

# ***Greenhouse Safety Manual***

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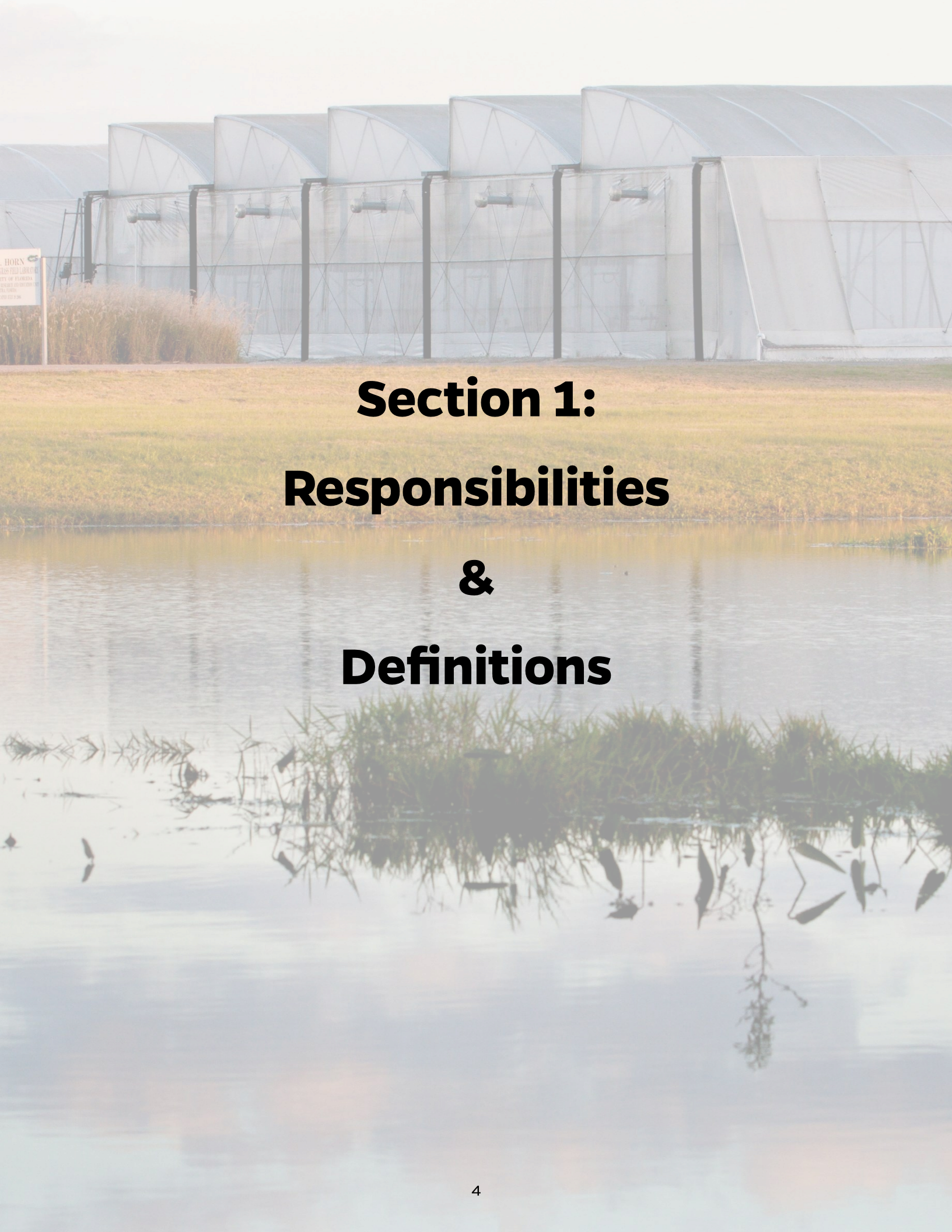


**Disclaimer:** The guidance in this document applies to the use of greenhouses for research and education. Greenhouses used by Facilities Services follow guidance from their own Facilities safety program.



## Introduction

Greenhouses are an essential component of research and education at the University of Florida and have supported its growth into a top 5 research institution in the nation. This manual provides guidelines for conducting safe and successful research in university greenhouses, shade houses, and plant growth chambers (definitions on page 6). The purpose of this manual is to detail greenhouse safety rules, hazard identification and control, housekeeping practices, personal protective equipment (PPE), emergency response, and incident and injury reporting.



# **Section 1:**

# **Responsibilities**

# **&**

# **Definitions**

# 1. Responsibilities

Environmental Health and Safety (EH&S) is responsible for:

- providing safety guidelines to minimize injury and illness to faculty, staff, students, and visitors and to minimize damage to university property.
- conducting safety surveys.
- developing training material for all greenhouse users.

The Greenhouse's Principal Investigator (PI) is responsible for:

- controlling greenhouse access.
- enforcing safety rules and procedures.
- providing personal protective equipment (PPE).
- preparing/maintaining the chemical inventory for all chemicals used in the greenhouse.

Faculty, staff, students, and volunteers, are responsible for following safe work practices including:

- reporting all injuries and accidents as well as reporting unsafe conditions, malfunctioning equipment, and other safety concerns.
- obtaining the appropriate training regarding specific hazards.
- using personal protective equipment (PPE).
- understanding what to do in the event of an emergency.

Visitors must understand and comply with the rules and regulations, in addition to completing the consent release and waiver of liability found on the EH&S website: [www.ehs.ufl.edu](http://www.ehs.ufl.edu).



## Definitions

**Greenhouses** are most commonly constructed with glass panels and have a concrete or gravel floor. In some instances, plexiglass or plastic sheeting will be used instead of glass (example: hoop houses).



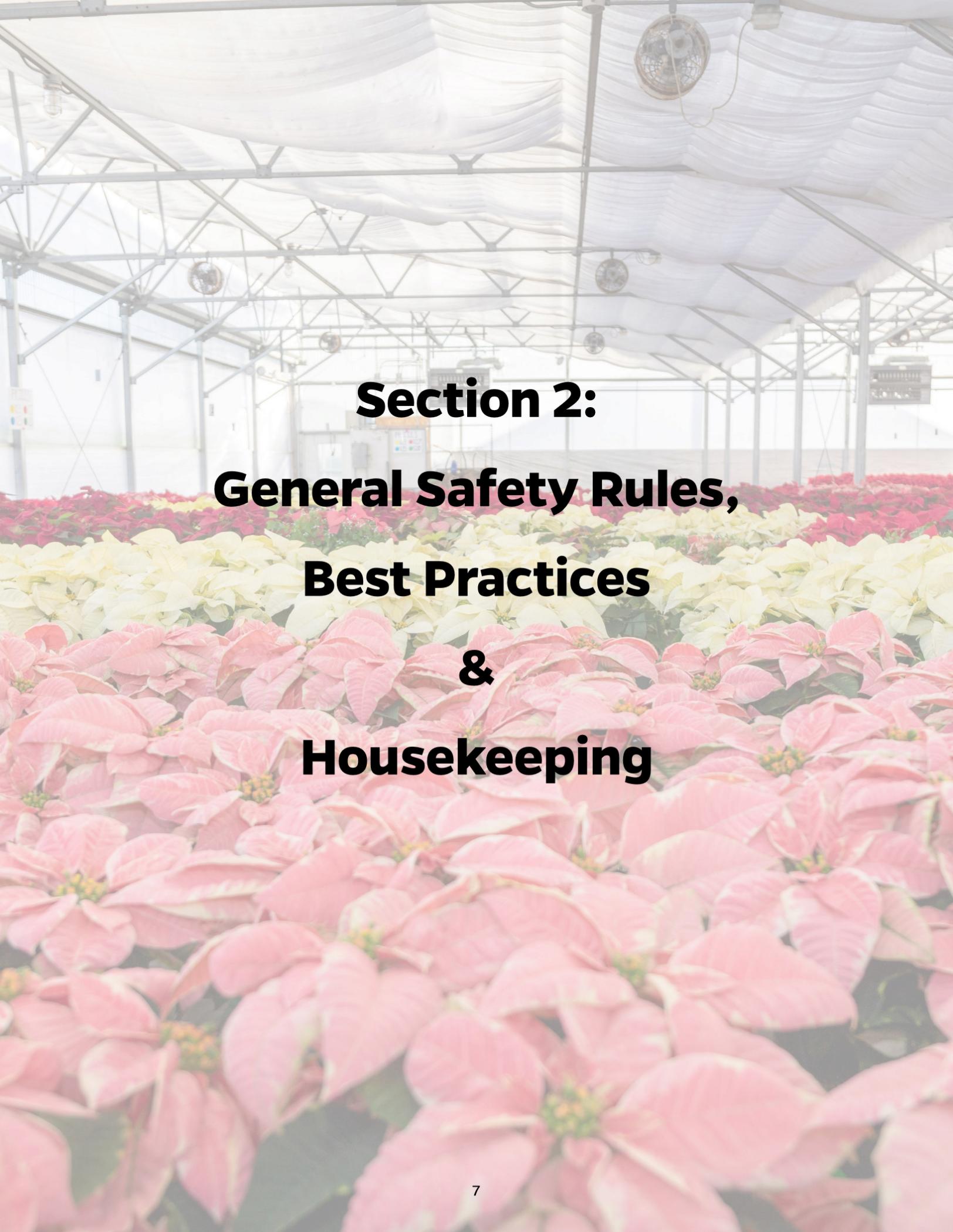
**Shade houses** can vary in construction, but are often a metal structure covered with black mesh/shade cloth to limit light and UV exposure. Most are not categorized as a building, but still possess the same safety concerns.



**Plant growth chambers** are sealed rooms, most often found within other structures/buildings and benefit from the extra protection from the weather and other elements. These chambers will be outfitted with grow lights (metal halide, fluorescent or LED) and have climate controls to provide a controlled growth environment.



**Note:** For the purpose of this document the term “greenhouse” will be applicable to all similar structures including shade houses and plant growth chambers unless otherwise specified.



**Section 2:**  
**General Safety Rules,**  
**Best Practices**  
**&**  
**Housekeeping**

## 2. General Safety Rules & Best Practices


Greenhouses will be required to display the name of the PI for easy identification and notice boards should be utilized whenever possible. If hazards are present, the relevant hazard identification signage will be displayed so all persons entering the greenhouse including emergency responders are aware of the hazards present.

1. Greenhouses should be kept locked during non-work hours, or when no one is present.
2. Access should be limited to those approved by the PI. Visitors to the greenhouse must be accompanied by a person who has been “trained and approved” by the PI.
3. Doors to greenhouses should always remain closed to prevent insects and other pests from entering. Proper heating and cooling will also be impeded if doors remain open. Negative pressure created by cooling fans can mean that doors will not automatically shut; before exiting the greenhouse, ensure all doors have closed and latched properly.
4. The movement of plants for research and teaching is only permitted for those applications.
5. Personal plants should not be stored within the greenhouses.
6. Turning equipment on/off or adjusting settings is not permitted without PI authorization.
7. Drinking water from any hoses or faucets in the greenhouse is not permitted.
8. Food, alcohol, tobacco, and vapes are not permitted. UF is a tobacco free campus.
9. Beverages are not permitted except for employees actively working in the greenhouses, and who require water for the prevention of heat stress.
10. While using electrical power outlets and devices be aware of electrical shock hazard due to the presence of water.
11. Wet floor signs should be posted to announce the presence of wet floors or standing water.
12. Blocking or stacking materials in front of intake vents in greenhouse zones is not permitted. This is to prevent uneven cooling and damage to vents.
13. Working with open containers of flammable or volatile materials (i.e., solvents) in enclosed or poorly ventilated areas is not permitted. This is to prevent the risk of explosion or suffocation.
14. Pesticides or hazardous materials may not be applied without permission from PI/ Supervisor.
15. If repairs are necessary, they should occur while research is inactive (if possible). All personnel performing maintenance or repairs should be notified of all potential hazards before they enter the structure.
16. Regular external and internal inspections are recommended to identify hazards.



## Housekeeping

1. Wash hands after leaving the greenhouse.
2. Materials should be labeled.
  - Plants should be identified with the species, experimental differences, and a unique identifier.
  - Chemicals and products used must be labeled (this applies whether it is water, nutrient solution, or a cleaning product).
3. No outside plants or animals are permitted in greenhouses.
  - For teaching spaces, only the plants required for the classes are permitted; greenhouses are not for personal plants.
  - Service animals may be permitted, but will require prior approval. For additional information please visit: <https://www.ehs.ufl.edu/about/policies/service-animals-in-labs/>



# **Section 3: Hazard Identification & Controls**

### 3. Hazard Identification & Controls

The **Hierarchy of Controls** is a method of identifying and ranking safeguards to protect workers from hazards. They are arranged from the most to least effective and include elimination, substitution, engineering controls, administrative controls, and personal protective equipment.

- **Elimination** ensures the hazard no longer exists.
- **Substitution** means changing out a material or process to reduce the hazard.
- **Engineering controls** reduce exposure by preventing hazards from coming into contact with workers. They still allow workers to do their jobs.
- **Administrative controls** change the way work is done or give workers more information by providing workers with relevant standard operating procedures (SOPs), training, and/or warnings. They are often used together with higher-level controls.
- **Personal protective equipment (PPE)** includes clothing and devices to protect workers. Higher-level controls are not always feasible, and PPE might be needed in conjunction with other control measures.

Often, you will need to combine control methods to best protect workers. For example, a local exhaust system (engineering control), training, periodic inspections, and preventive maintenance (administrative controls).



### 3.1. Hazard Identification & Controls: **CHEMICAL**

A chemical hazard is a substance that can cause harm or be toxic to the human body or environment. These hazards can exist as solids, liquids, or gases and be either pure in form or in mixtures. Chemical hazards commonly cause irritation or harm to the skin, eyes, or respiratory tract of an individual. Exposures to chemical hazards can be acute or chronic. Acute exposures are brief and commonly occur only once, or for a short period of time (fewer than 14 days). Chronic exposures involve smaller exposures but over a longer period of time such as years or decades. Examples of specific chemical hazards can include cleaning products, aerosols, corrosives, or carcinogens. For a full list of hazards associated with a chemical, reference it's Safety Data Sheet (SDS).

#### Chemical Storage

- To limit the risk of accidents and exposure, greenhouses should not be used for chemical storage including pesticides and herbicides.
- Food, drink, livestock feeds and tobacco products can attract pests and therefore should not be stored in the greenhouse.
- A chemical inventory in GatorTRACS is required for all chemicals being used in the greenhouse.

#### Fertilizers

- All fertilizers (granular and solution) need to be accounted for in the chemical inventory for the PI. If there are multiple areas of research, the location shall be specified for each container.
- Avoid applying fertilizers on windy days when product might blow or drift into other areas.
- To help protect our water resources and prevent runoff, sweep up and capture excess fertilizer off hard surfaces into an appropriate waste container.
- If the fertilizer is in a container that might become easily damaged (paper, weak plastic); utilize a secondary container to prevent spills.



## Weed Management (herbicides)

- Review all product instructions and safety data sheets (SDS) for required PPE before applying herbicides. Use caution when handling concentrated solutions.
- If pesticides/herbicides are being used to prevent weed growth in the greenhouse, ensure that growing media and materials are kept covered while in use. Plants used for experiments should not “escape” the greenhouse. If they do, physically remove them from the outside environment immediately.
- The first step in the prevention of weeds is prevention and sanitation. Minimizing weed growth outside of the greenhouse, keeping growing media clean and using clean plant materials for experiments will help reduce instances of weeds, seeds, and rhizomes in the greenhouse.
- Escaped research plants must immediately be removed and destroyed.
- Gravel beds are not to be >50% weed coverage.



## Pesticides

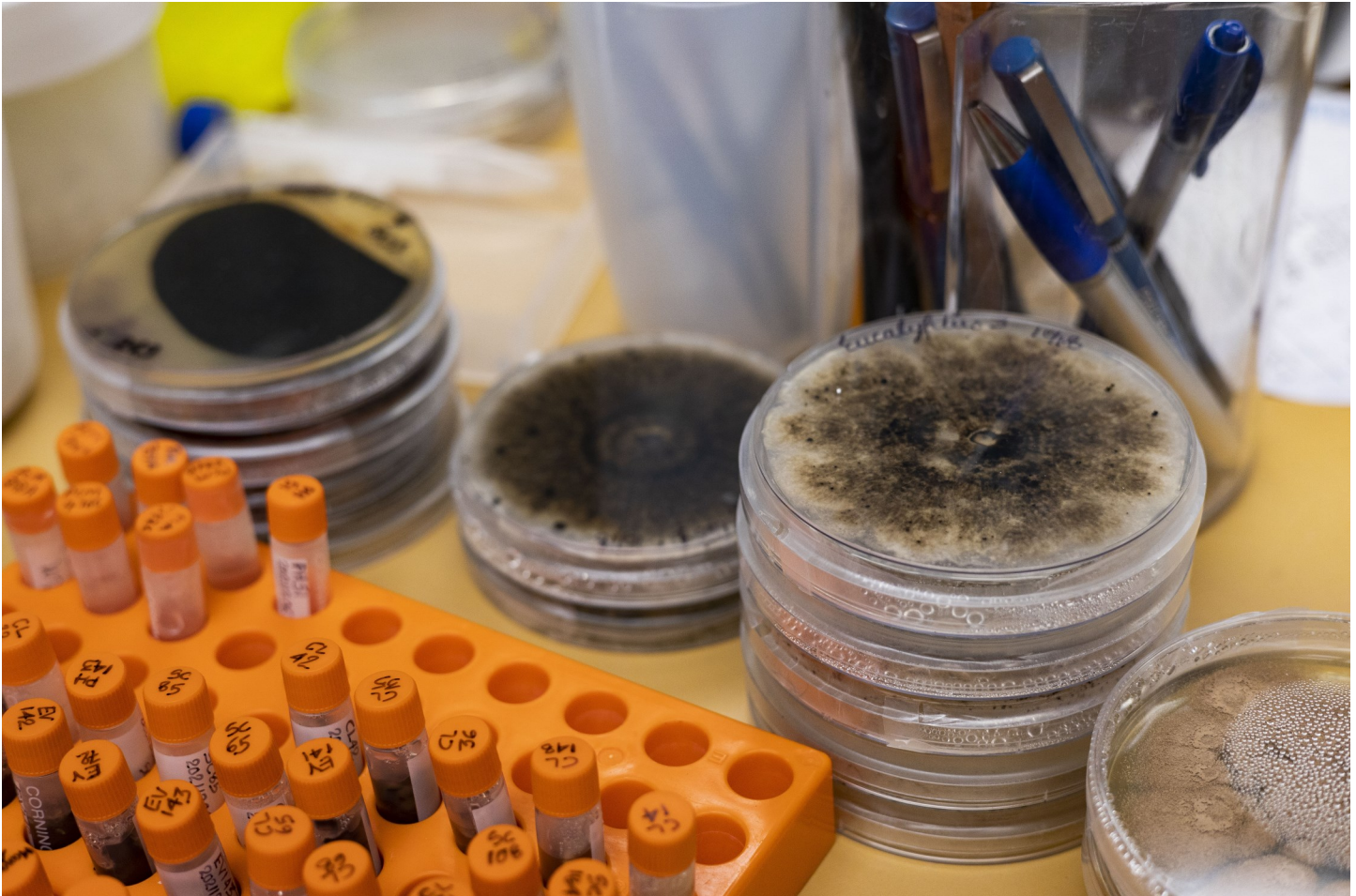
- Comply with all EPA regulations when using pesticides.
- Pesticide application should only be done by certified personnel.
- All pesticides need to be accounted for in the chemical inventory for the PI. If there are multiple areas of research, the location shall be specified for each container.
- Warning signs and/or hazard identification stickers must be posted when pesticides are in use (see appendix). Signage should include information about the date/time the area can be safely accessed.
- When not in use, store pesticides in a secured area that is only accessible by those who are trained in pesticide application.
- To minimize risk, use protective measures and don proper PPE as specified by the safety data sheets (SDS).

## 3.2. Hazard Identification & Controls: BIOLOGICAL

A biological hazard, commonly referred to as a biohazard, is an organic substance that poses a threat to the health of other living organisms (primarily humans). Examples of these hazards include bacteria, viruses, parasites, toxins from molds or fungi, and venom from insects or other animals. Routes of transmission for biohazards can include adsorption, inhalation, ingestion, or injection through a puncture to skin via a needle.

For specific greenhouse procedures with biological hazards use the resources below:

- Greenhouse Procedures for biological hazards should follow NIH guidelines for rDNA plants.  
[NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules \(NIH Guidelines\) - April 2019](#)
- Additional information can be found at <https://www.ehs.ufl.edu/departments/research-safety-services/biosafety/>, or in *A Practical Guide to Containment, Plant Biosafety in Research Greenhouses*, Information Systems for Biotechnology, Adair D. and Irwin R., 2008, <https://vtechworks.lib.vt.edu/handle/10919/78423>



### 3.3. Hazard Identification & Control: PHYSICAL

A physical hazard is a type of hazard that can cause harm without necessarily coming into contact with it. Examples would include noise, vibration, radiation, and heat or cold stress. The National Institute for Occupational Safety and Health (NIOSH) defines a physical hazard as a workplace agent, factor, or circumstance that can cause tissue damage by transfer of energy from the agent to the person (example: explosions).

#### Broken Glass

- Due to their constant exposure to the weather, greenhouses need maintenance periodically. This damage can include cracked and broken panels and as the damage progresses it can result in sharp, jagged shards of glass or plastic. To minimize the risk of deep cuts and damage to equipment, broken panels should be replaced as soon as possible.

#### Tripping Hazards

- The minimum walkway width is 18 inches to maintain maneuverability.
- All walkways should always be clear of debris, supplies and equipment. Dispose of all trash/waste in a timely manner and store all supplies appropriately.
- The flooring material used should not increase the risk of tripping hazards. If weed cloth is being used, it must be secured in a way to prevent catching a foot and tripping on the edge of it. In greenhouses with gravel beds and concrete paths, the gravel must be level and within 1 inch of the height of the concrete.
- Plumbing and electrical boxes must not interfere with the greenhouse walkways.
- Cords/cables and hoses should not permanently traverse walkways. If this is impossible to avoid, unplug and spool between use or utilize appropriate covers (on hard surface walkways only).

#### Fans and Guards

- Fans within 7 feet of the floor or working level must be guarded in accordance with OSHA 29 CFR 1910.212(a)(5) requirements. The guard must not have openings greater than one-half inch in width. The use of concentric rings with spacing between them not exceeding a 1/2" are acceptable, provided that sufficient radial spokes and firm mountings are used to make the guard rigid enough to prevent it from being pushed into the fan blade during normal use.
- Slant wall exhaust fans, a common type used for greenhouse exhausts, fall within the required guarding rule above as they are within 7 feet of the working space.
- Belt-driven fans require a belt guard with no opening larger than 1/2". Guards cannot have damage that could cause it to be pushed into the rotating assembly.

### 3.4. Hazard Identification & Controls: ELECTRICAL

An electrical hazard refers to the danger and risk associated with electricity. Improperly designed equipment or electrical systems can lead to electrocution, shock, or thermal burns. Common examples of electrical hazards include overloaded circuits, wet working conditions, exposed electrical components, damaged equipment, or improperly grounded electrical systems.



#### Cords and Connections

- Cords can rapidly deteriorate in the presence of high levels of UV and humidity. Check cords regularly and replace any damage or frayed cords immediately. PVC (duct) tape is not an acceptable fix.
- Cord separation from plugs or connectors can happen during cord routing. Replace if damage is observed in any area of the cord or connectors.

#### Outlets

- GFCIs are required within 6 feet of sinks but are strongly recommended for greenhouses.
- Outlets that might be sprayed during watering or by irrigation and should be protected with a cover, often referred to as a “While in use Weatherproof Box Cover”.

#### Timers

- Outlet timers must be UL or NRTL listed and should be approved for non-residential usage.
- 2 prong timers should never be used, and 2 to 3-prong adapters are prohibited.
- For high current draw items, an industrial timer, such as the ones typically used for water heaters, need to be installed by a qualified electrician through a permit with EH&S Building Codes.
- Irrigation timers must be UL or NRTL listed.

#### Low Voltage

- Sprinkler systems are low voltage and exempt from most electrical concerns.
- Cut wires should be removed or labeled as low voltage.

## Heaters / Chillers

- Heaters often have low and high voltage wiring. Standard voltage connections must be within an enclosure whereas low voltages can be exposed. Strain relief is required for standard voltage wiring.
- Thermostats must have a cover installed.
- Heaters must be in accordance with building codes.
- Electrical space heaters require approval prior to purchasing and must meet the following requirements:
  - a. Be UL listed for Factory Mutual approved for their intended use.
  - b. Have a thermostat to automatically shut down.
  - c. Have “tip protection” meaning it will turn off when knocked/tipped over.
  - d. Only oil filled electric radiator space heaters are approved.

## Electrical Boxes and Conduits

- All electrical boxes, conduits, and fittings must be intact and covered.
- No openings can be present.
- Open knock-out plugs must be filled with an appropriate material.

## Other

- Lighting shall be maintained in good repair. Broken lenses and lamps or excessively corroded fixtures should be replaced.
- Electrical panelboards are required to have proper dead fronts and covers in place. Panel openings shall be properly enclosed.
- Motors shall be properly installed, supported, and secured to prevent damage to connected equipment. Wiring to motors shall be done with proper wiring methods, and shall also be properly supported and secured.
- Switches and controllers shall not have exposed contacts or wiring.



### 3.5. Hazard Identification & Controls: **ERGONOMICS**

An ergonomic hazard is considered a physical hazard that includes actions such as pushing, pulling, lifting, sitting, or standing. Ergonomic risk factors are found in jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Repetitive motions in awkward positions can cause musculoskeletal injuries.

- Reduce ergonomic stress and fatigue when possible. Observe practices and analyze arm, wrist, head, and body movements. Switching between tasks during the day can reduce ergonomic stress by engaging different muscle groups and help reduce mental fatigue.
- Workers should be trained to recognize the signs and symptoms of Connective Tissue Diseases (CTD).
- Use proper lifting and handling techniques. Hand tools with loose heads or split and defective handles are to be repaired or replaced.
- Reduce heat stress by providing shade and/or installing fans in the work areas (if possible). Employees must be trained in heat stress prevention and should have drinking water available.



## 3.6. Hazard Identification and Controls: OTHER

### Venting and Cooling

- Ridge vents must be functional if the greenhouse is not conditioned.
- It is strongly recommended that there be a thermostat at the entrance of the greenhouse to determine if the temperature is safe to enter.

### Access Controls

- Doors and latches must be functional and in good condition.

### Rust

- Be aware of structural damage caused by rust. Rusty surfaces are more likely to cause injury.
- Guards for fans may be subject to rust and need to be monitored for damage.

### Portable Ladders

- Ladders will only be used in accordance with the manufacturer's instructions; read and follow all labels/markings.
- Inspect the ladder prior to using it. If the ladder is damaged, it must be removed from service and tagged until repaired or discarded.
- Maintain a 3-point (two hands and a foot, or two feet and a hand) contact on the ladder when climbing.
- Use a ladder only on a stable and level surface.
- Do not place a ladder on boxes, barrels, or other unstable bases to obtain additional height.
- Do not exceed the maximum load rating of a ladder.





## Hand & Power Tools

- Hand tools must be inspected before each use. Unsafe hand tools must not be used .
- Select the right tool for the job.
- Keep tool in good working condition.
- Operate according to the manufacturer's instructions.

## Surfaces

- Surfaces should be level and free of trip hazards.
- Gravel should be cleared of weeds routinely.
- Hard surfaces should be free of moss and algae growth.

## Pest Management

- UF EH&S provides pest management for insects and rodents on Main Campus; if there are any issues, please immediately contact 352-392-1591.

## Fire Prevention

- If there is a strong odor of propane, do not enter the greenhouse or turn lights and equipment on. Call the UFPD or Fire Department.

### 3.7. Personal Protective Equipment (PPE)

PPE is mandatory and based on the GatorTRACS LATCH Assessment. Due to slippery surfaces, wear slip-resistant shoes, and avoid wearing leather sole shoes when working in the greenhouse.

For additional information on PPE, please review the EH&S webpage on [Personal Protective Equipment](#).





**Section 4:**  
**Greenhouse Safety Survey**  
**&**  
**Training**

## 4. Greenhouse Safety Survey

Please refer to the EH&S webpage on GatorTRACS for more information regarding the Greenhouse Safety Survey: <https://www.ehs.ufl.edu/departments/research-safety-services/gator-tracs/>


EH&S will inspect greenhouses during the annual safety survey. Greenhouse PIs are responsible to implement corrective actions to deficiencies noted during the safety survey.



## Training

The Chemical Hygiene Plan/HAZCOM Training, which can be found at the [MyTraining](#) website, is required for those who work in greenhouses. These trainings must be completed before conducting any research activity. Additional training may be required based on the scope of work and the LATCH hazard assessment.

Greenhouse safety training is available for greenhouse workers.

A photograph of a hydroponic greenhouse. In the foreground, several rows of white, rectangular growing channels are visible, each containing small green seedlings. In the background, more mature plants with large green leaves are growing in similar channels. The greenhouse structure is made of metal frames and translucent panels, with a large white pipe running across the top. A blue ladder is visible on the right side.

## **Section 5: Planning for Emergencies, Incident & Injury Reporting**

## 5. Planning for Emergencies

Planning for emergencies helps greenhouse workers respond appropriately during an emergency.

The PI and greenhouse staff must be aware of:

- The nearest location of the safety shower and eyewash.
- The location of the nearest first aid kit and fire extinguisher.

**Note:** If an emergency occurs on main campus, contact the University Police Department at (352)-392-1111. If the structure is off main campus, please list the local emergency contact number and police department number on the notice board.



## Incident & Injury Reporting

If an injury/accident occurs, seek first aid or medical assistance as needed. Report all injuries to your supervisor. Injuries, accidents, and incidents must be reported through the EH&S website at <https://www.ehs.ufl.edu/report-to-ehs/report-incident/>

## References

Adair, Dann, and Ruth Irwin. "Practical Guide to Containment: Plant Biosafety in Research Greenhouses." VTechWorks Repository, ISB, 1 Jan. 1970, [vtechworks.lib.vt.edu/handle/10919/78423](https://vtechworks.lib.vt.edu/handle/10919/78423).

National Center for Appropriate Technology. "Greenhouse Manual: An Introductory Guide for Educators." United States Botanic Garden (USBG), <https://www.usbg.gov/greenhouse-manual>

NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines) - April 2019, [https://osp.od.nih.gov/wp-content/uploads/NIH\\_Guidelines.pdf](https://osp.od.nih.gov/wp-content/uploads/NIH_Guidelines.pdf)

OSHA. Machinery and Machine Guarding 29 CFR 1910.212(a)(5), 13 Mar. 2001, <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.212>

# EH&S Website Quick Links

Ergonomics:

<https://www.ehs.ufl.edu/departments/occupational-safety-risk/ergonomics/>

Fire Safety:

<https://www.ehs.ufl.edu/departments/facility-support-services/fire-safety/>

GatorTRACS:

<https://www.ehs.ufl.edu/departments/research-safety-services/gator-tracs/>

Heat Stress:

<https://www.ehs.ufl.edu/about/policies/heat-stress-policy/>

Ladder Safety:

<https://www.ehs.ufl.edu/about/policies/shop-safety-machine-guarding-policy/ladder-safety/>

Lifting:

<https://www.ehs.ufl.edu/departments/occupational-safety-risk/ergonomics/agricultural/>

Machine Guarding:

<https://www.ehs.ufl.edu/about/policies/shop-safety-machine-guarding-policy/machinery-and-machine-guarding/>

Pest Control:

<https://www.ehs.ufl.edu/departments/facility-support-services/pest-management/>

Power Tools:

<https://www.ehs.ufl.edu/about/policies/portable-power-tool-safety/>

PPE:

<https://www.ehs.ufl.edu/about/policies/personal-protective-equipment/>

***DANGER***

***Pesticides In Use***  
***DO NOT ENTER***

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***Date:***

***Time:***

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***Contact:***

***Phone:***

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