

Making a Plant Collection

This multi-part lesson plan was developed by Gregory Shenk of the Greater Hartford Academy of Math and Science in Hartford and revised in 2020 by Sarah Taylor (CONN). Students first collect plant specimens and mount them so they can be preserved in perpetuity for research and education. Then they will become familiar with using online herbarium data and will respond to questions about the meaning of the information they find in UConn's "Virtual Herbarium."

I – Making collections

Background: Throughout the 1800s and into the mid-1900s, academic institutions of all sizes used to maintain collections of preserved organisms as sources of material for use in the classroom and research. In fact, it was common for individuals to maintain private collections for their own study and leisure. With the dawning of the molecular revolution, changes in the culture of biological research have led to an increasing emphasis on experimentation and data collection in a laboratory environment. One of the unfortunate (and unintended) consequences of this shift has been a slow decline in the number and quality of biological collections at many institutions. Fortunately, collections at some of the larger institutions have been able to survive and in some cases even expand. The University of Connecticut is one such institution.

Much of the expansion of collections at the University of Connecticut has been a consequence of absorbing the collections from many smaller institutions as they made room for more technically oriented biological science programs. There can be a great deal of valuable data recorded with these specimens and many questions can be answered using these data. In order to keep the data up-to-date, new collections need to be made and archived.

While organisms of all kinds can be collected and preserved for long-term storage, this exercise will focus on botanical collections. You will be expected to collect, press, identify and mount a collection of 15 plants. Your collections will be submitted to the herbarium at the University of Connecticut and will become part of a collection that is available for researchers around the world to use. Your name and the name of your institution will appear on collection labels so students half a world away may one day be using your collections in their own research!

Materials:

In the field:

- Notebook and pencil to record field data
- Small trowel to dig out plants by the roots
- Hand pruners to collect woody branches
- Masking tape and permanent marker for labeling specimens
- Large plastic bag(s) for carrying specimens
- If available: handheld GPS or GPS app on a smartphone

In the classroom/at home:

- Plant press with straps or two sheets of plywood cut to 11 inches x 16 inches and rope or paracord
- Pens/pencils/permanent markers
- A pile of old newspapers
- Several sheets of cotton blotters, 11 x 16 inches
- Several pieces of corrugated cardboard "ventilators", 11 x 16 inches
- Archival, acid free herbarium mounting paper, 11 x 16 inches
- Archival PVA glue or white school PVA glue such as Elmer's
- Paintbrushes of various sizes

- Large sheet of Plexiglass (optional)
- Small container such as a saucer, petri dish, takeout container lid, etc.
- Acid-free printer paper to use for herbarium labels and to fold into seed packets
- Wax paper cut into approximately 18 inch lengths
- Dissecting tools (optional but very helpful)

Instructions: Find a location where you would like to collect plants and obtain permission from the landowner and collection permits (if applicable). Assemble your “field kit” as listed above. You will want to record as much information in your notebook as possible at the time of collection (see label below to see what you will want to record). You needn’t identify the plant (but it won’t hurt) at the time you collect each specimen, but you should record the collection number, the date collected, and a description of the location where the plant was collected. The collection number for each specimen is unique and most collectors start at 1 (so accessions with four- and five-digit collection numbers reveal a collector who has been very busy!). The date is very important as the developmental stage of the plant at the time when collected may reveal changes in environmental conditions over time such as global warming.

PLANTS OF YOUR TOWN

ROSACEAE

Rosa palustris Marshall

USA: Connecticut: Hartford County: Windsor: Northwest Park. Overgrown shrub-dominated marsh near landfill.

41°54'18"N, 72°42'07"W. Accuracy: GPS accuracy

Shrub, 2 m tall. Stipules very narrow. Most leaves with seven leaflets.
Petals pink.

Ted M. Zebryk 5045 10 July 1998

SCHOOL LOGO HERE

The description of the collection site ought to include the country, state, county, and town/city, and be as specific as possible. For example, “Eastern shore of the Broad River, 10 meters north of the Oak Street bridge” instead of “Near a bridge.” If you record the name of the property, it may be difficult for a botanist to pinpoint the location in 150 years if the name is no longer in common usage. On the other hand, latitudes and longitudes don’t change. In the past, these were gleaned from topographic maps. Now many collectors carry handheld GPS units or use a GPS app on their smartphones. Also, try to record physical characteristics of the site such as soil textures (e.g. sandy, silty, heavy organic layer, etc.) and moisture regime (e.g., dry upland, boggy area, flowing stream, lake), and the names of as many of the plants as possible that you find surrounding your specimen and/or the habitat type (e.g., mixed oak/pine forest, open meadow, sand dunes, etc.).

It’s actually best to identify the plant while it’s still fresh, but most botanists collect several specimens while in the field and transport their specimens to a common location where they can identify and press them. To keep the plant in its best condition while you are collecting in the field, you should place a piece of masking tape around the stem with the collection number that corresponds to the data you’ve recorded in your field notebook and enclose the plant in a large plastic bag.

Fieldwork tips:

- Safety first! Be aware of what's around you and potential hazards of the location, and collect with a buddy.
- When collecting herbaceous plants (wildflowers, grasses, ferns) use your trowel to carefully dig up the roots – you may need to know if the plant has a taproot or fibrous roots, a caudex or rhizomes, to identify it correctly. Remove as much soil as you can before placing the plant in your plastic bag.
- When collecting a branch from a woody plant, make sure the portion you select is representative of the whole plant. Include any flowers or fruits, thorns, leaves, buds, etc.
- When collecting plants in the Asteraceae (sunflowers, asters, goldenrods, etc.), break off one leaf and write down in your notebook if there is any latex (sticky sap) that oozes out, and if so, what color it is – you may need this information later.
- Record in your notebook any features of the plant that could be lost over time once dried and mounted – flower color, plant stickiness, texture (is it waxy? rough to the touch?), any scents you notice, etc. For woody plants, make note of what the bark looks like – is it shaggy? peeling?, how tall the entire plant is, and if it has one trunk or several stems.

When you're finished collecting and ready to identify and press the plants, you should remove them one at a time from the bag(s), identify them, and place them in a plant press as soon as possible after you finish the identification. Put the bottom of the press (or one piece of plywood) on a flat surface. Add one sheet of corrugated cardboard, then one sheet of blotter paper. Take a piece of folded newsprint and write your initials, collection date, and specimen number (from your masking tape) on the newsprint using a permanent marker. Open the newsprint "folder" so the right side is on top of the blotter paper, and arrange your plant on top. All the plant parts should be visible – flowers, fruits, leaves. Make sure that at least one leaf is turned so that the underside is showing, because the top and bottom surfaces of leaves are often different. This is your opportunity to arrange your



plant so that it is optimally useful as a scientific specimen, and that you find aesthetically appealing. If your plant doesn't fit within 11 x 16 inches, you can fold it or trim it so that it fits, but don't remove essential parts. Fold your newsprint closed over your plant, then add one blotter sheet and one corrugated cardboard. You are now ready to add the next blotter paper and continue your layers with the rest of your collected plants. When you've pressed the last of your plants in newsprint, add one more blotter paper, a final cardboard sheet, and then the top frame of the plant press. Use the straps or rope to cinch the press as tightly as possible. You can have a friend carefully stand on the press while you pull the straps tight. The plants should be dried as thoroughly as possible to avoid molding and will dry more quickly if the press can be stored in a hot attic or a car trunk.

After completing the information on the collection label and drying the plant in a press, you will need to mount the label and the plant on a herbarium sheet. A mounted specimen is illustrated below. The best method for mounting specimens is to use a paintbrush to spread a diluted museum-quality acid-free adhesive into a thin layer on a 16 x 24 sheet of Plexiglas (as an inexpensive alternative, try placing a large piece of freezer paper or overlapping strips of plastic wrap on a counter-top). Mount the specimen label by placing it in the glue, then transferring it to the lower right corner of the herbarium sheet. Next, lightly lay the plant down in this adhesive film and quickly lift it. Carefully position it on the herbarium paper. If there are loose plant bits left in the newsprint folder, fold a small packet using the same paper you used for labels. Place the loose plant bits inside and glue the packet to the herbarium sheet. Spread a sheet of wax paper over the specimen and label and place a board on top to hold the plant down while the glue dries. You can create a stack of specimens by layering cardboard, one specimen, wax paper, then repeat, ending with a sheet of cardboard; place a board or heavy book on the top of your stack. After a day or two, the adhesive should be dry and the specimen can be stored until you're ready to turn in the collection for a grade. (See the [rubric](#) for information on how collections will be graded.)

Mounting tips:

- The amount of water you use to dilute your glue is a matter of personal preference and trial and error. If the glue is too thick, your labels may wrinkle and your plant might get stuck to the Plexiglass and break apart when you lift it. If the glue is too thin, it won't hold the plant to the paper when dry.
- Brittle leaves and ripe grass fruits very often get stuck to the adhesive film on the Plexiglass sheet. You can carefully peel larger leaves up and glue them to your herbarium sheet, but do not glue them as if they'd never fallen off – place them to the side of your specimen.
- Dissecting tools such as probes and forceps are very useful for lifting plants and labels off of the adhesive film and precisely placing them on the herbarium sheet.
- If you are concerned that plant parts might get stuck to the adhesive film, you can pour some glue in a shallow dish and use a small paintbrush to “paint” it onto the back of the specimen, or use a glue bottle to “dot” diluted glue along the stem and backs of leaves/flowers instead of using the adhesive film method.
- Your goal is to have an herbarium specimen that is firmly attached to paper, but not completely glued down. Scientists often need to dissect a flower to observe its inner structures, or to remove a seed or leaf for further studies such as DNA isolation or Scanning Electron Microscopy. This is difficult, if not impossible, if the entire plant is attached to the sheet.

Additional information on collecting and mounting plant specimens is available in a publication from the [University of Florida Herbarium](#).



II – Making Digital Connections

Background: As smaller collections have been absorbed into larger collections at fewer institutions, the scientific utility of the records contained in these combined collections improved. Many of these collections are now being digitized and, consequently, the data associated with the specimens can be made available to anyone any place in the world with an internet connection. The George Safford Torrey Herbarium (CONN) at the University of Connecticut has one of the most comprehensive collections of New England plants in the region and over 90 percent of the specimens have been digitized. This exercise has been designed to familiarize you with the electronic resources that CONN has made available to you through their online database. You may want to conduct this exercise while your plants are drying in the press.

Using digital data: Pay a “virtual visit” to the University of Connecticut’s herbarium (<https://biodiversity.uconn.edu/herbarium-conn/>) and generate a distribution map for one of your species. Select “Access Database” then “Search the Herbarium Database” and conduct a simple query using the genus and species name from one of your specimens. At the top of the results page, click on “Map these results with Berkeley Mapper” to get a sense of where your species occurs. Several markers will probably appear on the map that you’ve just created. Click on

one of these markers and follow some of the hyperlinks to see what kinds of valuable data can be gleaned from this database. You can zoom in or out using the +/- buttons on the left side of the map or by using the scroll wheel on your mouse but the results are often unsatisfying. It's better to use the "zoom by box" (a magnifying glass icon) tool above the map. You also can toggle between the different background options (map, satellite, hybrid, terrain, etc.) in the upper right portion of the map.

Next, click on the hand tool and drag the map until you can see your own neighborhood. See if there are any accessions of this species that have been collected near your house. Now click back to the Search the Herbarium Database link and do an "advanced" query. In the "locality" field, type the name of your hometown. This will bring up all of the accessions for all species from your neighborhood for which data has been digitized. You might be surprised to find out how few species are listed in your neighborhood. Your specimens may be the first from your local area that will become digitized – in which case your name will appear to others who are doing the same virtual search in the future! After playing with the features of this mapping program, answer the questions below.

To see just how important your collections may become, go to the "Advanced" Query and enter the name of your town to map accessions of all species found in your immediate neighborhood. Zoom in on one or more of the sites that are closest to your home. Click on one of the markers and toggle through the accessions that have been collected there.

1. How many are there?
2. Why might there be more specimens recorded in one location than another?
3. Locate the accession record for *Gentiana clausa* at Northwest Park in Windsor. Who collected it?
4. How many accessions does the herbarium have from this collector?
5. From this record it is possible to determine that, at a minimum, this individual has collected *at least* how many specimens?
6. When was the specimen collected?
7. Offer two reasons why it should matter.
8. How *precise* is the latitude and longitude that is recorded for this species?
9. Not all of the locations recorded for this species are so precise. What might account for differences in the precision of these numbers?
10. Map the locations of *Poa pratensis*. How many locations did you find?

11. If this is a common grass found in many Connecticut lawns (it is), why isn't it mapped in more locations?
12. Look up the genus *Celastrus*. Notice that some accessions have only a "label name" and some have the additional field "Filed in CONN as." What do you think could explain these differences among accessions?
13. While you will see records for more than one species of *Celastrus*, one species clearly has the greatest number of records. Which one is it?
14. Try to come up with at least one explanation for this on your own and then look the species up online.
15. What is an invasive species?
16. Go back and do a general search of accessions from your town. View the records for at least five different species that were collected in your neighborhood. When you view the individual records for some of these accessions, you will probably see the word "introduced" under the camera icon. This means the species is a relative newcomer to your region (and was probably brought here by humans – either purposely or accidentally). How many of the accessions that you viewed from your town were "introduced"?
17. What does this mean about the condition of natural areas in Connecticut and does this make you concerned? Why or why not?
18. What other impacts may this change in the composition of the pre-colonial ecosystem have?
19. The colonists were not the first humans in New England and archeological evidence in other parts of the world show humans have had big impacts on ecosystems wherever they've been. Why might humans change the landscape and what might some of these changes in the plant communities before Europeans arrived have looked like?
20. Humans are not the only biotic force that changes ecosystems. Beavers can have substantial impacts on plant communities as well. Abiotic fluctuations such as those associated with climate can also have a large impact. Use your favorite internet search engine to look up "pollen stratigraphy." What is this and how would the information it reveals compare to the data in CONN's digital collections?