so simple and beautiful that they had taken for granted.

With most school class periods being 40–50 minutes long, science students have become accustomed to doing short “canned” labs. Teachers frequently purchase kits or design labs that allow students to solve problems in a single class period. In this activity, students pick a terminal tree bud that they will observe, outside of school time, from early spring or late winter until it opens. To extend the research, the project can start in autumn, when leaves drop and buds first form. In Figure 1, a student measures a bud on a horse chestnut tree. Figure 2 shows two students observing a serviceberry tree in their front yard.

○ Methods

Students are asked to “adopt” a terminal bud on a tree in their yard to study, observe, and measure from its dormant stage in winter until it blooms in spring. They are encouraged to wrap a piece of yarn or twist-tie around the twig near the bud so that it can be easily identified and found. We chose the terminal bud of a tree and not a shrub because trees often grow more dramatically. The activity begins with discussion questions like the following (the teacher can supply sample twigs with buds as examples): Have you ever observed the growth of your tree before? Have you seen the buds on the tree? Do you know what the buds will become? Do you know whether the buds on your tree will produce



Figure 1. Close-up of a horse chestnut bud (*Aesculus* sp.) in the fall.

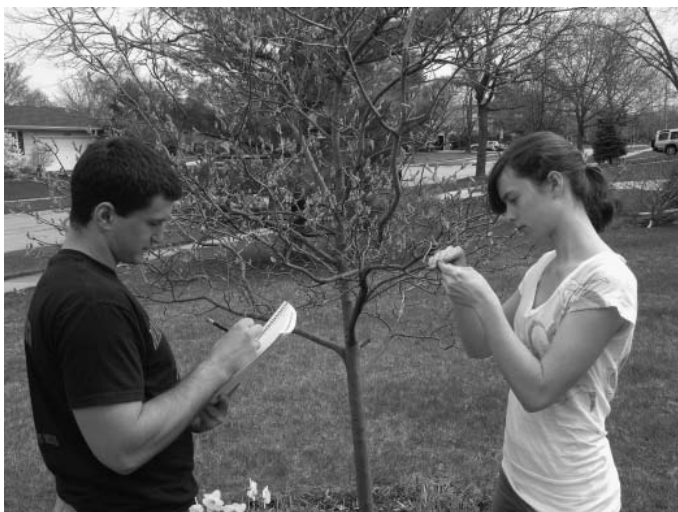


Figure 2. Students measure and record observations of a bud on a serviceberry (*Amelanchier laevis*) in the spring.

flowers, leaves, or multiples of both? Do you know where the leaves or flowers originate?

We give the students a written introduction that begins with the following:

The purpose of this activity is to give you a front-row seat to observe the development

of a bud from winter dormancy until the contents of the bud are fully exposed. Each spring, the trees around us “leaf out,” but this year you will document the event. Every other week you will submit a sketch and your observations of one bud. When the temperature is above 40 degrees Fahrenheit, you will make an observation every week. When your bud begins to open, you will be in the “spring” phase of the project. This phase will require four full-page sketches of the bud as described in this assignment. These sketches may actually occur at one-day intervals depending on the tree you observe and the weather in the Chicago area this spring. The final report will include a graph, summary, and reaction to the project.

The students are provided with a data table on which to record their observations (Figure 3). A copy of a metric ruler has been added to the edge of the paper to assist the students with their measurements. They will measure the length and width of the bud and record these along with a description and any other observations of the bud and a record of the weather. Some students choose to photograph their bud as well as draw it to document the growing process. This is encouraged, but an original drawing is still required. If the teacher wants to emphasize botanical structures, the parts of the bud can be labeled in the drawing.

The students are asked to bring in a twig from the tree they are observing. The twig needs to be big enough to show the position of the buds (opposite or alternate) and should include at least one bud scale scar to show the previous year’s growth. In our second-semester curriculum we cover classification and how to use a dichotomous key. What better way to learn how to use a key than to use it to identify a specific living thing? We use a winter tree-finder book with a key to identify the trees. Such books are helpful because they review the parts of the twig pictorially in their descriptions – lenticels, bud scales, leaf scars, vascular bundles, thorns, and much more. Be warned that most keys include only native trees, so ornamental or horticultural varieties of trees frequently planted around homes may not be in the books. These include crab apple varieties, Bradford pears, and other exotic trees. Students who already know the species of the tree they are observing are still encouraged to use the key, to practice its use. It is surprising how many students and parents do not know what species their tree is, and most parents appreciate finding out. Frequently, parents know that they have a maple or oak but do not know the type and sometimes are misinformed, thinking they have one type of tree, only to discover they have a different one. The project gets the whole family involved and raises interest and discussion in the home regarding trees.

It is helpful to have other books with pictures available for students to look at to discover what type of tree they have. We have several books, but the most helpful is *Durr’s Manual of Woody Landscape Plants*. We call it the “tree bible,” as it has descriptions of nearly every commercially available tree and drawings of most trees’ twigs, buds, leaves, and flowers. Several Web sites are useful in identifying native trees in Illinois, including *What Tree Is That?* (<http://www.arborday.org/trees/treeID.cfm>) and *The Illinois State Museum Herbarium Collection* (http://www.museum.state.il.us/ismdepts/botany/herbarium/Illinois_trees.html). These sites offer photo galleries and online keys. Be sure to search the web for online help for your part of the country.

Once the students have identified their tree species, they do research to discover the expected physical appearance and other information such as location of origin, uses for the wood, and tree products. The students use Web sites and printed resources, including the *Durr* manual, in their research. They encounter words like *monoecious* and *dioecious* to describe


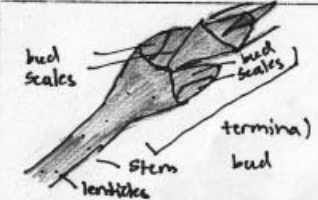
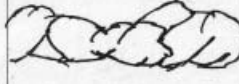
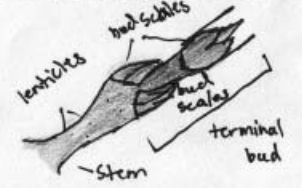

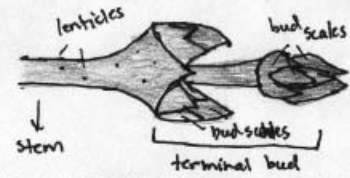

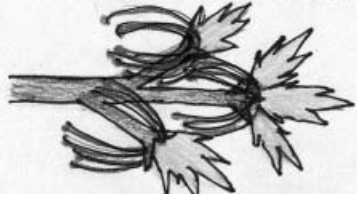
Bud Project Observation Sheet					
Date	Length (mm)	Width (mm)	Weather	Observations	Drawings
2/28/10	13.97	9.00	 -cloudy -high = 35°F -low = 26°F -Few snow flurries	-starting to open on sides and at top -fuzzy top layer -inside looks like an olive green -points on side of the top of the bud -larger in length and width	
3/13/10	14.0mm	9.5mm	 -cloudy -high = 36°F -low = 18°F -Few showers	-opening a little bit on all sides -fuzzy top layer -inside still looks olive green -relatively the same in length and width	
3/20/10	19.0mm	10.0mm	 -cloudy + sunny -high = 42°F -low = 34°F	-opening up on all sides -now concrete layer instead of fuzzy. -prominent bud scales present -red and green scales -bigger in length and width	
4/3/10	25.0mm	15.0mm	 -cloudy + sunny -high: 71°F -low: 54°F	-opening up on all sides -leaves and flowers are opening and growing -bud scales still present -red flowers and green leaves	

Figure 3. Example of a student's data sheet. We especially like how Nabihah Khan (Class of 2011) showed the weather with her observations.

the arrangement of male and female flowers on trees; *perfect*, *imperfect*, or *complete* to describe the flower; *compound* or *simple* to describe the leaves; and other botanical terms for characteristics such as leaf shape, margin, and venation. Some teachers take a few minutes a day for a week or so to present the bud fact of the day, give definitions, and show pictures that illustrate these terms. These examples are available for students to use. When the buds open, the students will draw the product – leaf, flower, or both – and use the terms they have learned to describe their drawings.

Next, the students predict when their buds will open as a result of the research on the species. This provides an opportunity for hypothesis formation, inquiry, and analysis. In their conclusions, students will discuss whether their prediction was correct. If it was not, they will analyze why – was it weather, the tree's location, or some other factor? Students with similar trees will be asked to discuss their results with others. This increases the lab's effectiveness, adding peer-review discussion to the inquiry process. These discussions can put students at ease because they see that different species break buds at different dates. Students seem to be more engaged in the process when they have some background knowledge regarding what to expect of their tree.

○ Results

For the culminating assignment, students are to organize and submit all their observations, along with graphs showing the width and length of their buds over time. They write a conclusion discussing their hypothesis and give a reaction to the whole process. Typically, students are amazed

and intrigued. Something that had been taken for granted or ignored has more meaning for them. They have learned to slow down and experience a detail of nature. By the end of the project, their awareness of plant bud development has decidedly increased. The following are excerpts of some students' reactions.

I think this is a good project to do because it teaches you to watch and learn about a specific tree and lets you observe the development of a bud while you are learning about it in class. It lets you relate to something outside of the classroom that is really happening to learn about it first hand. It makes the student more engaged during class while the teacher is talking about trees and buds. (Becca Paren, Class of 2011)

Overall, I feel like this project was very beneficial to me for many reasons. It majorly improved my observation skills. I was continually observing my tree to see if any changes occurred.... I just found this project very interesting. Some observations may have been tedious at times but now I am able to look back at them and really see the transformation of the bud. (Nellie Chung, Class of 2010)

I ended up enjoying this project a lot more than I thought I would simply because I really took the time to observe my bud accurately and carefully. It taught me to be patient. (Megan Philipp, Class of 2011)

○ Discussion

There are some additional issues to be considered by a teacher using the Adopt-a-Bud Project. Sometimes buds die or are trimmed off by the city or a forgetful father. We caution students that if their bud is not growing and the others on the tree are, to switch to a bud that looks similar to their bud and to make note of this in their observations. Another issue for the teacher is how to keep the students on task with their observation logs. It is challenging for students to make observations when it is snowing, raining, hot, or cold. We encourage students to make all their observations on the same day of the week so that the growth graph will be easier to construct. We normally collect and grade or make suggestions on the observation chart to make sure the students are keeping up. Some teachers require students to bring a look-alike bud from somewhere else on the tree or a photo to document that they are doing the assignment correctly. Once the bud starts to open, changes happen quickly and students may have to observe and make drawings daily. We call this the “spring phase” of the project. We have arbitrarily identified four phases of bud opening for ease of observation: (1) when the bud first changes color and splits open, (2) when something is protruding from the bud, (3) when the bud is obviously open and revealing some contents, and (4) when it is open all the way so that the leaves and/or flowers can be observed and drawn. Figure 4 shows a sample compilation of these four phases. For each of these spring-phase drawings, students must include a look-alike bud.

To encourage discussion and comparison, the dates on which the buds opened should be listed in a table. The class should discuss

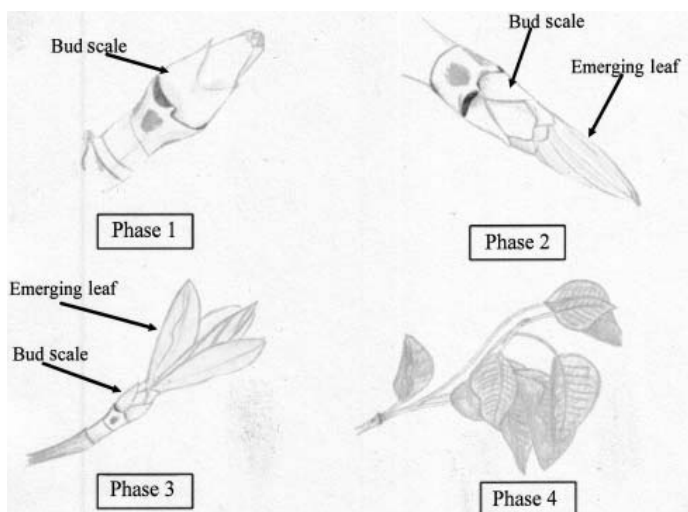


Figure 4. Student drawings of the four bud-opening phases (courtesy of Sherry Tang, Class of 2007).

why the buds of some tree species open earlier than those of others. Is it attributable to the species' places of origin (e.g., Asia, Europe, or America)? Do trees of the same species open at different times or at the same time? For further extension, students can also investigate whether there are any graphical relationships between number of leaves and length of bud or length versus width to go along with the growth-versus-time graphs.

Our Adopt-a-Bud Project has evolved with student input. A student provided the observation chart. Some students were frustrated that they didn't know what their tree was until it sprouted; thus, we expanded the project to identify the tree in winter and do research on the tree. Now students are curious as to what controls the bud's opening, and the assignment may once again need to be altered to include a study of plant hormones and their effects. The activity can be expanded to cover as much or as little of plant anatomy and physiology as a teacher chooses. Through it all, our students have become fond of the project, and most continue to enjoy the bud over the summer. Many write that they felt that the bud was “like my child” or that they were “parents watching their buds grow up.” Certainly they have been cured of plant blindness, at least temporarily.

○ Acknowledgments

Someone once said that we stand on the shoulders of giants before us. We don't know where the “Adopt-a-Bud” activity began or who started it. We know that biologists have been observing life for eons. The activity may have been written up in *ABT* many years ago. It's time to include it again so that more schools will use this activity. It was introduced to our school by an outstanding biology teacher, Sherry Yarema (now retired), who learned of it from her college botany professor. It transformed the way she noticed changes in spring. Other teachers – Betty Wine and Susan Pletz – contributed to this project at Naperville Central High School (NCHS), a school of 3100+ students in the western suburbs of Chicago. It is a high-performing school in the state and nationally. Students in Enriched Molecular Biology, an honors course with Chemistry as a prerequisite, have been doing this lab for about 20 years. Students in the regular-track class have also done the activity in the past.

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