INVESTIGATING PLANTS SAFELY

Lab Safety is Everyone's Job!

Before you begin any experiment, you and your team should consider safety issues. Always identify the specific materials, chemicals, equipment, and plants you will be using before you start. It is your responsibility to then use these resources with care during your work. If you are not sure about the safe use of a material, piece of equipment, or plant, be sure to find out before you start. **PlantingScience** protocols show specific safety considerations in **highlighted red text**.

General Lab Safety:

Lab safety involves several general guidelines that can apply to almost any research situation:

- ✓ Learn to recognize and evaluate hazards, such as broken glass or open flames.
- ✓ Never eat food or drink liquids in a lab or lab-like setting.
- ✓ Dispose of broken glass and sharp objects in their own containers, not the trash.
- ✓ Use lab gloves, goggles, and a lab coat to protect your skin, eyes, and clothing while working with sharp objects, toxic plants, or chemicals.
- ✓ Know where the safety shower, eyewash stations, and fire extinguisher are located in your lab.

Accidents happen, so be prepared. Be aware of the lab safety rules your teacher has put into place, and bring any broken rules to his or her attention. Report any potential hazards in the lab immediately to your teacher. If the hazard is small, such as an electrical cord placed so that someone might trip over it, it's okay to fix it yourself or point it out to your teammates. Finally, when in doubt, *always ask first!*

Equipment Safety:

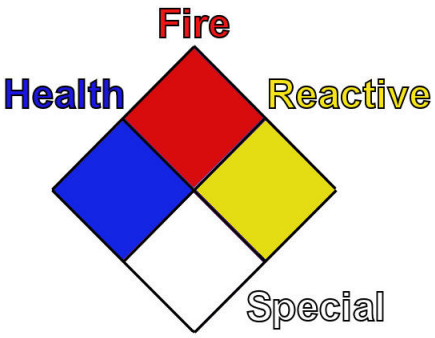
You may need to use specialized equipment in your research. Such equipment can be expensive and often must be shared among all members of the lab or class. Therefore, you should become familiar with how to properly use the equipment before you begin.

- ✓ Be aware of all safety procedures for the equipment.
- ✓ Always return equipment to where you found it.
- ✓ Clean the equipment and make it ready for its next use when you are finished.
- ✓ If there are any problems, always report them to your teacher.
- ✓ Leave a note for the next user if equipment isn't working as expected.

Chemical Safety

Research in the Lab provided some information about how to measure solid and liquid chemicals, working with acids and bases, and about pH. Still, chemical safety goes beyond working safely with acids and bases. Make sure you are familiar with the properties of all the materials and chemicals you are using in an experiment before you handle them. Even familiar materials, such as the bleach used to sterilize seed surfaces, can present risks. Household chemicals like bleach (sodium hypochlorate) or rubbing alcohol (isopropyl alcohol) may irritate your skin if you spill or drip them onto yourself. Soil or compost may contain food or animal waste products, and packaged seeds may be treated with fungicides. Based on these examples, you can see that washing your hands before leaving the lab is a good safety practice, even if you haven't touched any lab chemicals!

Chemicals are shipped to laboratories with Safety Data Sheets (SDSs) that provide useful background and safety information. Reading the SDS for a new, unfamiliar chemical can help you learn what hazards the chemical may present to you, the lab, or the environment, and what sort of safety equipment you should use when handling it. For example, isopropyl alcohol is highly flammable, so it should be kept away from heat, flames, and even electric outlets. In contrast, bleach can produce toxic chlorine gas when mixed with a strong acid, so careful use and disposal are important. In both cases, the skin irritation the chemical can cause is a good reason to wear lab goggles and disposable lab gloves; both chemicals can also produce respiratory irritation, so using a fume hood or only small volumes may also be a good idea.



If you decide to use a new chemical in your work, consult with your teacher before you start. Regardless of your familiarity with the materials and chemicals you plan to use, a few basic tips can help ensure safety for you and others in the lab:

- ✓ Know the risks of using all materials and chemicals in your investigation. If necessary, read SDS information to learn these risks.
- ✓ Wear lab goggles, disposable gloves, and a lab coat when using hazardous chemicals.
- ✓ Handle materials carefully and follow proper disposal instructions.
- ✓ Always clean up your area when the experiment is completed.
- ✓ Don't leave spills or used equipment for the next group to deal with.
- ✓ Never eat food or drink liquids in a lab or lab-like setting.

Can Plants Be Dangerous?

When thinking about lab safety, it's pretty easy to remember to be careful while using a razor blade, Bunsen burner, or strong acid. However, working with plants can also present risks. Plants have an amazing array of defenses, some mechanical and others chemical, that help protect them against

herbivores in their native habitats. Some people are also allergic to certain plants or plant parts, which can make it harder to work with those species.

It is generally a good idea to learn about your plant before you begin working with it.

- ✓ Take care when handling any plant or plant parts directly.
- ✓ Hand washing before and after you work with plants is a good idea.
- ✓ Carefully dispose of plants after completing your experiment, especially if they have mechanical or chemical defenses.

Mechanical Defenses:

Not all plant mechanical defenses pose a risk to humans. For example, many plants form wood or tough leaves to thwart herbivores. However, plants with mechanical defenses like spines, thorns, and serrated edges on succulent leaves can easily injure someone who isn't careful around them. If you have ever accidentally run into a cactus or grabbed the wrong part of a rose's stem, you already know how effective these defenses can be!

Mechanical defenses may include spines on cacti (1, 2) or euphorbs (3), thorns (4), serrated, spine-tipped leaves on agave (5), or prickles (6).

Fortunately, you can see mechanical defenses by looking carefully and avoid them by maintaining a safe distance or being careful about which parts of the plant you touch. If you need to hold onto prickly plants like thistles, wearing work gloves may be helpful. The biggest risk lies in working with a plant you have never seen before, since its spines or thorns may be well camouflaged.

Chemical Defenses:

In contrast to mechanical defenses, it is impossible to see chemical defenses in plants. Many plants produce molecules that limit infection or herbivory because they are toxic to microbes, fungi, insects, or other herbivores. Some of these chemicals can be used to make valuable medicines, but in their natural state they can be dangerous to humans. For example, digoxin, a compound from foxglove, has long been used to treat congestive heart failure. However, its dosage must be very precise to avoid causing further illness or even death. Other chemical defenses have no known human use but deter us very effectively. If you have ever unknowingly run into poison ivy, you know that simply brushing against certain plants can be risky!

Thought Exercise: *Scientists grew poison ivy plants in an atmosphere with the high carbon dioxide levels predicted to occur as humans continue to burn fossil fuels. What do you think happened?*

Toxic defensive chemicals may be present in leaves, stems, roots, flowers, seeds, or sap. Most of these compounds are toxic by ingestion. This is another reason never eating or drinking in the lab is a good safety practice, *even if you're not working with lab chemicals*. Other plant parts may contain chemicals that irritate your skin, eyes, or mouth, or cause you to more easily get sunburned after handling them. Using soap and water to wash your hands and trying not to touch your face during lab work can help minimize these risks. A little bit of background research on the plant you plan to work with may also be helpful.

Crocuses contain a compound that prevents cell division.

Allergens and Sensitivities:

Did You Know?

Dr. Paul Williams developed FastPlants, a rapid cycling variety of *Brassica rapa*, but he is allergic to their pollen!

Photo: Dr. Claire Hemingway

Do you get itchy eyes or a runny nose during the springtime or autumn? You might want to be careful about what plants you work with during the module ***Where Does Pollen Come From?*** Many trees produce airborne pollen in springtime, as do many grasses in autumn. Windborne pollen from these kinds of plants can often cause seasonal allergies. Other allergic reactions to plants can be more serious. For example, peanut allergies can be life-threatening. Be sure to inform your teacher about any known sensitivities or allergies you have before you start working with your plants. Some problems can arise the first time we come in contact with a new plant, while others can develop after repeated exposure. Even if you are unaware of any allergies or sensitivities, immediately report symptoms such as watery eyes, itchy skin, irregular breathing, or a sudden rash to your teacher.

Field Safety

If you have already read ***Research in the Field***, you may have come up with some ideas for an experiment that involves working outdoors. Remember that safety in the field is as important as it is in the lab. Although you will be less likely to encounter risks like strong acids or bases, working outdoors involves its own unique hazards. One of the biggest differences in safety is that you probably will not be able to get help in the field as quickly as you can in a classroom laboratory.

Communication is especially important for field safety!

- ✓ Make sure someone knows where you are going and when you plan to return.
- ✓ Bring a cell phone and know who to call for help if something goes wrong.
- ✓ Don't go alone; bring at least one of your teammates with you.

Other basic ways to stay safe in the field include:

- ✓ Bringing a compass and map of the site to help navigate.
- ✓ Knowing how to identify poisonous or allergy-causing organisms like poison oak, copperhead snakes, or bees.
- ✓ Bringing a first aid kit with an epi-pen for insect allergies, bandages, and antibacterial ointment.
- ✓ Checking the weather report before you leave and being prepared for any unexpected changes, especially severe weather.

Additional Resources

Videos and Visual Resources:

Laboratory Safety Guidelines, by the University of Texas at San Antonio's Office of Environmental Health, Safety, and Risk Management. This is a good example of a training video on safe laboratory practice, including chemical handling and storage, use of protective equipment, general lab safety, and chemical spill response in college laboratories.
http://www.youtube.com/watch?v=h8GLmc1UBVk

Lab Techniques & Safety: Crash Course Chemistry #21, by crashcourse. Hank Green uses humor and animations to teach viewers what not to wear in the lab, how to safely work with and dispose of chemicals, properly use fume hoods and safety equipment, and prevent lab accidents.
http://www.youtube.com/watch?v=VRWRmIEHr3A

Top Ten Rules of Science Lab Safety, by Gabrielle Hendel. This lab safety video is well suited to high school biology laboratories.
http://www.youtube.com/watch?v=s6lOQ5_Vlok

Web Pages:

Betrock's Allergenica™. This comprehensive site describes various sources of allergens, with specific sections on foods, poisonous plants, and pollen. The Allergenica database allows region-specific searches of allergenic plants.
http://www.allergenica.com/

Common Poisonous Plants and Plant Parts, by Texas A&M AgriLife Extension. One-page list of house, garden, and wild plants known to be toxic, which parts of the plants are toxic, and symptoms of poisoning.
http://aggie-horticulture.tamu.edu/earthkind/landscape/poisonous-plants-resources/common-poisonous-plants-and-plant-parts/

The MSDS FAQ, by Interactive Learning Paradigms, Inc. This large online resource can help you learn about Material Safety Data Sheets (soon to be shortened from "MSDS" to "SDS"), how to read them, and how to find one online for a specific chemical you plan to use if you do not have a hard copy for it.
http://www.ilpi.com/msds/faq/index.html

Of Thorns, Spines and Prickles, by Missouri Environment & Garden, Division of Plant Sciences at the University of Missouri. A brief article describes the differences among plant mechanical defenses. http://ipm.missouri.edu/MEG/2013/1/Of-Thorns-Spines-and-Prickles/

Plants Poisonous to Livestock, by Cornell University Department of Animal Science. The site includes a searchable database of plants poisonous to humans, livestock, or a limited number of pets. Names and images of the toxic species, poison(s), and species affected are categorized separately. http://www.ansci.cornell.edu/plants/

Plants with Poisons and Stingers, by University of Florida/IFAS Extension. This quick guide can help in identifying plant species risky to touch, such as poison ivy and stinging nettle. http://solutionsforyourlife.ufl.edu/hot_topics/environment/poisonous_plants.html

Prepare for Bad Weather Outdoors, by Outdoor Safe, Inc. Part of a larger outdoor safety website, this page gives safety tips on how to safely deal with lightning, heat, cold, and wind while in the field. http://outdoorsafe.com/read/2011/05/17/95/

Travel Advisories: Outdoor Safety, by the USDA Forest Service. This government website provides safety considerations for using established trails, camping, dealing with lighting, and what to do if you get lost outdoors. Scroll to the bottom of the page for a safety checklist to help you plan your excursion. http://www.fs.fed.us/recreation/safety/safety.shtml

Books and Articles:

Cold Spring Harbor Lab. 2007. *Safety Sense: A Laboratory Guide, 2nd Ed.* Cold Spring Harbor, New York: Cold Spring Harbor Laboratory Press. 105 pp.

Mohan, J.E., Ziska, L.H., Schlesinger, W.H., Thomas, R.B., Sicher, R.C., George, K., and J.S. Clark. 2006. Biomass and toxicity responses of poison ivy (*Toxicodendron radicans*) to elevated atmospheric CO_2. *Proceedings of the National Academy of Sciences* 103(24): 9086-9089.

Tilton, B. 2005. *Outdoor Safety Handbook.* Mechanicsburg, PA: Stackpole Books. 144 pp.

Turner, N.J. and P. von Aderkas. 2009. *The North American Guide to Common Poisonous Plants and Mushrooms*. Portland, Oregon: Timber Press. 376 pp.