

Guidance for Assessment of Remote Lab Experiments

With the increase in online instruction there is a strong interest in allowing students to perform unsupervised experiments in a location other than a University lab setting. While there is potential benefit for this type of learning experience, it also poses unique risks. A review of the hazards and the risks associated with those hazards needs to be performed to determine whether the proposed experiment is appropriate to be included in the remote curriculum. In some cases, the answer will be “no” while in other cases the risk assessment might identify ways to reduce the risk to an acceptable level. This guidance outlines questions and points of concern in key topical areas of safety and compliance that should be considered when evaluating remote or at-home lab experiments. As remote learning activities are being planned, please keep safety in mind and contact Environment, Health & Safety (EH&S) at 608-265-5000 or ehs@wisc.edu with questions or to request assistance with risk assessment, safeguards, or hazardous materials management.

Overview of Liability

Before covering the safety aspects of proposed experiments, it is important to understand the liability to the University for these experiments.

The University is protected for liability arising out of the negligent actions of its employees, agents and officers through the [State of Wisconsin Self-Funded Liability Program \(SSLP\)](#). The State’s liability protection is administered by the [Department of Administration under State Statutes 893.82 and 895.46](#) and extends to all employees and agents (including volunteers) operating within the scope of their employment or agency. The [State’s Self-funded Liability Program](#) provides coverage against claims made as the result of the negligent acts of University officers, employees, and agents. Negligence may be defined as the failure to act as a reasonable person would have under the same or similar circumstances.

A critical aspect of controlling liability is conducting a thorough hazard assessment and implementing proper controls. It is the responsibility of the instructor to assess the appropriateness of the activities and provide hazard communication to students to prevent injury or incident. In addition to protecting their students’ welfare, this protects the reputation of the University and its faculty and staff.

Identifying Potential Hazards

Have you identified *all* the potential hazards associated with the proposed experiment? Below is a list of potential hazards and considerations for each. This list may not be all-inclusive.

General Considerations

When experiments are performed outside of a university facility it is important that appropriate expectations are set. Among the expectations are that students will follow the general rules of the lab classroom setting:

- Do not deviate from the experiment, conduct only the experiment being performed
- No food or drink in the vicinity of chemicals or other hazardous materials. Do not perform experiments with hazardous materials in areas used to prepare or consume foods
- Keep all others in the household away from the experimental setup, including pets
- Always clean up and wash hands after performing experiments
- Ensure that the work area is free of clutter and other items that may interfere with the safe performance of the experiment

When experiments are performed in a student's home or remote location, the instructor has less ability to control the students' environment and behavior. As an instructor, you must consider what the consequences would be of students not following these general rules. Does the lack of controls increase the risk to unacceptable levels?

Public Health Considerations

Remote learning does not remove all dangers of the COVID-19 pandemic. The best protection from transmission of COVID-19 is to minimize person-to-person interactions. When evaluating remote learning activities, consider whether they could increase a student's risk of exposure to people outside of their immediate household. For example:

- Can the experiment be done safely alone? Some students may live alone or not have another adult household member to assist them.
- Can the experiment be done inside the student's home regardless of the type of residence? Some students do not have a private vehicle. If the activity must be performed outdoors or requires field work, they may need to use public transportation.

If activities require students to leave their homes, include good public health practices (e.g., physical distancing, wearing a mask, handwashing hygiene) in the safety instructions and consider providing alternative activities for students at high risk.

Chemical Hazards

Experiments may require use of chemicals – either household materials or materials supplied by the University. Consider the following questions for chemicals:

- Are the substances used in the experiment appropriately labeled?
 - Will the student have access to the material's Safety Data Sheet (SDS)?
- For this kit/experiment, is only the minimal amount of material being provided (no excess or bulk)?
- Do any of the chemicals fall into any of the following categories?
 - Toxic
 - Carcinogenic/Teratogenic/Mutagenic
 - Corrosive
 - Sensitizer

- Flammable
- Explosive
- Environmental Hazard
- Would exposure to any of the chemicals pose a particular risk to children or pets?
- What is the form and quantity of the material?
 - Is it solid, liquid, or a solution (aqueous or non-aqueous)?
 - In this experiment, is the student being asked to use a particularly volatile or odoriferous substance?
 - Is the quantity of the material low enough to mitigate the hazard?
- Is there the possibility of a reaction between a reagent and any material (equipment, surfaces or surface residues, cleaning materials) that can generate toxic solids, liquids, or gases?
- What would be needed to deal with a spill? Will spill clean-up materials be provided?

While it is advisable to exclude hazardous materials from experiments, an overall risk assessment needs to take into account the quantities and form of the materials, as well as potential exposure routes to determine the acceptability of the materials for a home experiment. Keep in mind that common safety features of laboratories, such as eyewashes, will not be found in a private home. Additional considerations, such as disposal and shipping, are discussed below.

Biological Hazards

Biological materials normally handled at biosafety level 1 are generally considered safe but can still pose risks when handled outside of the controlled laboratory environment. Consider the following questions for biologicals:

- Does this experiment require students to work with biological materials not normally encountered in a residential space (e.g., bacteria, fungi, cells, tissues, fluids)?
- If the experiment involves living organisms (i.e., microbes, animals, or plants including seeds):
 - Are they genetically modified? Are they exotic or invasive species, keeping in mind not all students working remotely may be in Madison? What would be the consequence if the organism escaped or was released into the environment?
 - Is there a risk of common allergic response to the organism (e.g., insect bite, plant pollen)?
 - For experiments involving microbes, the American Society for Microbiology offers guidance for [Biosafety considerations for at-home or DIY microbiology kits](#). It is important to keep in mind that even risk group 1 (RG1) microbes can pose a risk if mishandled or propagated. Some considerations include:
 - What is their potential to infect people or pets?
 - What is the infectious dose?
 - Would the microbe pose a risk to a student or household member that was immunocompromised?

- Will the activity have the potential to cultivate, enrich, or isolate disease-causing microbes from the environment?
- Will the experiment expose students to materials that carry a risk of bloodborne pathogens (BBP), such as someone else's blood or bodily fluids?
- What would be needed to deal with a spill? Will spill clean-up materials be provided?

Additional considerations, such as disposal and shipping, are discussed below.

Sharps Hazards

To reduce the potential for injury, the use of sharps in at-home lab activities should be minimized. Consider the following:

- Does the experiment require the use of knives, scissors, or other household cutting tools?
- Does the experiment require the use of medical sharps such as syringes with needles, scalpels, or razor blades?
 - Will medical sharps containers be provided?
 - How will medical sharps containers be collected for disposal?
- Will cutting tools/sharps be provided, or will these need to be obtained by the student?
- Does the experiment use glass that could cause injury if broken or when discarded, such as Pasteur pipets, slides and coverslips, or glassware? Are plastic substitutes available?
- Are the sharps used in conjunction with agents that pose an increased risk of exposure in the event of an injury that breaks the skin, such as an infectious microbe or toxic chemical?

Electrical Hazards

If the experiment has any electrical or power needs, these need to be included in the risk assessment. While the use of household electricity and common batteries are generally safe, the hazards should not be overlooked.

- Does the experiment require a power source?
 - Is there the possibility of having a high voltage or high current operation?
 - Is a battery required and if so, then what type?
 - Will this involve capacitors or other energized systems?
- Does this require multiple items to be plugged into an outlet?
 - Will a power strip or extension cord be needed?
- Will water be near any energized system as part of the experiment or as part of the local environment?
- Does the experiment require a Ground Fault Circuit Interrupter (GFCI) on an electrical outlet? A GFCI is a fast-acting circuit breaker designed to shut off electric power in the event of a ground-fault within as little as 1/40 of a second. All electrical outlets in laboratories, per code, have GFCIs, even if these are not obvious (the circuit interrupters

may be located down the line and not at the outlet). Electrical outlets within private dwelling are not necessarily equipped with GCFIs.

Students should check any power cords for frays or any obvious should also be told to limit use of extension cords and power strips. Power cords and power strips are typically rated for their specific power demands (which may not be obvious) and these also can present a trip hazard.

Thermal Hazards

Experiments may require heating or cooling or may involve exothermic or endothermic chemical reactions. Consider the following:

- Does this experiment require the use of, or generate, unsafe amounts of heat that could injure the student or damage property?
- Does this experiment require the use of, or generate, low temperatures that could injure the student or damage property?
- Will boiling or cryogenic liquids be used that would increase risk of injury or damage if spilled?

Fire Hazards

Lab classrooms are equipped with fire extinguishers that are inspected at least annually. It should not be assumed that a student will have access to a working fire extinguisher or that the student will be trained in its use. Consider the following:

- Does this experiment require the use of an open flame?
- What type of open flame is being used?
 - Gas burner, candle, Sterno can, etc.
- Does the experiment have the potential to generate sparks or flames?
- Does the experiment involve the use of flammable materials or chemicals?

Mechanical Hazards

Injury can also result from uncontrolled mechanical hazards. Consider the following:

- Does this experiment require the use of heavy weights?
 - Do these heavy weights pose a lifting or dropping hazard?
- Does this experiment require the use of powerful or highly tensioned springs?
 - Will proper PPE (safety glasses minimally) be provided to ensure the safety of the student if these springs break or detach?
- Does this experiment require the use of rapidly spinning or twisting pieces?
 - Are these pieces exposed and do they pose an entanglement risk (hair or clothing)?

Ergonomics Considerations

Ergonomics is an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely. Within University spaces, ergonomic issues can be assessed, and concerns addressed. Outside of the University, these concerns may not be obvious. For a proposed experiment with there be a requirement or a possibility of:

- Awkward postures?
- Bending?
- Compression or contact stress?
- Forceful exertions?
- Lifting?
- Repetitive motion?

Students will have varying physical abilities so experimental procedures should limit the need for any of the above.

Good housekeeping is an important element of lab safety and is also an ergonomic issue. Emphasizing the need for working in a clutter-free environment is important. Suggestions on material and equipment placement should be included in the instructions.

Location Assessment

Consideration should be made as to where a specific experiment should be performed. Some questions that will aid this determination are provide below.

- Where do you consider the appropriate location to perform this procedure (e.g., kitchen, bathroom, outside)? Will the students all have access to an appropriate site?
- Have ventilation requirements been taken into account? In the laboratory, both fume hoods and general room ventilation rely on dilution to control the potentially hazardous vapors from chemicals. In a home setting good ventilation cannot be assumed. Use of materials that give off noxious odors, toxic, or flammable vapors should not be performed in a home setting.
- Can insufficient lighting cause problems?
- Are there safety concerns for other occupants (including children and pets) that may be present? Consider the potential consequences for an unattended experiment.
- Activities involving field work may have additional considerations:
 - Will protective clothing, sunscreen, and insect repellent be provided?
 - How will safety concerns of working alone be addressed for students in potentially vulnerable populations (e.g., women, ethnic minorities)?

Personal Protective Equipment (PPE)

As part of the overall risk assessment, a determination of the appropriate PPE needs to be made. This needs to be provided for all necessary experiments in the quantity that is

acceptable. Examples include safety glasses, protective gloves, and lab coats. Sizing and the type of PPE need to be addressed. For example, if nitrile gloves are needed, there needs to be a process to ensure that the student gets the correct size. If the student wears corrective lenses they may require safety glasses or safety goggles that fit over glasses. There should also be a mechanism for obtaining additional PPE if the supplied PPE is lost or inadequate. In addition to these examples, the personal clothing that students wear can be an element of protection. All students need to understand the acceptable clothing, fabric type, and footwear for specific experiments.

Shipping Considerations

In the laboratory, many products we encounter on a daily basis may be regulated by the US Department of Transportation (DOT) as "dangerous goods" when shipped or otherwise put into transport. Dangerous goods are substances that when transported are a risk to health, safety, property, or the environment. Common dangerous goods include laboratory chemicals and household cleaners, but some items classified as dangerous goods may surprise you, such as lubricants, dry ice, aerosols, cosmetics, or devices containing lithium batteries, like mobile phones or laptops. In order to ship dangerous goods, special training is required. In addition to the health and safety concerns of improper packaging, failure to prepare, mark, and label these items properly can result in rejected shipments and civil penalties nearing \$80,000 per day, per violation.

Shipping materials to international students can also raise export control and customs issues that can be problematic. The Export Control Office works with UW-Madison staff to ensure compliance with the U.S. Export Control laws and regulations:

<https://research.wisc.edu/integrity-and-other-requirements/export-control/>.

Disposal Requirements

Once completed, how will the student dispose of materials that were used in the experiment? Disposal of materials created within a University lab is handled by trained staff that are knowledgeable in the appropriate disposal routes and the corresponding environmental regulations. Some of these regulations are specific to a location. Some considerations are given below.

- Sewer disposal requirements can vary widely depending on the local sewerage district. However, some dwellings rely on septic systems, which do not provide the same level of treatment.
- Acids and bases cannot be poured directly down most drains; however, neutralization can be performed. The acceptable pH range may vary, though neutralizing to pH levels between 5 and 9 should be acceptable. Bear in mind that mixing acids and bases can be dangerous. Neutralization materials should be either readily available or provided by the instructor.

- Also, waste (e.g., flammables, toxic materials, metals, oxidizers) that is considered hazardous waste by the Environmental Protection Agency cannot be thrown into the trash or put down the drain.
- Infectious materials should be inactivated prior to disposal. Since students will not have access to an autoclave at home, chemical inactivation will likely be needed. Disinfectants must be effective against the specific microbe/pathogen and proper concentrations and contact times must be used.
- Medical sharps cannot be thrown in the trash. Medical sharps containers must be taken to a Department of Natural Resources-approved site for disposal such as a hospital, clinic, or pharmacy.
- Returning materials back to the University can be problematic since this may have the same shipping issues described above.

Emergency Response

Laboratory procedures performed within University facilities have a built-in safety net in the case of emergencies. This will not be the case on off-campus experiments. While most lab experiments can be safely performed when activities go as planned, you need to consider the consequences of adverse events in a home setting.

- In the event of a spill, will the student be able to handle this?
- In the event of an exposure, is there significant risk to the student or other household members, including children and pets?
- Is there a risk of fire?
- Is there a significant risk of physical injury?
 - Will the student be able to respond?
- Is there a written emergency response protocol for this procedure/experiment?
- Should there be a requirement that another individual always be present in case of accident or need for emergency assistance (“buddy system”)?

Risk Communication and Training

Communicating the risks and required actions is an important means of improving safety and reducing liability to the university in the event of an injury or accident. Below are some considerations for this communication.

- Do the students have the necessary training to perform the experimental tasks without direct supervision?
- Have the students been provided with explicit instructions on the step-by-step procedures?
- Have they been provided with a discussion of the hazards and associated risks for all steps of the procedure?
 - Is there a mechanism to ensure that these have been read and understood?
- Is there a process by which students can get safety questions and concerns addressed?

An explicit “acknowledgement of risk” statement should be provided with the instructions. An example is included below:

Assumption of Risks:

The University of Wisconsin–Madison is committed to maintaining a safe and healthy environment. However, I understand that the Program, by its very nature, includes many inherent risks and hazards that cannot be eliminated regardless of the care taken to avoid injuries. I hereby expressly assume the risk of injury or harm while participating in this Program and agree to follow all safety and health directions provided. I agree to review any concern with the Department/Instructor. I understand that I have been advised to have health and accident insurance in effect and that no such coverage is provided for me by the University or the State of Wisconsin. I agree to conform to all applicable rules, training and standards of conduct as established by the University (*see attached set of rules for the specific activity (insert link)*).