Safety Guide

April 2025

Environment, Safety and Health Committee
Graduate School of Agriculture
Kyoto University

Introduction

Educational and research activities at universities include various experiments, practicums and field research. They usually involve special risks different from those which might be met in daily life, and some of these risks have led to serious accidents in the past. However, just as the possibility of a lion attacking people will drop substantially once the animal is put in a cage, it will be highly likely that you will be able to prevent the occurrence of accidents if you understand the risks that lie in experiments and field research and take steps in advance to confine them well. Should an accident happen, it is also important to prepare for taking proper emergency measures to minimize damage.

The first edition of this Safety Guide was compiled in 1997 by the Environment and Safety Committee of the Faculty/Graduate School of Agriculture, Kyoto University for the purpose of promoting graduate students' awareness of safety. At that time, the organization of universities in Japan was changed substantially in accordance with the Japanese government policy intending to strengthen the graduate school system at Japanese universities. With the level of research advancing and the number of graduate students increasing considerably, it was feared that basic safety education for graduate students was being neglected. Under these circumstances, the first edition was prepared with the aim of "raising awareness of safety in educational and research activities and teaching students how to cope with the occurrence of any accident (an excerpt from the Introduction of the first edition of the brochure)". Thereafter, the Safety Guide was revised several times in order to reflect changes in the university's regulations on safety and hygiene management, following the transformation of national universities into independent administrative entities and revisions of important related laws. This latest edition of the Safety Guide was substantially revised from the previous version. It includes many corrections, deletions and additions over the entire volume to reflect changes made in recent years.

Both the Yoshida Campus and the Uji Campus of the Graduate School of Agriculture have been subjected to large-scale seismic retrofitting work lately, so that the whole facility and its equipment have been revamped. Experimental apparatuses and methods are rapidly advancing and changing. The occurrence of the Great East Japan Earthquake on March 11, 2011 compelled us to review safety management and safeguards at Japanese universities. It seemed reasonable that this Safety Guide should also be completely revised to deal with these changes in outside circumstances. We hope graduate students and other concerned people will read this Safety Guide and become familiar with the safeguards at our university. We would appreciate it if you could give us your feedback or suggestions about items to be corrected or added.
We also hope this Safety Guide will help you to safely lead a full campus and research life.

March 2025
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Table of Contents

Before Commencing Experiments

A number of accidents have occurred within the university recently. Although none of these were serious life-threatening incidents, accidents resulting in burns and injuries do occur frequently, and small-scale explosions (e.g., involving high-pressure gas cylinders) also happen. In addition, mismanagement (e.g., theft and loss) of poisonous and deleterious substances has been reported. A single mistake can lead to serious accidents or incidents.

Here, we provide some common points of caution when performing empirical research or experiments in indoor or outdoor environments. Please take care to observe these guidelines to ensure safety.

1. As a rule, empirical research and experiments should not be conducted at the university on Saturdays, Sundays, public holidays or at night. If it is absolutely necessary to perform such work, make sure to notify your academic supervisor to obtain permission.
2. Empirical research or experiments should never be conducted alone. Always ensure that two or more persons are present and take care to establish a safe work environment.
3. Always check the evacuation route and emergency exit that need to be used in the event of an emergency.
4. Whenever performing empirical research and experiments (other than desk work) always wear a lab coat and appropriate work clothing, and as necessary make use of safety goggles, a safety helmet, and a protective mask.
5. If there is any risk or danger associated with any work, always make arrangements in advance with your academic supervisor to ensure that the work is conducted safely.
6. Always be aware of the locations of fire extinguishers before commencing work.

Telephone numbers

This booklet lists relevant internal extensions and external telephone numbers. Telephone dialing instructions are as follows.
Telephoning to internal extensions from within the university.

- Within Yoshida Main Campus, simply dial the 4 or 5 digit extension number.
- From Yoshida Main Campus, Kyoto University Hospital, or Katsura Campus to Uji Campus: dial 17 followed by the internal extension number.
- From Yoshida Main Campus, Uji Campus, or Katsura Campus to Kyoto University Hospital: dial 19 followed by the internal extension number.
- From Uji Campus, Katsura Campus, or the Kyoto University Hospital to the Yoshida Main Campus: dial 16 followed by the internal extension number.

(Here, Kyoto University Hospital includes the Graduate School of Medicine and Faculty of Medicine.)

Telephoning from within the university to external numbers.
• Dial “0” to get a dial tone, then dial the area code (if outside the city) followed by the local number.
Telephoning from outside the university to an internal extension at Yoshida Main Campus:
• Dial (075) 753 followed by the internal extension number. (The 5 digit extensions cannot be reached.)

Chapter 1　In an emergency

1) How to notify the fire

Fire department 119
(or 0119 for outgoing call)

Tell “Kajida”* in Japanese at first and then “on the **the floor of the ** building at the Faculty of Agriculture (or the Uji Campus) of Kyoto University!”
*”Kajida” means “Fire broke out ”

(Yoshida North Campus)

[For Uji Campus: Call the Environment Safety Section, Facilities and Environments Management Division at ext. 3395. Take necessary measures while referring to the diagram of the emergency contact.

Gatehouse
Ext. 2255

Accident Prevention Office
Ext. 6034

North Campus Safety Management Department
Ext. 3693

Tell “Kajida” in Japanese at first and follows “on the **th floor of the ** building at the Faculty of Agriculture! I have reported to the fire department.”

(In the RI control zone or near it)

Radiation Protection Supervisor
(Prof. Fumito Tani)
Ext. 6286

[Caution: Take necessary measures while referring to the diagram of the emergency contact network posted on the bulletin board.]

North Campus Safety Management Department Ext. 3693

2) Personal accidents, incidents, and emergency cases

Need ambulance?

Yes → Fire department 119 (or 0119 for outgoing call)

Yes → North Campus Guardhouse Ext. 2255
Uji Campus Guardhouse Ext. 4350, 4351

Use an AED if the person has suffered cardiac arrest.
(For its location and how to use it, see the next page.)

No → Available on a 24-hour basis
Kyoto Min-iren Asukai Hosupital　TEL: (075) 701-6111

No → Emergency hospitals near the Uji Campus:

Tokura Hospital (Uji)　TEL: (0774) 22-4521
Uji Takeda Hospital (Uji)　TEL: (0774) 25-2500
Ajirogikai Uji Hospital　TEL:(0774-32-6000)
Rokujizo General Hospital　TEL:0774-33-1717
Uji TOKUSHUKAI MEDICAL CENTER　TEL:0774-20-1111
Uji City Emergency Climic　TEL:0774-39-9430

Remember to report to the teachers and other staff concerned, including your supervisor.

3) Problems and trouble

① Water, oil or gas leaks
② Offensive smells
③ Trapped in an elevator
Elevator failure

(8:30 to 17:15 on weekdays)
North Campus
Facility Maintenance Office
Ext. 3617 or 6022

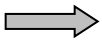
Uji Campus
Ext.3395

(evenings, weekends and holidays)
North Campus
Accident Prevention Office
Ext. 6034

Uji Campus
Ext.4350,4351

(Contact reference data)
Gas leaks:
Osaka Gas Co., Ltd. (24-hour system)　TEL: 0120-819-424

4) Trouble, crime or a suspicious person



(8:30 to 17:15 on weekdays)
North Campus
Safety Management Department
Ext. 2254 (or 075-753-2254 for incoming call)

Uji Campus
General Affairs Section
Ext.3333,3367

Gatehouse (evenings, weekends and holidays)
North Campus
Ext. 2255 (or 075-753-2255 for incoming call)

Uji Campus
Ext.4350,4351

5) Safety Support Card

Safety Support Card which details the emergency contact network is distributed to students.
It is advisable to carry this card with you at all times.


Safety Support Card
1003
Fire!
Ambulance!
119 Fire Station
Police!
110 Police Station
1,
Introduction of
medical facilities with
English-speaking staff
2,
Medical consultation
over phone
06-4395-0555
AMDA International
Information Center
English and Spanish:
Mon-Fri 9:00-17:00
Chinese:
Mon 10:00-13:00
Portuguese:
Mon 10:30-14:30
Immigration Office
in Kyoto
075-752-5997
Mon-Fri
9:00-12:00/13:00-16:00
General Inquiries
about visa
06-4703-2150
Immigration Bureau
Information Center

(Front)

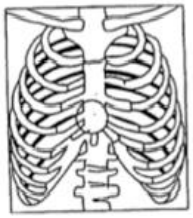
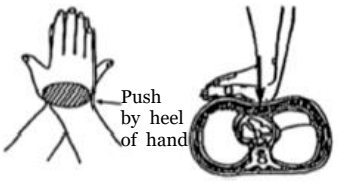

On-campus Hotline
Kyoto University North Campus Faculty/Graduate School of Agriculture
Deceived by illegal
business practice!
Facing problems...
Don't know
where to consult...
Lost and Found
Sudden illness!
Got injured!
Need ambulance!
Accident/Crime!
Need the police!
Suspicious individual!
Theft on campus!
075-753-2251
Student Affairs Office
Office hour
Mon-Fri
8:30-17:15
Telephone counseling
available

(Back)

Cardio-pulmonary resuscitation — Your actions save human life —

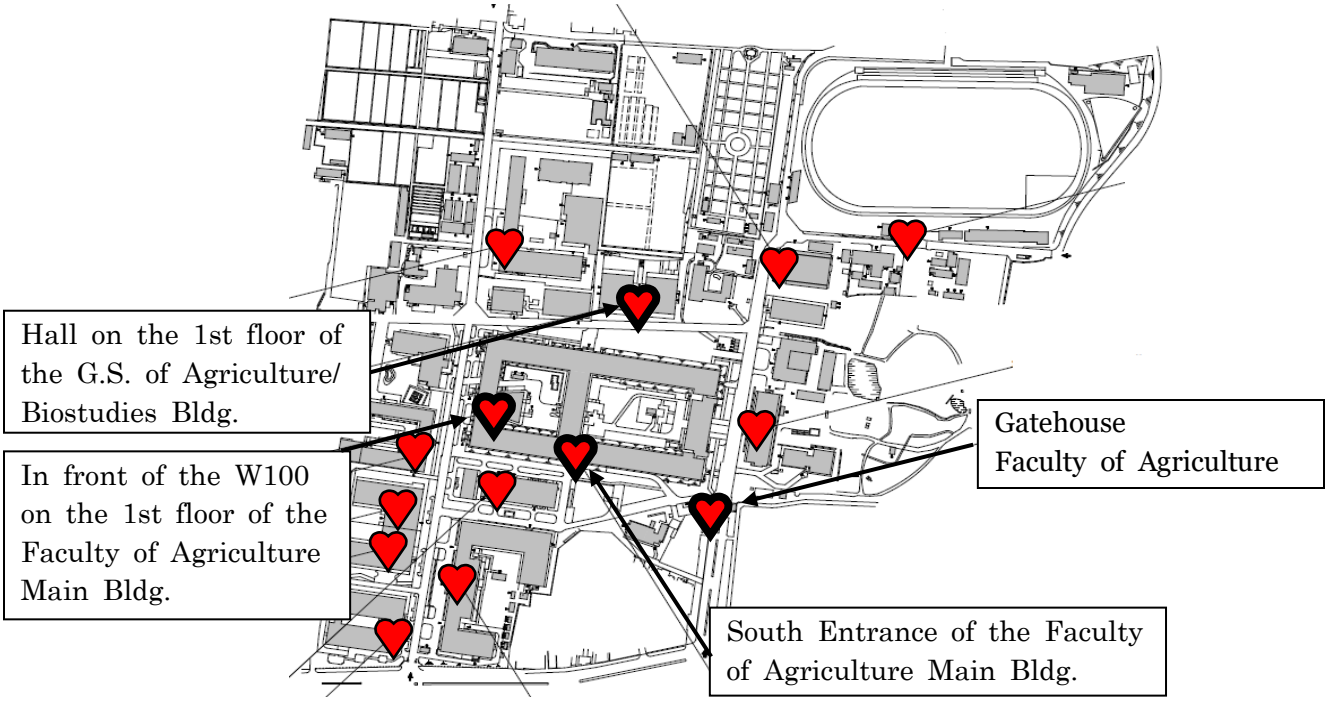
1. If someone falls to the ground or you find someone lying on the ground, the person might be suffering cardiac arrest. Run up to the person and evaluate if he/she is conscious by asking if he/she is all right.
2. If the person is not responsive, seek help and ask someone to dial 119 to call for an ambulance and to bring an AED.
3. Place one hand on the person's forehead and push his/her head back. Lift the person's chin using two fingers of your other hand so that air can easily reach the lungs via the nose and mouth. While keeping the airways free, use your cheek to gauge if the person is breathing, by putting it close to their nose and mouth. Check for about 10 seconds to see if there is any chest or stomach movement.
4. If there is no response and the person does not breathe normally, this is a strong indication that he/she is in cardiac arrest, and it is time to start cardio-pulmonary resuscitation (CPR).
5. If possible, perform two puffs of artificial respiration.
   (Breathe into the person's mouth slowly until his/her chest rises, for one second each time.)


6. If you still see no signs of life, then cardiac massage is needed immediately.
   (Cardiac massage is performed 30 times by pressing the breastbone that is located in the middle of the chest. This procedure involves 100 pushes on the chest per minute.)

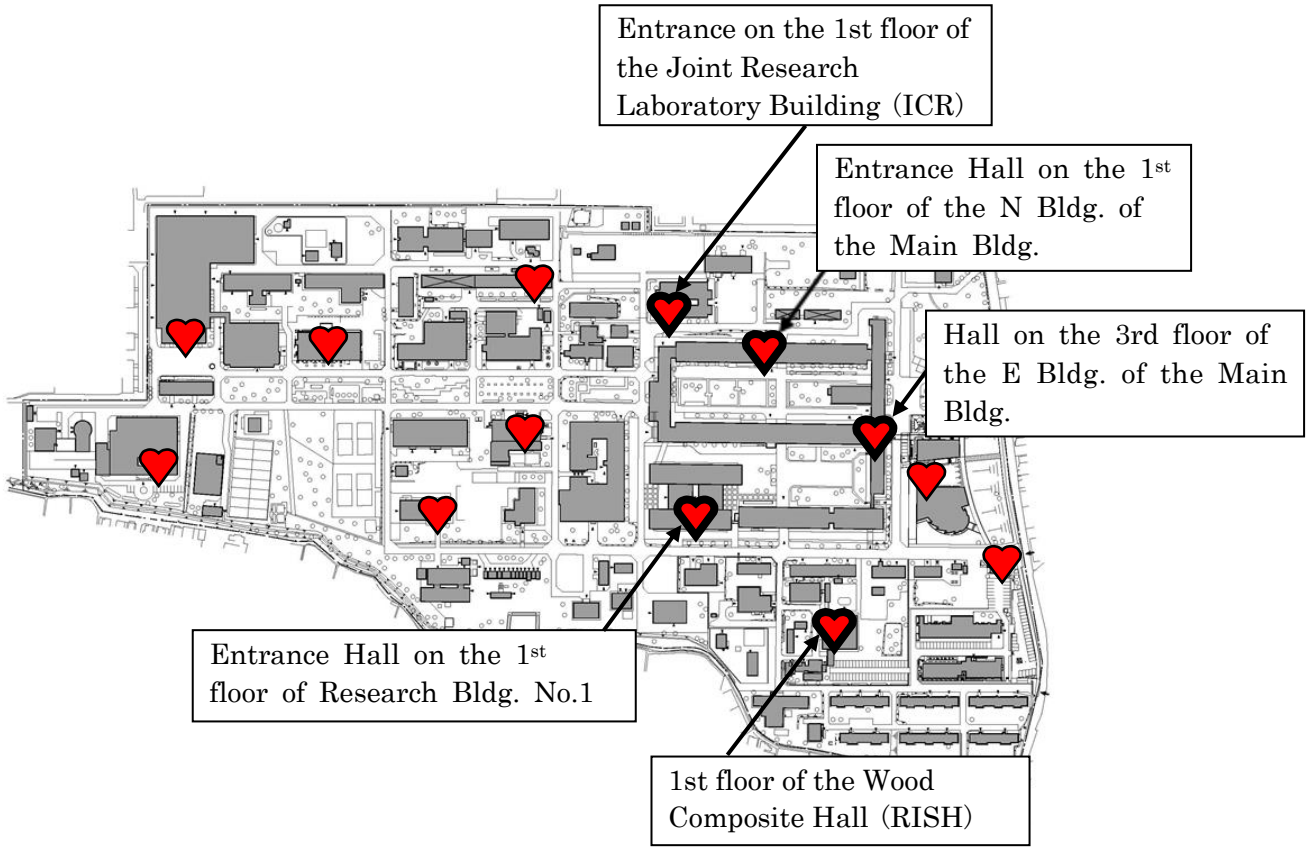




7. Repeat artificial breathing twice and sternum pressure 30 times.
8. When the AED arrives, turn on the device and expose the person's chest. Affix the electrode pads to the specified positions and apply electric shocks according to the spoken instructions provided by the device.
   Note: Even if the device delivers the message: "There is no need for defibrillation", that does not mean that the person's heart has begun to pump. If you cannot be sure the person's heart has begun to pump, resume CPR according to the instructions provided by the AED.

Location of AEDs



North Campus



Uji Campus

Chapter 2　Fires and Earthquake Disasters

It is necessary to be always aware of safety and observe specified safety rules:
① Know the locations of fire extinguishers, fire hydrants, and fire alarms and how to use them
② Know the locations of emergency exits and escape aisles, and evacuation routes
③ Keep laboratories, rooms and aisles in order to make sure evacuation routes are clear
④ Refrain from smoking in non-smoking areas on campus (buildings and grounds). Smoking is allowed at specified outdoor areas only.
⑤ When leaving a room, make sure to turn off the equipment power supplies and the room. Close the main tap of the city gas, too.

1) Fires

a) Preventing fires

① Keep a bucket filled with water where there is a high possibility of fire.
② Do not place flammables near sources of heat or ignition.
③ Check the operating status of electric and gas appliances at periodic intervals and use them as specified.

b) Measures to take when a fire breaks out

① Cry out an warning like “Fire! Fire!” Don’t hesitate!
② If possible, put out the fire, observing the following precautions:
I) Turn off the electrical switches of equipment and apparatuses and the main gas taps where the fire has started and put out the fire using a fire extinguisher.
II) If your clothing catches fire, pour water over yourself immediately or roll yourself on the floor to try to put out the flame.
III) Put any flammables away.
③ If you find it is difficult to put out the fire yourself because it has gotten too big, call 119 as directed in Chapter 1.

2) Earthquakes

a) Preventing hazards related to earthquakes

① Hazardous materials should be properly controlled to prevent them from falling, dropping or vibrating due to an earthquake.
② Furniture (including bookshelves, storage sheds, racks and lockers) taller than about 150 cm should be secured in place to the floor, wall or to a pillar, using anchor bolts and other devices. In addition, piles of things should be secured together using latches or something like that.
③ Heavy experimental equipment which it is difficult to secure using anchoring devices and PCs should be secured to prevent them from falling or dropping, using adhesive sheets or quake-resisting mats.
④ Objects on higher shelves in storage sheds, on racks or bookshelves which do not have doors should be properly secured to prevent them from falling.
⑤ Objects in high places, including TV sets hanging from the ceiling, should be secured firmly to prevent them from falling.

b) Measures to take when an earthquake happens

① Turn off all sources of heat and ignition.
② Take shelter under a rigid desk. Stay away from tall objects which might fall.

③ If a fire breaks out, shout an warning to those around you and try to put it out.
④ If anyone has been injured, rescue the person from danger.
⑤ Do not dash outside impulsively. Stop and think about the best way to evacuate, evaluating the surrounding circumstances. Do not use elevators.

3) City gas hazards

a) Measures to take when a gas leak takes place

① Turn off all sources of heat and ignition.
② Turn off the mains tap.
③ Open the windows and doors. Do not turn on the fans.
④ If you find the situation is beyond control, escape or take refuge immediately.
⑤ Report to the specified authorities and persons concerned (see Chapter 1).

b) Preventing gas leaks

① Check the gas appliances and pipes at periodic intervals and observe the specified instructions for use.
② When moving experimental equipment and furniture, be careful not to damage the gas cocks or pipes.
③ Make sure you know where the main cocks are located and how to use them.

Notes

What is fire-extinguishing equipment?

The Fire Service Law classifies fire-extinguishing equipment into the following five categories:

Class 1 fire-extinguishing equipment: Indoor or outdoor fire hydrant systems

Class 2 fire-extinguishing equipment: Sprinklers

Class 3 fire-extinguishing equipment: Fire-extinguishing systems using steam, foam, carbon dioxide, or haloid, which are larger than usual fire extinguishers

Classes 4 and 5 fire-extinguishing equipment: General, large and small-size fire extinguishers

(The agent in dry chemical fire extinguishers is usually hydrogen phosphate or hydrogen carbonate.)

Class 5 fire-extinguishing equipment: Water in a bucket or dry sand

How many years between filling and the expiration date of fire-extinguishers?

The expiration date of general fire-extinguishers is reported to be about 8 years. However, this expiration date is recommended by the manufacturer, not one required by law. The expiration date of aerosol and other special type of fire-extinguishers is reported to be about 1 to 2 years.

If an emergency situation including a fire or a natural disaster occurs:

★ Yoshida North Campus

The Sports Ground of the Faculty of Agriculture is specified as a safe evacuation area. Also, there are few temporary evacuation areas which are set by each division and Depend on where you are at the time of a fire or a natural disaster. If an emergency situation occurs, move with all due speed to the specified safe evacuation area without bolting or panicking. If an instruction to evacuate is announced over the PA system or a guard gives evacuation advice, follow it. You can view the evacuation routes of the buildings of the Graduate School of Agriculture at the following URL:

https://www.kais.kyoto-u.ac.jp/japanese/2011/04/27/post_45/ (in Japanese)

There are some dead spots in each building where mobile phones have difficulty making a connection or cannot make a connection at all. Spots where signals cannot reach or are difficult to pick up are shown at the following URL. Know the information in advance so that you can move to spots where signals are easy to pick up in an emergency.

(Places other than these have good phone reception.)

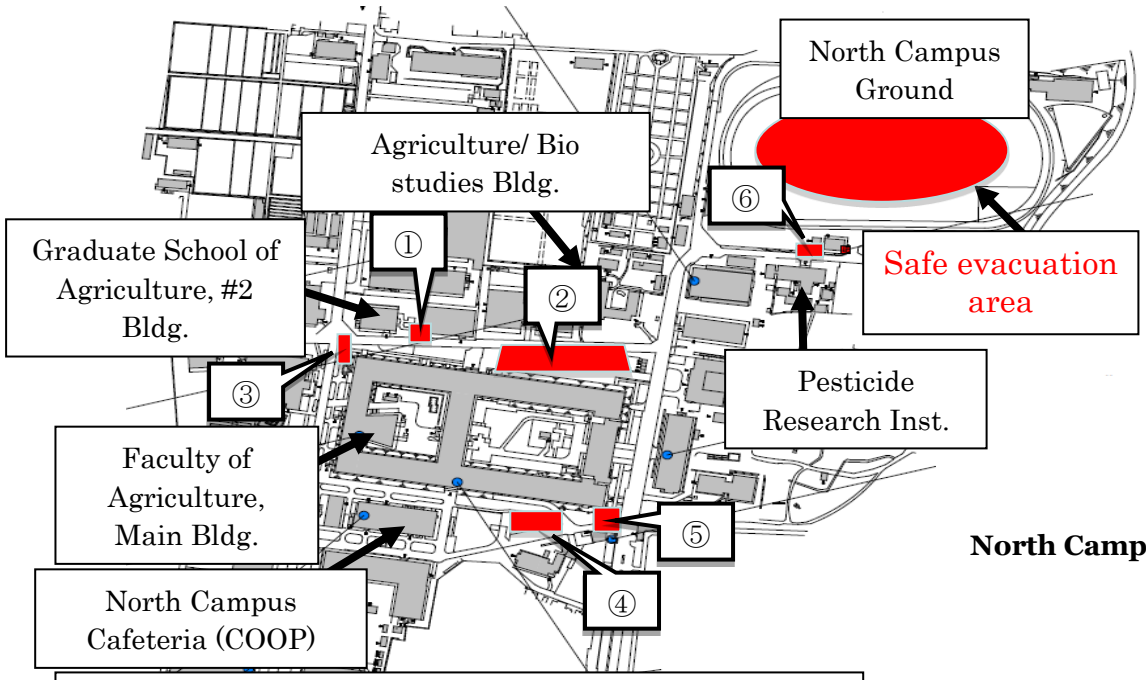
https://www.jimu.kais.kyoto-u.ac.jp/shisetsu/keitai/index.html (in Japanese)

★ Uji Campus

The vacant lot in front of the Obaku Plaza and the vacant lot to the south of the Campus Cafeteria (shown in the map on the next page) are specified as safe evacuation areas.

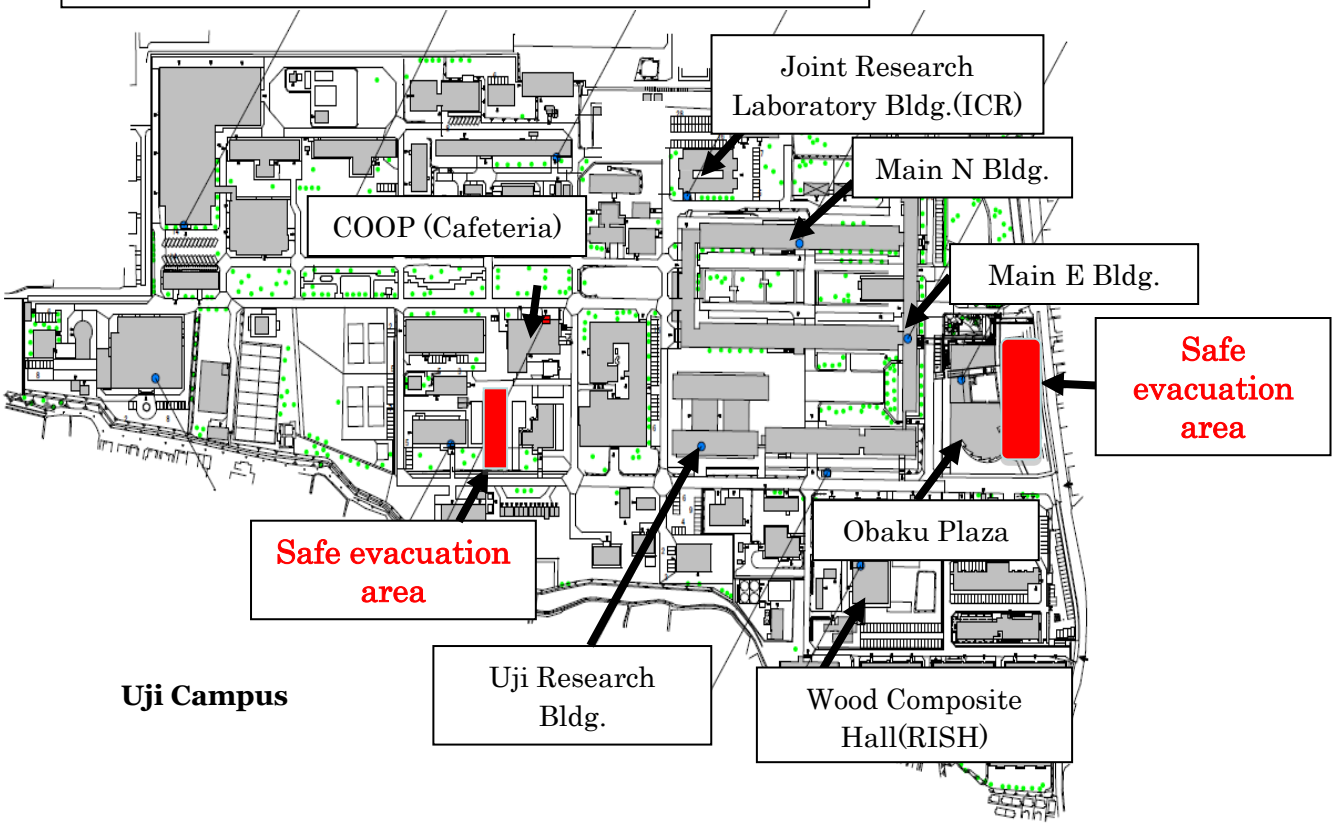
If an earthquake with a magnitude of 4 or more is anticipated to occur, a warning is announced through the PA system along with a chime.

Disaster evacuation area



North Campus

Temporary evacuation area
① #2 Bldg. ② Life Science, Bioscience, Library, Agriculture/ Biostudies Bldg., Lecture Rooms ③Food Science ④Administrative offices, Forest Science, ⑤Environmental Science, Natural Resource Economics, Comparative Agricultural Science ⑥ Agricultural Chemical



Uji Campus

Chapter 3　Electricity

1) General precautions to take when using electrical appliances

Accidents due to electrical appliances are often caused by a failed safety device or improper use of the appliance. It is necessary for experimenters in laboratories to have basic knowledge of electricity, understand the rules for using electricity, check the appliances at periodic intervals and use them in an appropriate manner.

① Do not have many electrical cords connected to a single outlet, using a multiple socket.

② The capacity of a multiple socket should be larger than the capacity of the electrical appliance that is plugged into it.

③ PVC wires should be connected to an outlet or appliance using a plug. Do not solder them to connect them.

④ Use electric appliances and materials which meet the authorized safety standards.

Examples of the marks which meet the authorized safety standards

⑤ When using a cable reel, make sure to unwind the cable completely. Do not use the cables wound up on the drum. (There is a danger of burning.)

⑥ Electrical appliances should be provided with individual switches, and labeled to show the rated current value for fuses.

⑦ Do not use cables with frayed or deteriorated coatings or insulation.

⑧ Avoid running cables over the floor to the extent possible. If it's unavoidable, cover them to prevent stepping or tripping on them.

⑨ If electrical appliances are used in a chemical or gaseous atmosphere, use caution to prevent the appliances or cables from being damaged by the chemicals or gases.

⑩ Large-current electromagnets can be very dangerous because they attract iron objects by leakage magnetic field. Never come close to one if you have a cardiac pacemaker implanted.

⑪ Before switching on an electrical device become familiar with its instructions for use and its performance characteristics.

⑫ Make sure to ground electrical appliances when using them. Do not connect the ground cable to a water pipe or gas pipe. Connect to the ground terminal of the distribution panel.

⑬ When leaving the laboratory after you finish with an experiment, make sure to turn off the electrical appliances you have used. If any electrical appliance must be operated unattended, make sure it will operate safely before leaving the room.

⑭ If an experiment is suspended due to a power failure, or when you leave the room after suspending an experiment, remember to turn off the power supply to the electrical appliances.

⑮ Have a flashlight ready to hand in the room in case a power failure occurs.

2) Preventing electrocution and measures to take if someone receives an electric shock

a) Preventing electrocution

Electrocution occurs when a person comes close to or touches a current-carrying part or charged part, so that electric current flows through the body to the ground. Use special caution when working with a high-voltage electrical appliance, because a person can get electric shock due to aerial discharge without directly touching a live part.

① Ground electrical appliances securely.

② When using electrical appliances in a wet or humid place, install a ground fault interrupter in addition to grounding them.

③ If you need to touch the current-carrying or charged part of an electrical appliance, turn off the power supply and then discharge the part using a drop bar before touching it.

④ Do not touch an electrical appliance with wet hands. Do not perform electrical work in a wet place. Wear a safety hat, rubber gloves and rubber shoes as needed to prevent getting an electric shock.

⑤ To avoid current from leaking from an electrical appliance, remove dust, dirt and excess lubricant from the appliance to keep it clean.

⑥ When handling a high-voltage or large-current appliance, shield all current-carrying or charged parts with insulation material and put signs like: “Hazardous Area” or “Danger – Keep Away!” to prevent anyone from touching them. Such an appliance should be provided with a red warning light that turns on when the appliance is in operation.

⑦ A high-voltage appliance should be operated by a group of two or more people. Prepare an operation manual which explains how to operate it.

⑧ Perform an insulation resistance test (insulation measurement) at periodic intervals to find any incipient malfunction or electric leak as soon as possible. Perform adequate daily inspections and servicing.

b) Emergency measure to take if someone receives an electric shock

If you find a person who has gotten an electric shock, take the following emergency measures:

① Turn off the power supply immediately and then take emergency measures. If it is unavoidable to pull the person away from a cable or electrical appliance while it is live, use a dry wood or bamboo pole and wear rubber gloves.

② Move the victim to a nearby convenient place and loosen the person’s clothes to give them some ease. Call for an ambulance to take the victim to the hospital as soon as possible.

③ If the victim does not breathe or is in cardiac arrest or shock, have an experienced person deliver continuous artificial respiration or cardiac massage until an ambulance arrives.

3) Electrical fires and preventing explosions

Fires attributable to electricity can be roughly divided into two categories: ordinary fires which arise from heat buildup of flammables due to heat from overloaded circuits or leaking current and explosive fires which arise from electric sparks igniting explosive gas or powder.

a) Ordinary fires

① Observe the "general precautions" given in Section 1) of Chapter 3. In addition, use caution not to have current beyond the allowable limit flow into cables or electrical appliances.
② Flammables might catch fire due to sparks that occur from short circuits. Do not place flammables near electrical cables or appliances, to the extent possible.
③ Fire can occur due to heat buildup attributable to poor contact at cable connections. In particular, screwed in cable connections should be retightened regularly.
④ Perform an insulation resistance test (insulation measurement) at periodic intervals to find any incipient malfunction or electric leak as soon as possible. Perform adequate daily inspections and servicing.

b) Preventing explosive fires (accidents)

Use due caution when handling explosive gases or powder dust.
① Use a draft chamber or dust arrester to prevent explosive gases (flammable gas or ignitable vapor) or powder from filling up the laboratory atmosphere.
② Install a gas detector.
③ It is necessary to consider using explosion-proof switches or appliances because electrical switches can cause sparks or arc even if they are operating normally.
④ To prevent a danger of discharge sparks due to static electricity causing an explosion, proper measures should be taken, including shielding charged objects, using conductive insulating material, using a grounding method that reduces the amount of charge, or installing a static eliminator.

c) Cautions to take when fire-extinguishing

Do not use water to put out an electrical fire while the appliance or cable is conducting or charged; there is a danger of getting an electric shock. Use a chemical or carbon dioxide gas fire-extinguisher. If it is unavoidable to use water to put out an electrical fire, it is advisable to ground the water injection hose or the fire-extinguisher nozzle.

Notes

How dangerous are electric shocks?

The magnitude of an electric shock is generally determined by the square of conducting current times the conducting time. It varies with the magnitude of the voltage, the frequency waveform, and the route inside the body through which the current flows. As a rough guide, if a person gets an electric shock from AC voltage at 50 – 60 Hz, the victim will develop muscular rigidity at 10 milliamps, or a fatal cardiac disorder leading to shock death at 100 milliamps.

Chapter 4　Mechanical Work and Welding

If you want to use an engine or machine tool as part of your research project, or if you need to sling a load or use a machine tool (a grinder or other such tool) or an electrical appliance, you are required to follow the rules and regulations in the Industrial Safety and Health Law (Article 61 and other provisions), the Ordinance on Industrial Safety and Health (Articles 36, 634 and other provisions), and an administrative notification called the Guideline for Sling Work Safety, Feb. 24, 2000, Labor Standards Bureau Notification No. 96. Note that some kinds of work require special qualifications, acquiring a license or receiving training (specific education).

1) Keeping work rooms in order

It is important to keep work rooms and other work sites in order. A cluttered work room can lead to an accident. Make sure an escape route is always clear in case of an emergency. Post an emergency hospital telephone number in a prominent place.

① Make efforts to always keep the work room in order and the machinery inside it in good condition.

② Keep machinery, devices and tools distinctly separated from aisles, and establish specific places for everything and have a system for storing equipment and supplies.

③ There should be more than 80 cm of space between the side of each aisle and the machinery inside the work room.

④ Make sure there is sufficient space to work safely and remove any obstacles that could hamper your work. Materials and tools should be put on a bench, not down on the floor.

2) Work clothing and protective gear

① Wear light, snug work clothing. When welding, operating an engine, doing machining that might cause chips to fly, or handling live cables, make sure you wear long-sleeved clothes. Tighten the cuffs and tuck your shirttail in your trousers. Avoid clothing with large pockets. Do not wear a lab coat for mechanical work.

② When working near machinery or power transmission devices, wear a work hat that covers your hair. Wear a safety hat in an environment where there is a danger of damage from hard or heavy items overhead.

③ Do not wear sandals or slippers. Avoid wearing slippery footgear. More foot injuries occur than most people think. It is best to wear safety shoes with a JIS specification.

④ Do not wear gloves when operating a machine with rotating parts or high-speed reciprocating parts.

⑤ Do not put flammables or sharp-edged objects in your pockets.

⑥ When danger is a possibility, use protective gear suitable for the work.

Here are some examples:

i) When grinding or deburring, use goggles, a dust-proof mask or visor screen to prevent flying chips, grinding dust or splashes of harmful chemicals from entering your eyes or mouth.

ii) When welding, protect yourself from the light and heat by wearing shielding glasses, a visor screen, leather gloves, leather foot coverings, and a leather apron, etc.

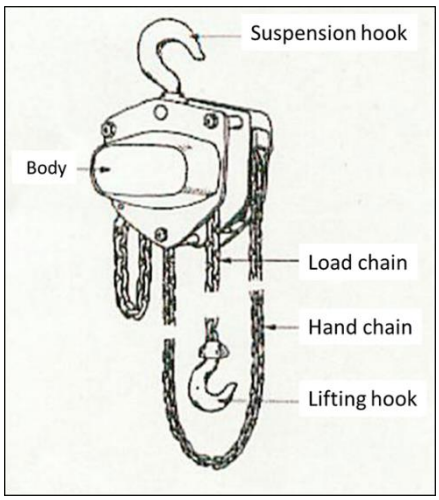
3) Lifting using a hoist or chain block

When people are carrying heavy loads, the weight should be limited to 25 kg for men and 15 kg for women. If you want to lift a load heavier than that, make sure to use a hoist or chain block.

Hoist: A winding device (for loading and unloading) that raises or lowers loads using wire rope, consisting of a winding drum, a reduction gear, and an electric motor, in a compact arrangement.

(A telpher, which is a type of crane, features a hoist that moves over a rail, so it is also called a monorail hoist.)

Chain block: A device that combines a pulley and gears for raising heavy weights with a small amount of force. The mechanism works as follows: you pull a chain (hand chain) to rotate several gears, causing another chain (load chain) to be pulled up.



Example of a chain block

Generally, lifting a load heavier than a ton can be performed only by specially trained or licensed people. Even if the weight is less than a ton, an experienced person needs to be present to give instructions. Here are some of the precautions to take when hoisting loads:

① When installing a chain block on a temporary setup or structure, check its strength and how much deformation occurs, and reinforce the setup if needed. Take measures to prevent the supports from skidding.

② Before starting lifting, check the chain block and ropes to make sure they are normal. Do not use cables with broken wires, or deformed or corroded ropes.

③ Label the weight limit on each lifting tool and device. Understand the weight of the load you are going to lift and do not try to lift a load weighing more than the weight limit of the tool or device.

④ When suspending a load with ropes, have sufficiently long ropes and keep the angles between ropes small enough to reduce tension on the ropes. Do not suspend a load from a single rope.

⑤ Work in a group of two or more when lifting loads: one person watching the load and the other operating the chain block, responding to signals.

⑥ In the event that a lift is used to move a load, secure the castors of the lift when lifting or

lowering the load to hold the lift in place. Keep the load's center of gravity low while carrying the load.

4) Precautions to take when working with manual tools

① Check the tools carefully for wear, deformation, and sharpness before using them.
② Wipe lubricant off the tools to prevent your hands from slipping. Do not wear gloves.
③ Do not use the tools other than as specified.
④ Screwdrivers and wrenches are designed so they apply the appropriate force for the sizes of the screws, nuts and pipes that they fit. Do not try to exert extra force using an auxiliary tool or other means; otherwise the screws, etc. might be damaged.
⑤ Levers are also designed to produce the right amount of force when using them normally. Do not apply undue force; otherwise there is a danger of getting injured or damaging the mating parts.
⑥ When installing a part like a flange with many screws, tighten the screws in an order that crosses the circle diagonally. When loosening the screws, take care not to allow the article to drop.

5) Precautions to take when using machine tools

① Have basic knowledge of the machine tool you are going to use, such as its operating principles, procedures and precautions to take when using it. When using it for the first time, get guidance from a skilled operator.
② Avoid working alone in the work room with a machine tool. You should be able to get a helper in an emergency.
③ Check the machine's condition carefully before turning it on. Operate it in idle to check whether it operates normally.
④ Secure the workpiece in place. Pay attention to its balance and take care to prevent eccentricity when working on a rotating workpiece.
⑤ Select a suitable cutter for the workpiece and install it securely.
⑥ Store the tools and measuring devices in specified places. If a chuck or wrench is left inserted anywhere in the machine, a serious accident could occur when the machine is started.
⑦ Select cutting oil suitable for the workpiece and exhaust if the workpiece might smoke.
⑧ Do not try to touch a rotating workpiece. Do not wear gloves. If you need measure the workpiece, make sure to stop the machine first.
⑨ Make sure the cutter is moved away from the workpiece before stopping the machine.
⑩ If a power failure occurs, first turn off the switch. Move the belt or the clutch (or other equivalent parts) to the neutral position.
⑪ Observe the following conditions when using woodworking machinery.
i) Keep the cutters clean and sharp at all times.
ii) Do not use any machine with its safety device removed or disabled.
iii) Before starting the machine, make sure the cutter is not touching the workpiece or any other object and there is no one near the machine.
iv) Use special caution when working with materials which are corroded, cracked, excessively warped, or of uneven thickness.
v) Use a whiskbroom, picker, or air-gun to carefully remove sawdust or wood shavings near the cutter.
⑫ Replacing a grindstone on the grinder should only be performed by a specially trained person.

6) Precautions to take when performing arc welding

a) Checking the device

Make sure the welding machine power supply switch is on and check the following points:

① Connect the wiring between the arc welding machine, the piece to be welded and the object to which the piece will be welded. Check the connections of the primary and secondary cables and the ground. Do not ground the welding machine to a water or gas pipe or a building wall.

② Check the welding rod holder insulator for damage, loose screws, or damaged welding cable, and repair or replace with a new one if needed. Make sure that the holder and cable meet the JIS standards. (For cable diameters, see Table 4-1.)

b) Clothing and protective gear

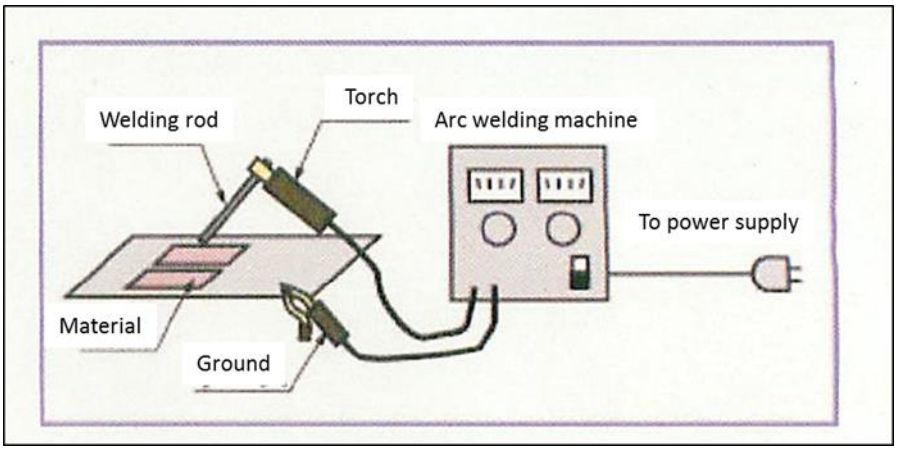
Observe the following precautions to avoid electric shock or burns:

① Wear dry, long-sleeved clothes and long pants. Use caution not to allow sweat to drip outside your clothing.

② Wear insulating safety shoes (with rubber soles).

③ Wear dry leather welding gloves when performing arc welding.

④ Use a welding visor with a colored glass plate that has the correct light shielding level for the working current. Put a piece of clean, transparent glass on each side of the colored glass plate.



Arc welding schematic diagram

Table 4-1 Relationship between working current and cable cross section

Secondary current	Recommended cable cross section
150 A or less	22 mm^2
250 A or less	38 mm^2
400 A or less	60 mm^2
600 A or less	100 mm^2

※) The rated duty cycle (working time) is 50%.

Chapter 5　High-Pressure Gas and Liquefied Gas

1) High-pressure gas

When manufacturing, storing, and using high-pressure gas, observe and comply with the High-Pressure Gas Safety Act, the High Pressure Gas Safety Regulations, and the Regulations for the Prevention of Hazards of the Kyoto University High-Pressure Gas Manufacturing Facilities (https://www.kyoto-u.ac.jp/uni_int/kitei/reiki_honbun/w002RG00000302.html) (in Japanese).

a) Handling precautions

Remember that general high-pressure gas cylinders with a capacity of 7m^3 have a gas filling pressure of 150 kgf/cm^2 (approx. 15 MPa). Take due caution when handling them.

① The Kyoto Prefecture High-Pressure Gas Container Safety Guidelines dictate that gas suppliers and gas consuming business operators (i.e., those who handle and/or use gas) should make sure that high-pressure containers (or cylinders) are provided on a rental basis, as a general rule, and that in principle the same gas container does not remain at the same business site (or the same storage location) for longer than one year. Return used containers immediately to the relevant gas supplier. Any gas container, whether fully or partially emptied, must be returned to the gas supplier after one year has passed. A pressure test of any gas cylinder is required every five years. Using any purchased gas cylinder beyond five years is not allowed without its undergoing a pressure test.

② Upon obtaining any filled high-pressure gas cylinder, register it with the Kyoto University Chemicals Registration System (KUCRS) without any delay.

③ When storing gas-filled cylinders in a laboratory, anchor the gas cylinder stands to both the wall and the floor. Then place each cylinder vertically on a stand, and use chains to secure the cylinder at the top and bottom. (Do not secure gas cylinders together using a single chain.)

④ When transporting a gas cylinder, use a dedicated gas cylinder hand cart (a gas cylinder carrier).

⑤ Pay attention to the temperature in the room at all times and especially during heating and any other operations that may affect the high-pressure gas cylinder's temperature. Do not allow the cylinder temperature to exceed 40 °C. In addition, keep gas cylinders out of direct sunlight and take measures to ensure adequate ventilation.

⑥ When handling high-pressure gas cylinders, keep in mind the following considerations concerning the contained gas: its toxicity, flammability, support of combustion, explosivity, and other possible hazards. (For example: carbon monoxide must not be allowed into the atmosphere where it can be inhaled because it binds with hemoglobin, thus endangering health. Carbon monoxide may only be handled in a draft chamber.)

⑦ As a general rule, do not use a high-pressure gas cylinder when it is lying on its side.

⑧ Do not use fire within 2 m around a cylinder containing a flammable gas or a gas (such as oxygen) that supports combustion, unless special measures are taken. In addition, do not place combustible or ignitable items within the area specified above.

⑨ Sufficient ventilation must be provided in a room when any inert gas is handled, in order to prevent oxygen deficiency.

⑩ When installing and/or using a pressure-reducing valve, obtain and follow the instructions of an experienced person.

⑪ The screw on a pressure-reducing regulator may have either left- or right-hand threads.

Use a pressure-reducing regulator that is appropriate to the type of gas used. Never use the regulator for one specific type of gas, for any other types of gas.

2) Liquefied gas

a) Handling liquid nitrogen and liquid helium

① When using any liquefied gas supplied by the Research Center for Low Temperature and Materials Sciences, make sure to attend the training course for cryogen users held by the Center every year and follow the instructions given.

② Remember that liquefied gas creates rapid cooling as it evaporates. Wear low-temperature gloves, as needed, when handling it, in order to prevent cryogenic burns. The use of wet gloves is strictly prohibited. In addition, the gloves must be easy to take off.

③ Do not allow bare hands to contact liquid nitrogen, liquid helium, or any low-temperature metal parts.

④ Remember that old liquid nitrogen always has some oxygen in it if stored for a long period of time. Because oxygen has a higher boiling point than nitrogen, the contents of a cylinder containing old liquid nitrogen could explode if they come in contact with an organic substance. Use extra caution when using old liquid nitrogen.

⑤ Take note that liquefied gases (liquid nitrogen, liquid helium) evaporate rapidly at ambient temperatures. Once evaporated, the volume of a liquefied gas expands to approximately 800 to 1,000 times greater than the original volume. This can pose a risk of explosion. A container of a liquefied gas must not be hermetically sealed, in order to prevent a potential explosion.

⑥ When transporting a container containing a liquefied gas on an elevator, use the specified elevator and observe the relevant rules for transport via elevator. No one is allowed to get on the same elevator as the one where the container is riding.

⑦ Nitrogen is a suffocating gas. Do not inhale vapor from liquid nitrogen.

⑧ A liquid helium container has a very small outlet, which can clog due to icing as the container containing the liquid helium is cooled in liquid nitrogen. If this happens, the evaporated helium gets trapped and can explode. Take special precautions when handling liquid helium containers.

⑨ Provide sufficient ventilation when using liquefied gases in a laboratory.

b) Handling liquid oxygen

Refer to the same precautions described in item a), and be careful to prevent cryogenic burns or explosions. Provide sufficient ventilation. Keep in mind the fact that liquid oxygen supports the combustion of other substances, and do not allow it to come into contact with oils or any other ignitable substances.

c) Handling liquefied carbon dioxide gas

① Normally, this gas is contained in high-pressure gas cylinders, so refer to 1) in this chapter for cautions regarding the handling of high-pressure gas.

② Refer to 2) a) in this chapter for cautions regarding frostbite, explosions, and ventilation. (CO_2 gas is heavier than air so in rooms with low ceilings it tends to accumulate at high concentration, and in some cases it can result in an oxygen deficit.)

③ When rapidly using the gas from a seamless container, dry ice may form within the container due to the latent heat from the vaporization of liquefied CO_2 gas. For this reason, as and when necessary, apply heat to prevent the formation of dry ice. For this heating, use a hot compress or warm water up to 40°C.

Notes

Classification of gases:

The High-Pressure Gas Safety Act classifies gases into the following four types:

➢ Inert gas: 9 types (including nitrogen, helium, argon, and carbon dioxide).

➢ Flammable gas: 39 types (including acetylene, hydrogen, and ammonia), and any other gas which meets the given explosion limit conditions.

➢ Toxic gas: 33 types (including carbon monoxide, hydrogen sulfide, ammonia, and sulfurous acid gas) and any gas with a threshold limit value (equivalent to an acceptable concentration) of 200 ppm or less.

➢ Specific high-pressure gas: 7 types (including arsine, disilane, diborane, and phosphine).

Cylinder color:

High-pressure gas cylinders are color-coded according to the types of gases:
Hydrogen (red), chlorine (yellow), carbon dioxide (green), oxygen (black), acetylene (brown), ammonia (white), other (gray)

Pressure-reducing regulator:

Generally, pressure-reducing regulators for high-pressure gases have left-hand thread screws for flammable gases and a right-hand thread screws for other types of gas. Although the screw on the helium gas regulator has left-hand threads, the thread pitch is different from that on the screw for the flammable gases regulator.

Chapter 6　Chemical Experiments and Chemicals

1) General precautions

Experiments are inherently hazardous by nature. Be aware of this and take adequate precautions to avoid accidents.

I. Plan your experiment carefully

Unrealistic time schedules are a common cause of accidents. Draw up a detailed plan of your experiment before you begin. Always follow your supervisor's directions, and schedule your experiments to finish within regular hours wherever possible. For experiments that will extend beyond regular hours, or will be conducted after hours, you are required to obtain permission from your supervisor first. Never work alone in the lab, even when working after hours. Always make arrangements to have another person present in the room with you.

II. Prepare for your experiment thoroughly

Be thorough when preparing for your experiment. In addition to checking the equipment and chemicals you will use, be sure to take adequate precautions with your attire. Always wear a long-sleeved lab coat when in the lab. Avoid wearing nylon or Tetron garments which will melt and adhere to the skin if set alight. Wear additional protective gears, such as gloves, safety glasses, and a mask, when necessary. Wear shoes that have closed heels, and note that flat shoes are preferred. Footwear such as sandals and slippers are not appropriate. High-heeled shoes are prohibited.

III. Know the hazards

While accidents cannot be predicted, the hazards an experiment poses can. For all experiments you undertake, familiar or not, it is vital that you make an accurate assessment of the hazards associated with your experiment, and take appropriate measures to deal with any and all emergency situations that may arise during the course of the experiment.

IV. Review your emergency procedures

Take note in advance of the location of gas taps, electrical switches, fire extinguishers, and emergency showers, and be sure to review their means of operation. Know the nearest escape route, the proper first-aid procedures, and who needs to be contacted in the event of an emergency.

V. Clean up with care

The final cleanup should be performed with the same care and diligence you afford every other stage of your experiment.

VI. Keep the lab tidy

A clean and tidy lab minimizes both the chance and severity of accidents.

2) Handling chemicals

Each chemical in use in your experiment will differ with regard to the amount required, its concentration, and its strength, and each chemical will pose a greater or lesser hazard in terms of its flammability, combustibility, toxicity, explosivity, and corrosivity. Every chemical, however, presents a danger to you and those around you.

Read the “Material Safety Data Sheet” (MSDS) for each and every chemical you will use before handling it, taking special note of its toxicity, properties, and form, and always heed your supervisor's instructions regarding its use.

a) Chemical hazards

Chemicals are classified by hazard into the types discussed below. However, attention should be drawn to the fact that the term “hazard” has several definitions.

① Hazardous materials

Hazardous substances: Any material that is easily ignitable, flammable, or explosive and that can cause a fire or explosion. However, the Japanese Fire Service Law designates any material with any properties that can lead to a fire as a hazardous substance. (The hazardous substances stipulated under the Fire Service Law are distinguished from hazardous substances as that term is used in a general sense. See the description below.)

High-pressure gas: Any gas under pressure that can cause a fire, an explosion or poisoning.

② Toxic substances

Harmful substances: A highly poisonous substance that can cause acute intoxication or is a hazard to health.

Pollutants: A substance that can have significantly adverse effects on human health or environmental conservation.

③ Hazardous chemicals

Hazardous chemicals are various substances specified by laws and ordinances.

i. Organic solvents: Class 1, Class 2, Class 3 (Ordinance on Prevention of Organic Solvent Poisoning)

ii. Specified chemical substances: Class 1, Class 2, Class 3 (Ordinance on Prevention of Hazards due to Specified Chemical Substances)

iii. Poisonous substances including specified poisonous substances (Poisonous and Deleterious Substances Control Act)

iv. Deleterious substances (Poisonous and Deleterious Substances Control Act)

v. Asbestos (Ordinance on Prevention of Health Impairment due to Asbestos)

vi. Hazardous substances (Fire Service Law): These are classified in terms of their type of hazard into six classes (Class 1 to Class 6), as shown in **Table 6-1**.

b) Precautions for dealing with chemicals

① Register any chemicals obtained for educational or research purposes (such as chemical agents, hazardous chemicals, or high-pressure gas), with the KUCRS.

② Manage chemicals properly in accordance with the Kyoto University Chemical Substance Management Regulations and Guidelines. (visit https://kananzen.sisetu.kyoto-u.ac.jp/spfcweb/kyoudai/anzen/ and click 8. and 2)-(1), (2).) (in Japanese)

③ The necessity of using highly hazardous substances (such as harmful, toxic, flammable, or explosive materials) and the availability of suitable alternatives must be fully reviewed at the experiment design stage. Efforts must be made to minimize the use of those substances through utilizing the KUCRS risk assessment function, especially when you use the 640 materials designated by the Industrial Safety and Health Law for the first time.

④ Follow appropriate safety measures on a routine basis, to prevent containers of chemicals from being damaged due to drops, falls, or collisions, especially keeping in mind the fact that earthquakes may occur. It is necessary to store and manage the containers safely so that, even if the containers should be damaged, no fires or explosions will take place as a result of spills or mixture of chemicals.
⑤ Do not eat, drink or smoke in any laboratory.
⑥ Always have protective clothing, glasses, masks, and gloves ready, and wear them whenever needed.
⑦ In a location where organic solvents or other hazardous substances are handled, ignition and explosion sources (such as flame, electrical sparks, intensely heated materials, static electricity, impacts, and friction) must be fully controlled to ensure safety. Fire extinguishing equipment must be available at all times.
⑧ Use special caution when handling organic solvents. Organic solvent vapor is usually heavier than air and spreads along the floor, so it can reach distant locations and catch fire or explode if it contacts an ignition source.
⑨ Provide sufficient ventilation when handling a chemical that can produce an explosive gas mixture of the chemical's vapor and air.
⑩ Any person who is engaged in handling harmful substances must undergo a special medical checkup once every six months.

c) Handling hazardous chemicals

The hazardous chemicals listed in item a) (3) must be handled with special caution.
① Do not use hazardous chemicals for purposes other than education or research work. These chemicals may not be taken off campus. If taking these chemicals off campus is absolutely unavoidable, the permission of the relevant supervisor must be obtained.
② When handling hazardous chemicals, take great care to prevent them from being splashed, leaked, misplaced or lost. The containers for these chemicals must be rugged and must have a secure cover or plug.
③ Do not dispose of hazardous chemicals in the general trash.
④ A laboratory where Class 1 and Class 2 organic solvents or specified chemical substances are used must not be used as a living space.
⑤ Poisonous and deleterious substances can only be handled by a person who has been registered with the KUCRS as a Poisonous and Deleterious Substances Handler. Every poisonous or deleterious substance must be stored in an individually lockable depository.
⑥ When handling Class 1 and Class 2 organic solvents and/or Class 1 and Class 2 specified chemical substances, use a local exhaust ventilation system with an enclosing hood (a draft chamber). The exhaust capacity of the draft chamber must be as follows: The capture velocity at the hood opening must be 0.4 m/s or more for organic solvents and 0.5 m/s or more for specified chemical substances.
These capture velocity values must be checked voluntarily every year, to prevent hazards.
⑦ The exhaust gas from a draft chamber where legally-specified harmful substances are used (such as organic solvents or specified chemical substances) must be released into the atmosphere according to legally-defined methods, such as rendering the exhaust gas harmless via exhaust-gas treatment equipment (e.g., a scrubber) before it is discharged. The exhaust gas must be treated by a combination of various techniques, such as aqueous cleaning, alkaline cleaning, activated carbon treatment, and whatever other methods are appropriate (including oxidation or incineration) as needed, and all possible measures must be taken to ensure that appropriate exhaust can be achieved.

3) Waste, waste liquids from experiments / laboratory wastewater, and unused chemicals

As a general rule, do not dispose of hazardous waste and chemicals (including cloth and paper impregnated with a significant amount of such chemicals) in a sink, at a garbage dump site, into a sewer, or into the atmosphere. They must be disposed of in accordance with Kyoto University's guidelines on waste disposal (visit https://kananzen.sisetu.kyoto-u.ac.jp/spfcweb/kyoudai/kankyo/ and click on 3 and 3)-(1)) (in Japanese).

a) Waste classifications

① Waste is classified as either general waste or industrial waste.

General waste: Refers to household trash and garbage from business establishments that are not industrial waste.

Industrial waste: Refers to materials disposed of by industries, chiefly business establishments. Industrial waste is further divided into ordinary industrial waste and specially-controlled industrial waste.

i) **Ordinary industrial waste**: Includes cinders, sludge (muddy discharge from a manufacturing process, such as carbide residue, muddy waste in building pits), waste oil (oil, tar pitch, etc. with a flash point at or above 70 °C), waste acid (acids with a pH of 2 or higher, for example, organic acids), waste alkali (alkaline fluids with a pH of 12.5 or lower), waste plastics, waster rubber, metal scrap, glass waste, demolition debris. An individual is allowed to have a contractor dispose of this type of industrial waste. Acid or alkali aqueous solutions (either clear or colored) may be discharged with a large amount of water, after being neutralized to around pH 7. Silica gels also fall under this category of industrial waste.

ii) **Specially-controlled industrial waste**: Includes waste oil (flammable and volatile oils, kerosene, light oils), waste acid with a pH of 2 or lower, waste alkali with a pH of 12.5 or higher, and infectious industrial waste (including injection needles). An individual is not allowed to have this type of industrial waste disposed of (or treated) at his/her discretion. Correct disposal requires performing the appropriate procedures in accordance with the specified rules. Waste liquids from experiments (organic and inorganic) and unused chemicals fall under the category of industrial waste. Within the category of Specially-Controlled Industrial Waste, that which is particularly hazardous is classified as Specified Hazardous Industrial Waste, which applies to PCBs and asbestos-related waste.

b) Waste liquids from experiments and laboratory wastewater

I. Organic waste liquids

The Kyoto University Faculty/Graduate School of Agriculture currently outsources the disposal of its organic waste liquids. Organic waste liquids are classified into the following four types. Each type of waste liquids is accumulated and stored separately and is retrieved at specified times and dates. (This requires any sediment in organic waste liquids be removed beforehand by filtration.)

1. Waste oil containing halogens
2. Waste oil without halogens
3. Dilute aqueous solution containing halogens
4. Dilute aqueous solution without halogens

Some specific criteria (or conditions) must still be met (for example, it cannot contain fluorine or mercury). For details, refer to “Precautions for the Disposition and Retrieval of Organic

Waste Liquids." To access the document, contact the Environment, Safety and Health Technology Office at the Graduate School of Agriculture where the document is on file.

II. Inorganic waste liquids

Inorganic waste liquids here refer to liquid waste that contains heavy metals, mercury, cyanogen, fluorine, or phosphoric acid. All of these types of waste liquids are, in principle, treated using the Inorganic Waste Liquids Treatment System (KMS) in Kyoto University at specified times and dates. (For the times/dates and other details, contact the supervisor designated as being in charge of treating inorganic waste liquids for the current year.)
Inorganic waste liquids must be accumulated and stored in Kyoto University-specified containers, individually for each content type. (A 20-liter blue plastic container must be used for heavy metal waste liquids; a 20-liter gray plastic container for all others. Waste liquid containing heavy metals must be accumulated in the form of an acid aqueous solution by dissolving the metals, usually in sulfuric acid). Any precipitates in the waste liquid must be removed before it is accumulated and stored.
For details about the Inorganic Waste Liquids Treatment System (KMS), refer to the Manual for the Kyoto University Inorganic Waste Liquids Treatment System.

III. Laboratory wastewater

① Aqueous solutions generated in a laboratory, such as ordinary acid/alkaline aqueous solutions and any liquid (aqueous solutions) used to clean laboratory instruments must be neutralized to around pH 7 before being discharged as wastewater.
②In particular, halogen-containing solvents such as dichloromethane are subject to strict emission standards, so they should not be discharged into laboratory wastewater.
③ Laboratory wastewater from each building on the Yoshida North Campus is fed to a corresponding reservoir where the pH value of the wastewater is monitored and checked. (The Faculty of Agriculture's main building has three pickup points for lab wastewater.) If the pH value in any of the reservoirs is found to be outside the specified pH range (4 to 10), an alarm will be activated. If this happens, the University will warn the Faculty of the problem. Depending on the situation, the Faculty may be required to investigate the cause and to submit a plan for corrective action. To avoid triggering such a sequence, it is therefore important to ensure that the wastewater is neutralized before discharge.

* All wastewater is currently sent from the reservoirs to the laboratory wastewater management building on the Yoshida North Campus. Then the wastewater is pH-adjusted to meet the standard specified by Kyoto City, before discharge.

c) Unused chemicals

"Unused chemicals" generally refers to:
・Chemicals previously procured for experiments, that remain unused after many years.
・Left-over chemicals for which proper disposal is preferable to long-term storage, for the sake of avoiding complications of a disaster.
・Chemicals that are not expected to be used in the future.

Because unused chemicals are classified as specially-controlled industrial waste, no individual is allowed to treat or dispose of this at his/her discretion. The Faculty/Graduate School of Agriculture has unused chemicals disposed of by an external contractor, so the relevant administrative procedures must be followed. For procedural details, consult the

Environment, Safety, and Health Technology Office of the Graduate School of Agriculture or the North Campus Safety Management Department (ext. 2254 or 3693).

Notes

Accidents Records (at Graduate School of Agriculture)

1. For purification of tetrahydrofuran (THF, Class 4 hazardous under the Fire Service Law) to pure water, they used potassium (Class 3, water-reactive substances hazardous under the Fire Service Law) for distillation and then, inactivated potassium residue inside of a fume hood. Normal procedure is to put the alcohol into the residual material for three hours. Once it turns to alkoxy potassium, add water to potassium hydroxide (KOH) and then proceed neutralization with acid. However, at that time, they added alcohol, transferred residual material in a bucket, and then rushed into watering in the bucket. Untreated potassium reacted with water, caused outbreak of hydrogen and went up in flames. Used an extinguisher, fire was stopped soon, however a fume hood's intake was burned. No one was injured in this accident.

☞This accident was caused by frapping fire with water in rush and without switch ing off fume hood when they used a fire extinguisher.

2. During the experiment in a fume hood, a glassware containing 100 mL of dichlo romethane was accidentally tilted and dichloromethane spilled.
Some dichloromethane flowed into the drain outlet of the draft, making the experi--mental wastewater unusable.
Finally, 2,160 liters of wastewater was pumped and the accident was reported to the Kyoto City Waterworks Bureau.

☞ The emission standard for dichloromethane is 0.2 mg/L.
This is the concentration of 1 mL leaking into 6,650 L of water.
Dichloromethane should never be flush into experimental wastewater.

3. Using diethyl ether for solvent, they were handing a soxhlet extractor. When the y shut a solvent cock, the cock was broken by accident. In order to repair the brok en part, they put a lighter close to the soxhlet extractor. This action caused diethyl ether to catch fire from the lighted lighter. Although it supposed to be used fire e xtinguisher, water was used to extinguish fire.

☞ This accident was caused by using ethanol which is highly inflammable (Class 4 hazardous under the Fire Service Law: the flash point -45℃, the boiling point.35℃, spontaneous ignition temperature 160℃) and putting burning material close to the ethanol.

4. For extraction of heavy metals in soil, hydrofluoric acid, perchloric acid and nitric acid were being heated on two 10A hotplates in a draft chamber using the power supply attached to the chamber. While the maximum current permitted in the attached power was 20A, a 15A autoclave was used in addition by mistake. This caused the circuit breaker of the chamber to operate, and led to leakage of gas emerging from reagent chemicals. No one was injured in this accident.

☞ It is important to check the maximum current permitted in the power supply and amperage of an electric instrument in advance, and to call attention by a notice.

Table 6-1. Hazardous substances stipulated under the Fire Service Law

Classification	Type	Substances	Properties	Fire prevention and fighting
Class 1	Oxidative solids	Sodium chlorate Potassium perchlorate (explosive) Sodium chlorite Potassium bromate Sodium peroxide Potassium permanganate Sodium bichromate Potassium iodate Potassium nitrite Ammonium nitrate Chromium trioxide Metaperiodic acid Other	May explode when subjected to heat, friction, or shock (sodium peroxide). Can promote combustion when mixed with flammables. May cause an explosion if shocked (sodium chlorate).	Avoid heat, friction, and shock. Do not allow contact with any substance that promotes decomposition. To fight a fire, use: Dry chemical fire extinguishers, a large volume of water, foam fire extinguishers, and/or dry sand.
Class 2	Flammable solids	Phosphorus sulfide Red phosphorus Sulfur Iron powder Aluminum powder Zinc powder Magnesium powder Solid alcohol, rubber cement Other	Highly flammable solids. Toxic gas is produced when phosphorus sulfide, red phosphorus, or sulfur burns.	Avoid contact with oxidants. Do not allow metal powder to contact water or acid to avoid chemical reaction. To fight a fire, use the same materials as above.
Class 3	Hypergolic substances and water-reactive substances	A. Hypergolic substances and water-reactive substances Potassium, sodium Alkylaluminum Alkyllithium Calcium, calcium phosphide Sodium hydride Lithium hydride B. Water-reactive substances Lithium Carbide C. Hypergolic substances Yellow phosphorus	Hypergolic substances ignite upon contact with oxygen in the air. Water-reactive substances ignite or generate flammable gas upon contact with water. (Sodium, potassium, calcium phosphide, etc.)	Avoid contact with water. To fight a fire, use special dry chemical fire extinguishers or dry sand. Do not allow hypergolic substances to contact air. Water and foam fire extinguishers are effective.

Classification	Type	Substances	Properties	Fire prevention and fighting
Class 4	Flammable liquids	Special flammable substances (Ignition point: -20 °C or lower) Diethyl ether Carbon bisulfide Acetaldehyde Propylene oxide, etc. Class 1 petroleum materials (Ignition point: 21 °C or lower) Gasoline Petroleum benzene Hexane Acetone Benzene Toluene, etc. Alcohols Methyl alcohol Ethyl alcohol Propyl alcohol Class 2 petroleum materials (Ignition point: lower than 70 °C) Kerosene, light oil Xylene, acetic acid, etc. Class 3 petroleum materials (Ignition point: 70 °C or higher) Heavy oil, glycerin Gear oil, etc. Oil extracted from animals and plants Canola oil, coconut oil, sesame oil, etc.	Flammable and combustible liquids. The vapors from these liquids are heavier than air and tend to trail along the floor, so they can reach distant locations and catch fire or explode upon contact with an ignition source. Special flammable substances have a very low ignition point. Extra caution should be used to prevent ignition.	Keep away from flames, sparks, high-temperature objects. To fight a fire, use foam fire extinguishers, dry chemical fire extinguishers, CO2 fire extinguishers, halogen fire extinguishers, and/or dry sand.
Class 5	Auto-reactive substances	Benzoyl peroxide Cellulose nitrate Picric acid Trinitrotoluene (TNT) Sodium azide Hydrazine sulfate Guanidine sulfate Azobisisobutyronitrile Other	Can burn without oxygen. May explode from heat, friction or impact.	Use water or dry sand to fight a fire.
Class 6	Oxidative liquids	Perchloric acid Hydrogen peroxide Iodine pentafluoride Nitric acid Sulfuric acid Other	Highly oxidative. May generate heat or fire upon contact with flammables.	Avoid contact with flammables, or any substances that promote decomposition. To fight a fire, use water or foam fire extinguishers, or dry sand.

Chapter 7　Chemical Experiment Apparatus

Here we describe pressure vessels and centrifuges, which are apparatuses commonly used for chemical experiments. Failure to observe the cautions below may lead to serious accidents.

1) Pressure vessels (autoclaves)

Pressure vessels (not including high-pressure gas cylinders) are pressure-resistant devices or containers that are designed to contain substances at high pressures. A high-pressure steam sterilizer is frequently referred to as an autoclave. It consists of a vessel (often a cylinder-shaped tank) to which water is added, and which is then subjected to pressure and heat in order to generate steam.
The process of using a high-pressure steam sterilizer to perform sterilization is known as "autoclaving."

a) Cautions when working with pressure vessels (autoclaves)

Since the heat source, vessel structure, and pressure control method for an autoclave vary according to the design and manufacture, it is essential that operation is in accordance with the particular model being used. Firstly, make sure to understand the construction of the autoclave you are using and to read the operation manual. In particular, take careful note about exactly where the high-pressure steam that is generated in normal use is discharged, i.e., the location of exhaust vents, exhaust valves, pressure control valves, etc. Also, since the pressure gauge is the most important element of the product, always check that it is working properly and accurately. During operation, if you ever suspect that there is any problem or abnormality, immediately stop the heating process.

At this graduate school and faculty there have been quite a few accidents and injuries involving the use of autoclaves or handling of sterilized materials immediately after autoclaving. It is vital to recognize that high-temperature and high-pressure steam and the very hot liquids that tend to bump during autoclaving are very dangerous.

Below, we consider the use of a small-scale autoclave with electric heating regulation for sterilization, in order to point out things to be cautious about.

①Before use, always check the level of the water used for sterilization inside the vessel. If the water is below the prescribed level, add more water to top it up the appropriate level. (Both the heater and also the bottom plate of the vessel should be submerged in water.)
②If the material to be sterilized is not stored within a sterilization basket or other kind of container, take care that the openings of exhaust vents or safety valves inside the vessel are not blocked, and that no significant pressure is applied to temperature sensors.
③Make sure the cover of the autoclave is securely locked in place.
④The body and cover of the autoclave become very hot during use, so take care to avoid touching them.
⑤During sterilization do not stay (stand) directly in front of the cover.
⑥During sterilization (while the inside of the vessel is pressurized), never open the cover. Any slight opening between the cover and vessel will result in the ejection of high-temperature, high-pressure steam, which can cause serious burns.
⑦After the prescribed heat-sterilization time has elapsed, heating stops automatically. However, always wait for the pressure inside the vessel and the temperature of the vessel to decrease naturally before handling. Reducing the pressure by operating the exhaust valve

while the vessel is still pressurized may cause the liquid culture medium or other sterilized material to bump, or the culture medium container to rupture due to the sudden change in pressure or temperature. Some autoclaves feature functions to rapidly reduce the vessel temperature and pressure by forced cooling of the vessel exterior using fans. It is essential to understand, however, that using such functions increases the temperature difference between the vessel and the sterilized material, which increases the risk that the sterilized material bumps when it is taken out of the autoclave.

⑧When removing the sterilized material, open the cover slowly after checking that the temperature inside the vessel has dropped to 80°C or lower (85°C or lower in the case of some models) and that the pressure inside the vessel has dropped to 0 kgf/cm^2 through the release of steam from inside the vessel. When removing the material, make sure to wear gloves and long-sleeved clothing for protection against high temperatures. It is also important to be fully aware that the vessel temperature displayed on the machine and the temperature of the sterilized material will be different. This is particularly important when there is a large quantity of sterilized material, or when the material is a liquid having a high specific heat or high viscosity.

2) Centrifuges

There are several types of centrifuge designed for different applications and featuring various kinds of rotors. Each kind of rotor has a specific capacity and a maximum rotational speed, so it is necessary to select the optimum kind for the purposes of your experimental work. Using the wrong type of rotor can result in serious accidents, or the loss of precious samples, so always exercise great care about this.

a) Types of centrifuge

I) Low-speed centrifuge

This type of centrifuge has a maximum rotational speed of around 3,000 rpm and is used for separation of relatively large particles within a test sample. Some models are equipped to cool the sample.

II) High-speed refrigerated centrifuge

This type of centrifuge has a maximum rotational speed of around 20,000 rpm and is equipped with a powerful refrigerator to prevent the temperature of the test sample from rising as a result of friction due to contact with air. It is used for samples that require cooling and for the separation of particles that cannot be separated using a low-speed centrifuge. There are models that also reduce the pressure (to approximately 0.5 atm) within the rotor housing.

III) Ultracentrifuge

This type of centrifuge has a maximum rotational speed of one hundred thousands of rpm and the capability of generating centrifugal forces of eight hundred thousands of g (g = gravitational acceleration). By rotating the rotor at extremely high speed, this design can generate a high vacuum within the rotor housing. It is used for the separation of microsomes, proteins, and other substances that necessitate extremely high centrifugal forces. There are models that are very compact and enable rapid centrifugation of minute test samples.

IV) Compact tabletop centrifuge

This compact type of centrifuge can be used on a test bench. There are a low-speed centrifuge and a high-speed refrigerated centrifuge. Usually a small centrifuge tube or a microtube can be used according to the centrifuge machine.

b) Types of rotor

I) Fixed angle rotor (angle rotor)

This is a heavy rotor so its handling requires caution. There are many types that vary in terms of the angle of the centrifuge tube relative to the drive axis and the capacity. It is important to note that the maximum speed varies according to the type of rotor.

II) Horizontal rotor (swinging rotor)

Buckets in which centrifuge tubes are inserted swing along with the rotation of the rotor in the direction of centrifugation, remaining horizontal. Since the buckets always move in the direction of centripetal force, the samples do not swirl up and their density gradient is not disturbed, so these centrifuges are mainly used for separation using the technique of density gradient centrifugation. Some models have a fixed maximum rotational speed.

III) Vertical rotor (vertical tube rotor)

This is a special kind of rotor, used for rapid separation of materials by high-speed density gradient centrifugation.

c) Cautions when handling centrifuges

①Select a suitable centrifuge tube that is compatible with the rotor of centrifuge in terms of size and load capacity, and by judging whether or not chemical resistance to the rot by solvent used and sterilization are necessary.

②When using heavy rotors such as large angle rotors, careful consideration needs to be given to how to store, carry, and attach them to centrifuges. The storage place in particular should be carefully chosen; it should not be too low or too high, but rather at about waist height.

③In the case of swinging rotors, when placing buckets on rotor pins (attaching buckets to a rotor), it is important to check that the movement is smooth.

④After adding test samples to centrifuge tubes, and before setting the tubes on the rotor, ensure that a balance is achieved by placing pairs of samples of the same weight (including the weight of the cover, if any) on the rotor. If there is an odd number of samples so that there is one sample left over, balance the weight by using a centrifuge tube containing the same solvent being used, or water. (If the weights are not balanced the axis of rotation will deviate during centrifugation.)

⑤When setting a centrifuge tube containing a sample on the rotor, always add a tube containing something of the same weight (for balance) at the diametrically opposed position with respect the center of rotation. However, in the case of adding three samples to a rotor with six positions, use samples of the same weight and place them at intervals of 120°, so that they will counterbalance each other.

⑥After the setup procedure is finished and you have started the centrifuge, pay careful attention to any rotation noise or vibration until the meter indicates that the preset speed has been reached. (Never leave the centrifuge unattended during this acceleration phase.)

⑦If you notice any abnormality, immediately stop operation. (Continuing operation in this case can lead to a serious accident.)

⑧During centrifugation, always monitor the centrifuge regularly, checking the speed and temperature.

⑨When you have finished using the centrifuge, thoroughly clean the inside and outside of the rotor, and the rotor housing. This is one of the most important elements of centrifuge care.

MEMO Pressure units conversion

MPa N / mm^2	Pa N / m^2	Mdyn / cm^2 bar	kgf / cm^2 at	lbf / in^2 psi	Std. pressure atm	Mercury column mmHg
1	1×10^{6}	10	10.2	145	9.87	7500
1×10^{-6}	1	1×10^{-5}	1.02×10^{-5}	1.45×10^{-4}	9.87×10^{-6}	7.50×10^{-3}
0.1	1×10^{4}	1	1.092	14.5	0.987	736
9.81×10^{-2}	9.81×10^{4}	0.981	1	14.2	0.968	722
6.90×10^{-3}	6900	6.90×10^{-2}	7.03×10^{-2}	1	6.81×10^{-2}	51.7
0.101	101×10^{3}	1.01	1.03	14.7	1	760
1.33×10^{-4}	133	1.33×10^{-3}	1.36×10^{-3}	1.93×10^{-2}	1.32×10^{-3}	1

Figures displayed to 3 significant figures.

The relationship between hectopascals (hPa) and millibars (mbar), the units currently and previously used by the Japan Meteorological Agency to denote atmosphere pressure, is 1 hPa = 1 mbar.

Chapter 8　Explosions

An explosion is a phenomenon which involves the bursting of a container due to a rapid occurrence or release of pressure, or involves a rapid expansion of gas that has a destructive effect on the surroundings, and also a huge noise.

1) Types of explosion

Explosions are classified into either physical burst phenomena (such as the explosion of vacuum bottles or boilers) or chemical explosions (such as an explosion of gas, dust, or explosives).

2) Physical explosions

Physical explosions are the result of intense outbreak and liberation of the pressure induced by physical processes such as the expansion of liquids or gases, or the change in phase of liquids.

3) Chemical explosions

Chemical explosions are the result of violent exothermic reactions, such as chemical combustion or decomposition. If combustion starts when thermal energy is supplied to a gaseous mixture of flammable gas and air (containing 21% oxygen) within a closed container, further heat of combustion will be generated. The resulting temperature increase will lead to increased pressure, which will in turn lead to a rapid acceleration of the combustion rate, and finally explosive combustion. This is known as non-stationary combustion or explosive combustion.

a) Flammable gases

Flammable gases include hydrogen, utility gas, diborane (boron hydride: a gas with an unpleasant odor), arsine (arsenic hydride: a highly toxic gas), etc. The gas itself burns intensely.

b) Flammable liquids

Flammable liquids (including organic solvents), such as gasoline, kerosene, light oil, ether, alcohols, and acetone, do not burn by themselves. Combustion occurs when a flammable gas, which is vaporized (or evaporated) from the surface of a flammable liquid, becomes mixed with air and if an ignition source is present that has a sufficient amount of heat to cause ignition. Whether or not combustion occurs depends upon the ratio of gas and air in the mixture. The mixture ratio (expressed in the concentration of the flammable gas in the air) has a range, which is referred to as the flammable range (explosive range or explosive limit). The highest concentration of the range is called the upper limit; the lowest concentration of the range is called the lower limit. (See Table 7-1.)

c) Reactive compounds

Reactive compounds refer to compounds that generate a large amount of energy when they decompose rapidly. This type of compound includes nitroglycerin, nitromethane, organic peroxide, hydroxylamine, azid compound, etc.

4) Handling explosive gases and flammable liquids

① An abundance of caution must be applied when handling any explosive gases and flammable liquids. Handle them under the supervision of a qualified instructor or supervisor, in a laboratory equipped with a ventilation fan. Only a licensed Specified High Pressure Gas Handling Supervisor is allowed to handle mono-silane.

② Acetylene, diacetylene, monovinyl acetylene, and ethylene oxide may spontaneously decompose and explode even if unmixed with air or oxygen, if there is sufficient energy to

promote ignition (such as pressure).Handling these substances involves risks. Those who handle them must receive the instructions of a supervisor who has sufficient technical knowledge.

③ When handling sodium azide or other explosive substances, follow the instructions of the person responsible for experiments and laboratory work (or the relevant supervisor).

Table 8-1 Explosive limits of typical flammable gases (percent by volume in air)

Flammable gas	Lower limit	Upper limit
Hydrogen	4.5	75
Carbon monoxide	12.5	74
Acetylene	2.5	100
Ethylether	1.9	48
Acetaldehyde	4.1	55
Gasoline	1.3	7.6
Kerosene	1.2	6.0

Notes

Examples of explosion accidents on campus

1. While an alkylation reaction was performed using a pressure-resistant glass container, the heat of the reaction caused the pressure in the container to rise and an explosion occurred. Injury to an arm resulted.
(→ Attention must be paid to the reaction temperature at all times.)

2. The second example case concerns the Curtius rearrangement reaction using diphenylphosphoryl azide. This organic chemistry experiment was intended to synthesize 1,2-cyclohexanediamine hydrochloride from 1,2-cyclohexandicarboxylic acid. The experiment got to the point where the intermediate product (1,2-Cyclohexanedicarbonyl azide) was extracted and concentrated. The experimenter put a stirring bar in the flask. When he looked away from the flask briefly to prepare for the next action, the flask burst and its contents splashed. Of the six people in the laboratory, one suffered cuts to his face and neck from flying glass fragments. Another complained of ringing in the ears due to the noise of the explosion.
(→ Although the intermediate product is relatively stable, it can explode if mixed with transition metals as impurities. The probable cause of the explosion is that the stirring bar was not clean enough and was contaminated with a small amount of transition metal. The amount of material used in the experiment was on the order of 10 grams. This demonstrates that dangerous experiments must be designed with as small an amount of material as practicable.)

Chapter 9　Handling Radiation and Radioisotopes

1) General precautions

Radioisotopes (RI) and X-ray equipment (hereafter referred to as “radioisotopes, etc.”) must be handled in accordance with the Regulations for Preventing Radiation Hazards at Kyoto University (https://www.kyoto-u.ac.jp/uni_int/kitei/reiki_honbun/w002RG00000310.html) (in Japanese). The Graduate School of Agriculture has in place the Kyoto University Graduate School of Agriculture’s Regulations for the Prevention of Radiation Hazards, to prevent radiation hazards due to radioisotopes, etc. while ensuring safety inside and outside the Faculty. Radiation emitted from radioisotopes, etc. cannot be detected with the ordinary senses. Even a slight exposure to radiation is thought to have some effect on living organisms. Improper use can cause serious radiation hazards. If any contamination with radioisotopes occurs, it will have a significant effect not only on the person handling the material, but on others and the environment. Therefore, the use of radioisotopes, etc. requires a carefully-deliberated plan and implementation, with top priority given to ensuring the safety of not only the person handling the material but also the people and environment in and around the site of use.

2) Registration and retraining of those who handle radioisotopes, etc.

① The need for registration

Anyone who handles radioisotopes, etc. must be registered to do so. No one except those so registered is allowed to handle radioisotopes, etc. Those who want to register must apply for training and a medical checkup, and must go through any other necessary procedures. Those who only wish to handle X-ray equipment must apply for registration as an X-Ray Equipment Handler, using the same procedures as above.

② The need for retraining

All those who are registered must participate in a retraining program held by the Graduate School of Agriculture (or any relevant department) every year after their first year of registration. In addition, those registered must keep their knowledge up-to-date and seek out new knowledge and techniques regarding the use of radioisotopes, etc., by attending training sessions and any other relevant events held by the Agency for Health, Safety and Environment, Kyoto University.

3) Precautions to take when handling radioisotopes (RIs)

① Radioisotopes must be handled at specified locations using specified methods. Do not use RIs anywhere else, and do not use any other methods than those specified. Handle RIs in the prescribed manner, under the direct instructions of an experienced handler with abundant experience using RIs, as well as the directions from the Radiation Protection Supervisor, the Radiation Protection Deputy Supervisor, and/or any other relevant personnel, and follow those instructions and directions faithfully.

② Wear a personal dosimeter, such as a glass badge, during experiments in order to measure any individual radiation exposure. In addition, use a radiation meter, such as a survey meter, as needed to measure the dose rate in the work environment.
③ Efforts must be made to keep radiation exposure as low as possible. To achieve this, conduct a "cold" or rehearsal run to find any problems and make any needed improvements to the methods of use.
④ The handling of RIs must always be recorded in the prescribed manner.
⑤ If any doubts or questions arise, consult an abundantly experienced RI handler immediately. When a consultation is provided, the consultant handler must report the nature of the consultation to the Radiation Protection Supervisor and the Radiation Protection Deputy Supervisor.

4) Precautions to take when operating radiation-emitting equipment*
① When operating radiation emitting equipment, wear a glass badge and take all other necessary protective measures. Operate the equipment in the prescribed manner, under the direct instructions of an experienced handler with abundant experience operating the equipment, as well as the directions of the Radiation Protection Supervisor, the Radiation Protection Deputy Supervisor, and/or any other relevant personnel, and follow those instructions and directions faithfully.
② When entering a facility where radiation emitting equipment is to be used, check interlocks and any other safety functions for proper operation.
③ Before irradiation, make sure that no one is in the area to be irradiated.
④ While irradiation is in progress, post a sign at the entrance/exit of the room to clearly indicate that irradiation is being carried out inside.
⑤ The distribution chart (map) for the dose rate previously measured during operation of the radiation emitting equipment is available in the room where the equipment is housed. Prior to using the equipment, review the map fully to work out safe experiment plans.
⑥ Operation of radiation emitting equipment must always be recorded in the prescribed manner.
⑦ Records must be kept concerning the storage of radiation sources.
⑧ If any doubts or questions arise, consult an experienced handler with abundant experience operating the equipment immediately. When a consultation is provided, the consultant handler must report the nature of the consultation to the Radiation Protection Supervisor and the Radiation Protection Deputy Supervisor.

5) Precautions to take when operating equipment containing sealed radioisotopes
① Operate the equipment in the prescribed manner, under the direct instructions of an experienced handler with abundant experience operating the equipment, and/or any other relevant personnel.
② Maintain the equipment in proper operating condition, in order to prevent any radioisotope leaks.
③ Manage sealed radiation sources correctly to prevent them from being lost.

④ Operation of the equipment must always be recorded in the prescribed manner.
⑤ Records must be kept concerning the storage of radiation sources.
⑥ Disassembly of equipment that will involve exposure of radiation sources must not be performed.
⑦ If any doubts or questions arise, consult an experienced handler with abundant experience operating the equipment immediately. When a consultation is provided, the consultant handler must report the nature of the consultation to the Radiation Protection Supervisor.

6) Precautions to take when operating X-ray equipment

The X-ray equipment covered here includes:
1) Equipment that generates less-than-1-mega-electron-volt X-rays (including electron beams, the same applies hereafter) and that has a rated voltage of 10 kV or more, or any other equipment that incidentally produces X-rays that are equivalent to the ones described above.
2) Electron microscopes with a rated voltage of 100 kV or more.

① When operating X-ray equipment, wear a glass badge for X-rays and take any other necessary protective measures. Operate the equipment in the prescribed manner, under the direct instructions of an abundantly experienced handler of that equipment, the Operations Deputy Chief of Radiography with X-Rays, and/or any other relevant personnel.
② Operation of the equipment must always be recorded in the prescribed manner.
③ The distribution chart (map) for the dose rate previously measured during operation of the X-ray equipment (including electron microscopes) is available in the room where the equipment is housed. Prior to using the equipment, review the map fully to work out safe experiment plans. Low-voltage electron microscopes with an acceleration voltage of 300 kV or less approved by the Kyoto University Agency for Health, Safety and Environment may not necessarily need to follow the above operating procedures ①–③ (for further details, please see Kyoto University's guidelines on radioisotope equipment operations at:
https://www.rirc.kyoto-u.ac.jp/~esho/var/xraysys/index.php?id=rule (in Japanese).
④ If any doubts or questions arise, consult an experienced handler with abundant experience operating the equipment immediately. When a consultation is provided, the consultant handler must report the nature of the consultation to the Operations Deputy Chief of Radiography with X-Rays and the Radiation Protection Supervisor.

7) Compliance with the relevant laws and regulations, and arrangements to ensure safety

Those who handle radioisotopes, etc. must be familiar with and observe the Act concerning Prevention of Radiation Hazards due to Radioisotopes, etc.; the Regulations for Preventing Radiation Hazards in Kyoto University; the Radiation Hazards Prevention Regulations of the Kyoto University Graduate School of Agriculture; this Safety Guide; and all other arrangements made for each facility that uses radioisotopes, etc., with the objective of ensuring safety.

8) Health oversight of people who handle radioisotopes, etc.

Those who handle radioisotopes, etc. must receive a special medical checkup designed for such conditions, before starting to deal with them (i.e., before registration) and periodically once every six months thereafter, or more often.

9) Actions to take in the event of an accident or hazard

Any person who discovers a problem with a facility using radioisotopes, etc. or related equipment must first take emergency measures, and then immediately report for instructions, according to the emergency contact list.

In addition, anyone who has identified any of the following events related to radioisotopes, etc. must report it to the Dean and the Radiation Protection Supervisor.

i) Theft or loss of RIs, or RI contamination or any other accident

ii) The occurrence or potential occurrence of a radiation hazard in the event of an earthquake, fire, flood, and other disaster.

Chapter 10　Laboratory Animals and Microorganisms

Life science experiments (involving humans, animals/plants, microorganisms, or tissue-derived cells/substances, etc.) require close consideration of ethical and safety issues.
When importing animals/plants or microorganisms from overseas that are subject to regulation under the Act on Domestic Animal Infectious Diseases Control or the Plant Protection Act, permission must be obtained from the Minister of Agriculture, Forestry and Fisheries.
In addition, microorganisms subject to regulation under the Plant Protection Act require the submission of a report detailing the results of an annual inspection by the Plant Protection Station.
When alien species that are designated as "invasive alien species" are reared, or handled in any of the specified ways, permission must be obtained from the Minister of Health, Labour and Welfare or the Minister of the Environment, in accordance with the Invasive Alien Species Act.

1) Handling laboratory animals

The laboratory animals that may be studied by the Faculty/Graduate School of Agriculture include the following two types: wild animals, and narrowly defined laboratory animals that are artificially bred in pure lines. Wild animals can include all vertebrates and invertebrates, so it is difficult to cover them all in this Safety Guide. An important point common to both types of animals is that rearers and researchers must fully familiarize themselves with the characteristics of animals they are handling. Here, only laboratory animals will be discussed in this Guide.

a) Rearing laboratory animals

Only a small number of laboratory animal species, such as rabbits, guinea pigs, rats, mice, cows, sheep, chickens, pigs, African clawed frogs, drosophila (fruit flies), and silkworms, can be raised by the Faculty/Graduate School of Agriculture. Raising other laboratory animals, such as monkeys, dogs, and cats, requires specific facilities appropriate to each animal type so scrupulous preparation must be made before undertaking such research. Meticulous attention must be paid to assure that the laboratory animals remain healthy. To deal safely with laboratory animals, the handlers need to maintain cleanliness and be well acquainted with the correct manner of handling the animals. For details, refer to the technical literature for each relevant type of lab animals. ("Laboratory Animal Rearing Management and Procedures," Soft Science Inc., 1979).
Extreme care must be taken to protect the laboratory animals being raised against infection with mad cow disease (BSE), swine flu, or bird flu, which have recently been identified as serious sources of concern.

b) Safety of the handlers

Regarding the safety of those handling laboratory animals, this section will, in particular, discuss hemorrhagic fever with renal syndrome (HFRS), which may be transmitted to the handlers by way of rats. HFRS viruses are known to be highly pathogenic to humans, and are characterized by a high fever with renal involvement that can cause death.

Many wild rodents are potential carriers of HFRS viruses, which can be directly or indirectly transmitted to lab rats via wild rodents that live near the lab rats' living quarters. It is therefore best to avoid rearing rats if it is not possible to get rid of wild rodents near where they are housed.
Even when a seemingly safe environment is available, blood testing of the animals is essential before they are placed in that environment. The points to remember are 1) when purchasing commercially-available rats, the rats must be ones that are shipped immediately after testing and they must be purchased from as reliable a supplier as possible, and 2) when obtaining non-commercial rats, i.e., from other researchers, prior consultation must be sought with the relevant facility for animal experiments at Kyoto University Hospital, to obtain information regarding any necessary testing of the rats to be obtained.
Moreover, those who use rats in experiments must attend the relevant training session dealing with rat-transmitted diseases and receive a medical checkup, prior to use. If experiments using rats continue for a long period of time, the training session and medical checkup must be repeated on a regular basis.

c) Preliminary review of the plan for an experiment

Animal experiments are subject to a preliminary review of the plan for the experiment, which must be created in accordance with the Kyoto University Guidelines for Animal Experiments, the Faculty/Graduate School of Agriculture Guidelines for Animal Experiments, and any other relevant requirements.

2) Handling microorganisms

The Faculty/Graduate School of Agriculture only uses bacteria and viruses that have a low pathogenicity to human, primarily as subjects or technical material for molecular biology studies, and it is rare to conduct a full head-on study of the pathogenicity of such microorganisms. Given the complexity of dealing with any possible accidents, it is prudent for the Faculty of Agriculture to avoid studying the pathogenicity of human-pathogenic microorganisms. If such a study is unavoidable, it must be performed in close cooperation with medical personnel.
The foregoing notwithstanding, it can be said that there are no microorganisms that are completely irrelevant to considerations of pathogenicity. Some of the precautions to take when conducting experiments using microorganisms are:
① Do not allow any microorganisms to mix into other experimental materials.
② Mark each microorganism container with the name of the microorganism, the name of the person handling it, the date, and any other necessary information, before storage.
③ Use containers specifically designed for storing microorganisms, to prevent the microorganism from escaping.
④ Wear the specified lab coat during experiments.
⑤ Never use your mouth to suck liquid into a pipette.
⑥ Sterilize used lab instruments and bacteria culture media using an autoclave or other appropriate means, before washing or disposing of them.
⑦ Make sure the cap on the centrifugal tube is secured before centrifuging.
⑧ Wash your hands after experiments.

3) Recombinant DNA experiments (Genetic engineering experiments)

① Before conducting recombinant DNA experiments, submit a plan to the Kyoto University Recombinant DNA Experiment Safety Control Committee for review, and have it approved by the President, in accordance with the Kyoto University Recombinant DNA Experiment Safety Control Regulations, etc. (hereafter referred to as the "Recombinant DNA Experiment Control Regulations, etc." Refer to Chapter 6 of the Kyoto University Regulations List at https://www.kyoto-u.ac.jp/uni_int/kitei/reiki_mokuji/r_taikei_main.html) (in Japanese).

② Prior to embarking on recombinant DNA experiments, the relevant training must be received in accordance with the Recombinant DNA Experiment Control Regulations, etc. Then the experiments must be carried out with scrupulous attention to safety, using the lab equipment and facilities that are appropriate to the level of the experiment, in order to prevent accidents.

③ When storing or transporting test samples and/or waste containing genetically-engineered organisms, etc., the person responsible for the experiment or those designated by the responsible person must adhere to the instructions set forth in the "Recombinant DNA Experiment Control Regulations" etc.

Chapter 11　Working with VDTs

Nowadays everyone has their own computer. This means everyone spends time in front of a VDT (Visual Display Terminal).
Use of VDTs may cause fatigue according to:
・ Intensity of work
・ Density of work
・ Time period of work
・ Mental concentration
・ The type of work
・ How frequently breaks are taken

Health issues of the following types may be caused by the use of VDTs:
Muscle aches, decreased muscle strength, stiffness or other disorders of the neck or shoulders or arms, eyestrain, chronic eye fatigue.

Keep the following points in mind when using a VDT:
・ Sufficient lighting and luminance (at least 300 lux)
・ Avoid screen glare
・ Comfortable work posture (desk and chair height adjustment)
・ Work no more than four hours at a stretch
・ Take a 10-minute break after each hour of work
It is up to each individual to monitor and manage his or her own health.

Chapter 12　Fieldwork

Unlike work that is done on campus, field work and field research involve exposure to various other types of risks, and special precautions are necessary.

1) General precautions for fieldwork
① Create a thorough plan of the actual work in advance.
② There are always risks, so be sure to obtain accident insurance and life insurance.
③ At this time, traffic accidents are the most common type of accident occurring during fieldwork. Be especially careful when driving in an unfamiliar area. Never set plans that may exhaust you. If you are involved in a traffic accident, always contact the police.
④ During fieldwork, you may have to enter dangerous areas or perform dangerous activities. Stay constantly alert. Safety gear, such as a helmet, must be worn in some situations.
⑤ There may be high humidity levels in underground observation rooms or other settings, causing risk of short circuits. Always wear rubber boots or other footwear that provide good insulation.
⑥ Stay informed about the characteristics of dangerous animals (poisonous snakes, bees, sharks, etc.), and be prepared and knowledgeable for dealing with an incident (know how to use blood serum, how to get to a hospital, etc.).
i) In an area where pit vipers or other poisonous snakes may be present, always wear shin guards and high boots.
ii) In an area frequented by bears, carry a hand bell or other device for giving an alarm signal. This is especially important around brown bears in Hokkaido.
iii) As much as possible, avoid contact with plant thorns and with hazardous plants such as the lacquer tree. Use gloves and arm coverings. Wear shirts, jackets and pants with tight cuffs. Any loose cuffs must be pulled tight to avoid exposing skin.
ⅳ) Wasps become most active through September to October, and the accidents reported to the university also concentrates during these two months. When working near the grass or woods, refrain from exposing skin and provoking the wasps by, for example, shaking them off or yelling at them, and leave the place promptly but quietly. It is recommended for those who have been stung by wasps to check if you have an allergy to wasp toxin in advance. In the case you may have a severe allergic reaction, it is desirable to take an automatic syringe (Epinephrine autoinjector) with you under a doctor's guidance.
⑦ There may be emergency situations when it is not possible to call an ambulance. You must know some first-aid. Always carry emergency medical supplies.
⑧ Use a radio or other medium to stay constantly aware of weather conditions.
i) Suspend fieldwork when dangerous weather such as a typhoon, heavy rain, or blizzard is predicted.
ii) When thunder is audible or thunderclouds are approaching, stop working, remove all equipment and tools from your body, and immediately retreat to a suitable location.
Safe locations include a ground depression or inside a vehicle. (Stay away from tall trees.)

⑨ As much as possible, do not do fieldwork alone in a hazardous location or at night. If you must work alone, give somebody advance notice of your work location and be absolutely sure to remain in contact, using a mobile phone or transceiver or other medium.
i) Do not do fieldwork alone in a wooded or hilly area, because there is a risk of falling and being injured and unable to move. If you must work alone, be sure to carry a mobile phone or transceiver.
ii) When a team is working at different levels on a steep slope, everyone must be careful not to dislodge rocks or other material that could fall down the slope.
iii) A steep slope may be slippery during and after rainfall. Bring crampons or spiked shoes to prevent slipping.
⑩ Always practice fire safety.
i) Before lighting an open fire, remove all flammable material from the vicinity. Do not leave the fire site until the fire is fully out. Extinguish the fire by throwing soil or water on it, and make certain that it is dead. In very dry conditions when there is a high risk of fire, do not light an open fire.
ii) Limit smoking to a prescribed smoking area, taking care not to start a fire. Extinguish matches and cigarette butts with water, and dispose of them properly (a smoker should carry a portable ash holder).
⑪ During the heat of the day, avoid working continuously for a long period. Take regular rest breaks.

2) Fieldwork in the mountains
① Wear a hat, long-sleeved clothes, long pants, and climbing shoes, and carry rain gear. Remember that the temperature drops an average of 6 °C for every 1000 meters climbed, and carry enough warm clothing.
② Carry enough clothing, including a change of clothes, to cope with sudden weather changes.
③ When working near a cliff or rock wall, wear a helmet.
④ Carry a pack cover to protect your pack from rain.
⑤ Commonly required equipment includes insect repellent, mask, work gloves, rubber gloves, goggles, sunglasses, compass, map, hammer, scoop, field note, sample gloves, mobile phone, and GPS device.
⑥ Carry enough water, food and equipment to cover an emergency situation. For example, when a day of work is planned but a wrong turn is taken the outing may extend past sunset, so always carry flashlights. Consider carrying a bivouac sac or light tent in case it becomes necessary to bivouac the night in the mountains.
⑦ Near mountain ridges and peaks the weather typically changes sharply after about 2:00 p.m. Plan to start climbing early and return early to a lower elevation.
⑧ When traveling as a group, station experienced persons at the front and rear of the file, to make sure the rear does not fall too far behind and the group does not become scattered.
⑨ For activities that involve camping, rock climbing or snowy mountain terrain, complete equipment and constant vigilance are required. There must always be an experienced person in the group.
⑩ When working near a cliff or on a rocky slope, always beware of falling rocks.
⑪ When it is raining or rainfall is predicted, streams flowing from the mountains may rise so they cannot be crossed, and flash flooding may occur. Stay away from streams whenever there is flood danger.
⑫ During a group activity, if someone is unable to keep pace due to fatigue, ill health or injury, that person must be closely accompanied at all times, and consideration should be given to

suspending the activity.
⑬ Avoid camping or bivouacking on a ridgeline, where the wind is likely to be dangerously strong. Try to find a sheltered location.
⑭ If you are lost in the mountains, do not wander aimlessly about. Moving without any clear plan may add to fatigue and increase the risk of falling. Instead, remain within sight of one another while awaiting assistance. Never descend to a stream when lost.
⑮ Driving on mountain roads requires both experience and caution, as many roads are rough and have unstable shoulders. Avoid excessive speed.

3) Fieldwork along the coast
a) Fieldwork on beaches and rocky coastlines
When working along coastal beaches and rocks, there is a risk of injury from unexpected items such as oyster shells. Use the following precautions for fieldwork.
① Wear shoes or diving boots in the field, not sandals. Wear gloves. When possible wear a wetsuit.
② To guard against sunburn and sunstroke, keep the skin covered and wear a hat or other head covering.
③ Be aware of risks from sea animals, including sharp-edged shells and sea urchins that may be attached to rocks, poisonous fish (such as the aigo spinefoot, haokoze waspfish, striped eel catfish, or stingrays), and sharp-toothed fish (such as moray eels or sharks).
④ Waves include a mixture of waves of various heights. Statistically, one in every hundred or so will be twice the average height, and one in every thousand will be about three times the average height. Such “freak waves” are common and it is not unheard of for them to sweep people away. Caution is required. Consider assigning a team member as a lookout.
⑤ A person wearing high boots or waders who falls over in the water may have great difficulty regaining a footing. Caution is required. An inexperienced person should never act alone in the water.
⑥ Always check weather and tide predictions before working, and plan the survey accordingly.

b) Diving
Be mindful that danger is always close by when diving. Never dive alone. Take the following precautions.
① Only qualified divers may engage in diving. Diving survey work is limited to persons possessing a diving license and certification card, as well as some diving experience (20 tanks is a common minimum standard). A participant with no diving experience must obtain a diving license and certification card, and receive appropriate practical instruction from an experienced diving survey participant.
② When preparing the diving fieldwork plan (with detailed locations, schedules, etc.), consult people who know the area well, and coordinate as necessary with the local fishery cooperative, tourism association, or other concerned organizations.
③ Before diving, perform safety checks on the following kinds of equipment:
・ Depth gauges: Submerge the gauge in the ocean to check accuracy.
・ Dive timers: Check clock accuracy and watertightness.
・ Regulators: Make sure the annual inspection has been completed. Regularly perform thorough desalination.
④ Before diving, always do stretches or other warm-up exercises.
⑤ In the water, each diver should wear a wetsuit or drysuit, and carry a dive timer, a depth gauge, a sharp knife, and emergency equipment including a signal float. For a deep dive (20

meters or deeper), always use a dive computer.
⑥ When entry is from a ship, display the international signal flag A (alpha), or deploy a separate lookout vessel to warn other vessels in the vicinity to proceed carefully. Station a watchperson aboard the vessel. The watchperson should be very familiar with rescue equipment and should be prepared to enter the water during an emergency. Safety gear aboard the vessel should include a descent line, life ring, and radio equipment.
⑦ Always notify personal emergency contacts (research colleagues and families), and the staff of any cooperating facilities near the fieldwork location (such as a marine research center or dive shop) of the precise diving location and schedule and the nature of the fieldwork. After the diving is completed, immediately contact each of the notified persons. If a vehicle is left near the entry point, leave the above information easily visible inside the vehicle.
⑧ Do not dive alone. Be sure the work will not overburden the divers.
⑨ Residual pressure in the oxygen tank should be at least 50 bar. However, that minimum does not apply for shallow diving.
⑩ After a deep dive, make the safety stop during ascent as long as enough air supply is available (three minutes at six meters deep is a common standard).
⑪ Minimize alcohol consumption on the day of a deep dive.
⑫ After diving, use the dive computer to schedule air travel and other activities.
⑬ During diving fieldwork, pay close attention to weather reports. Do not try to accomplish too much during bad weather (strong storm, high waves, etc.).
⑭ All participants in diving fieldwork should carefully monitor their physical condition, to notice any effects of water pressure changes or other factors. Avoid excessive exertion.

c) Fieldwork aboard a ship or other craft
I) General information
① Field researchers should consider themselves to be members of the ship's crew. Some behavior that would be permissible for a passenger is not permissible for a crew member. Each of the following items is to be thoroughly performed.
② Before leaving shore, complete all necessary discussions between the captain and crew of the ship, and the leader and members of the fieldwork team, as well as between the fieldwork leader and the team members. Regarding any matter that arises while at sea, engage in discussion only after returning to shore. Never engage in discussion or argument while aboard ship.
③ Team members must be courteous at all times, and must comply with the orders and instructions of the captain, the crew, and the fieldwork leader. Objection to an order or instruction is useless and inappropriate.
④ Always keep a humble attitude toward the ocean. Know your own capacities, and avoid overconfidence. Never place yourself in a situation that feels dangerous.
⑤ If an unexpected situation arises, do not panic. Assess the circumstances calmly and take appropriate actions, based on the preparedness that has been acquired through training and practice sessions.
⑥ Operate the ship or other craft in compliance with all applicable regulations.

II) Before leaving shore
① Prepare the Survey Plan well in advance of the scheduled departure date, and present and explain it to the captain.
Complete all necessary discussions with the captain at that time.
② Before leaving shore, notify the university office of the following: survey name (indicating

the nature of the survey), leader's name, nature of the fieldwork, ocean location, team member names, scheduled date of return, and emergency contact procedures.
③ Prepare a list of all survey instruments and other equipment and supplies. Before loading the boat, confirm that everything is on hand and in working order. No additional items will be available at sea, so be sure to bring ample amounts of everything required.

④ Load everything on the vessel well before the departure time, and double-check the equipment list.
⑤ Carefully arrange the on-deck survey equipment. Items that can blow away or be damaged by water should be below deck or stored in secure containers.
⑥ Place no unnecessary items on deck or in a corridor below deck.
⑦ Wear casual clothing that allows free movement. As a rule, wear long sleeves and trousers to keep the skin covered.
⑧ Wear lifejackets as needed, and as required under applicable laws. Be prepared for winter even in summer. Always be prepared for rain, with a rain jacket, winter jacket, towel, etc. close at hand.
⑨ Wear a hat or headband to protect the head and keep the hair out of the eyes. Put on a helmet before starting any activity where there is a risk.
⑩ Wear high boots or sneakers with non-slip soles.
⑪ Never be late for a team meeting. Be sure to arrive five minutes early.

III) Safe navigation and ethical behavior
① Be thorough and cautious when entering or leaving a harbor or dropping anchor. Always remain vigilant concerning the safe navigation of the ship.
② Being on a boat always involves risks. Falling overboard is a serious, life-threatening risk. Be extremely careful in stormy weather. Never forget that falling overboard tends to happen when it is least expected. To avoid falling overboard:
・Do not sit at the edge of the ship. Never drop your vigilance near the edge of the ship, or on deck near the stern (rear).
・Always have a plan for responding to sudden pitching motion.
・Hold the railing when walking in a passageway at the side of the ship.
・Do not draw water from the sea while the boat is moving.
③ To avoid injury, always mind your head and your step. Sometimes just a small injury can cause the termination of a survey voyage.
④ Strive to remain fully alert at all times aboard the ship. Do not move around aimlessly.
⑤ While the ship is moving, regardless of whether survey work is under way, always be mindful of your proper task.
⑥ On a small vessel, be careful not to upset the vessel's balance. While it is moving, remain seated in a lowered posture. Avoid sudden movements, and avoid gathering in one place.
⑦ Placement of survey equipment and collections also must be done with awareness of the vessel's balance. Make sure that none of the equipment can fall or blow away. Tie it down whenever necessary.
⑧ Smoking aboard ship is discouraged. Never smoke outside the designated smoking area. Be extremely cautious on an outboard motorboat, where gasoline leakage from the tank or piping is not uncommon.

⑨ To avoid a slippery deck, always keep the deck drain clear and clean.
⑩ Upon noticing any situation or information that could affect the safe navigation of the vessel, report it to the captain with full and precise details. If the captain is busy with other tasks, keep a lookout around the vessel yourself, in lieu of the vessel command.
⑪ Place yourself where you will not obstruct the vision of the ship's operators. Keep an eye in the direction of the operator's blind spot.
⑫ When operating an outboard motorboat, there is a risk of moving inappropriately and falling. To prevent surges or loss of control, connect the shutoff cord to the emergency shutoff knob with a cord or strap.
⑬ Never throw trash into the ocean.

IV) Survey activities at sea
① Mechanical noises at sea make it difficult to hear voices. Always speak loudly when conveying instructions or other important information. Likewise, after receiving instructions, speak loudly to acknowledge or repeat them.
② Never forget that survey work aboard ship involves some risk, and you are responsible for your own physical safety.
③ Always wear a helmet and life jacket during survey work aboard ship.
④ Remember that seasickness can impair judgment and physical capacity.
⑤ Work in a high place or work done with the body's center of gravity beyond the edge of the ship may only be performed by persons designated by the captain.
⑥ Operation of a winch, capstan or side roller, and hoisting of a heavy object are hazardous work, to be performed only by persons designated by the captain.
⑦ When a winch, capstan or side roller is being used, be very careful to avoid any chance of your body or clothing becoming tangled in the machinery or ropes or wires.
⑧ Place yourself where you will not obstruct the vision of the operator of a winch, capstan or side roller. Keep an eye on the wires and ropes in the operator's blind spot, and shout out immediately if you notice anything unusual.
⑨ When an instrument, net or other object suspended by a rope or wire becomes visible in the ocean, shout out "mieta" ("sighted") to inform the operator. When the object reaches the ocean surface, shout out "kaimen" ("surface").
⑩ Take care not to wander beneath the derrick boom when a heavy load is suspended.
⑪ Do not place hands or feet beneath a suspended heavy object.
⑫ Do not place hands or feet inside a rope coil. A suddenly closing rope can cause injury or drag a person overboard.
⑬ Do not wander close to a strongly tensioned wire or rope.
⑭ When in the vicinity of a strongly tensioned wire or rope, always be aware of the direction of greatest danger if it were to snap, and position yourself in a safe spot.
⑮ Do not over-tighten a rope or cause it to rub against an angular object.
⑯ Do not allow survey equipment or other objects to fall into the sea. A messenger weight is especially susceptible to being dropped. Stow objects in a rack or other secure location, as anything left carelessly on deck may fall over or fall overboard if the ship pitches.
⑰ Always arrange a rope neatly so it can be played out easily when needed.
⑱ Help others and work cooperatively so the tasks can be smoothly accomplished.
⑲ To prevent undue risks, choose days with calm weather and calm seas for survey work, and heed official warnings concerning weather or sea conditions.
⑳ Pay close attention to weather and sea conditions during survey work. Suspend work during bad weather. Also, immediately suspend work when any danger is recognized. Post a

lookout during survey work to watch for ship traffic or other nearby activity. If the survey work appears likely to interfere with the navigation of another vessel, take appropriate measures to reposition the survey ship.

V) After returning to shore
① After the boat has stopped at the pier, do not go ashore until permission is given.
② Complete the landing tasks, and wash the decks.
③ Immediately wash, desalinate and dry the equipment, then stow it in the storage area.
④ Be sure to report any damage or malfunction to the captain or the faculty member in charge of equipment.
⑤ The boat's furnishings or equipment may not be taken off the boat. If it is absolutely necessary to borrow something from the boat, get the captain's permission, and return it as soon as the task is completed.

VI) Miscellaneous precautions
① Violation of fishery regulations is strictly prohibited.
② In case of an accident or disaster, take emergency measures and proceed quickly toward safety.

4) Fieldwork outside Japan
For fieldwork outside Japan, in addition to the above precautions, the following precautions are necessary.
a) General safety measures
① In foreign countries in general, incidents of pickpocketing, purse snatching and theft are more common than in Japan. Be especially cautious about evening excursions or romantic-sounding invitations. When it is necessary to go out in a city after dark, always use a car.
② Before going to sleep in a hotel, identify the fire exit location and evacuation route.
③ Mobile phones and transceivers may be used in foreign countries, but models designed for the Japanese market will not work elsewhere. Each country has its own communications regulations, which should be researched in advance.
④ Familiarize yourself with the customs of the host country. Be especially careful about taking photos. In some countries, photos of stations, bridges, ports, etc. are prohibited for security reasons. Also, depending on local customs, people may become quite upset if their photo is taken.
⑤ In a politically unstable country, if a coup or public disturbance should occur, take care not to become involved in any way.

b) Health precautions
① Illness due to tainted food or insect bites is common. Beware especially of parasites, viral hepatitis, malaria, and infectious diseases. In some cases it may be advisable to take preventive steps before leaving Japan.
② Register with a flying doctor service if it is available in the host country. (This is a type of insurance, with an annual membership fee of only a few tens of dollars. With this service, a physician comes to a remote location and sees you in case of serious illness.)
③ It is advisable to carry more emergency equipment and basic medicines than when traveling in Japan. A supply of disposable syringes and needles may also be expedient, to avoid possible infection with hepatitis or HIV virus.
④ The stress of adapting to new environments, both natural (temperature and humidity) and

social (diet and customs), may cause a buildup of fatigue. Constantly monitor your health.
⑤ A travel-related illness may arise weeks or months after returning home. Receive medical checkups as needed.

c) Safety information
Obtain safety information for your destination from the Ministry of Foreign Affairs travel advisory page (https://www.mofa.go.jp/mofaj/toko/) (in Japanese). For health information, consult the Osaka Quarantine Station (https://www.forth.go.jp/keneki/osaka/) (in Japanese). Health facilities near the university which provide immunizations are listed on the faculty website (https://www.kais.kyoto-u.ac.jp/english/student/safety/).
It is also advisable to check with government or commercial offices in the host country for additional information on health protection measures.
In case of a serious accident, inform the nearest Japanese consulate.

Notes

School procedures for overseas travel

I. Notifying the school of travel plans

When planning to travel overseas for research, academic meetings, fieldwork or a course of study, submit the following documents to the Student Affairs Office. Forms are available at the Graduate School of Agriculture website (https://www.kais.kyoto-u.ac.jp/english/procedures/voyagereport/).

1. Notification of Overseas Travel (Form 9);
2. Letter of Reason of Overseas Travel: a written statement of the travel (in any format) prepared by the traveler's academic supervisor: required for a stay exceeding three month;
3. Written Notice of Student Overseas Travel (Form 3);
4. Pledge: *Pledge aims to make the students aware of personal safety while researching, surveying or studying abroad; and
5. Travel Insurance Certificate/Statement (either photocopy or PDF copy).

II. Travel insurance

Be sure to obtain travel insurance to cover such unforeseeable situations during the travel period. It is recommended by the university to take out Study Abroad Insurance Coupled with Personal Accident Insurance for Students Pursuing Education and Research (Gakkensai) or AIU Overseas Travel Insurance. Medical treatment and patient transportation in foreign countries may incur extremely high expenses, and in those cases credit card travel insurance might be unable to provide prompt services and/or emergency reunion coverage, due to the low amount of compensation.

III. .Overseas Residential Registration and *Tabireji*

It is requested by Japan's Ministry of Foreign Affairs that Japanese nationals planning to stay overseas for more than three months apply for Overseas Residential Registration (ORR) without exception and that those for less than three months register with *Tabireji.* Please either apply for ORR or register with *tabireji* when traveling overseas. For details, please see the links below:

ORR (for those who stay overseas more than three months due to studying abroad etc)
https://www.mofa.go.jp/mofaj/toko/todoke/zairyu/index.html

Tabireji (for those who stay overseas less than three months)
https://www.ezairyu.mofa.go.jp/tabireg/

Chapter 13　Management of Environment, Safety and Health at the Graduate School of Agriculture

Persons employed by the National University Corporation, Kyoto University are guaranteed the right to a safe and healthy workplace under the Industrial Safety and Health Law. To fulfill the various compliance obligations and applicable regulations, the University has established a system to implement and maintain suitable working environments.

Safety throughout the university is the responsibility of the Kyoto University Agency for Health, Safety and Environment. The Director-General of the Organization is also the chair of the Environment, Safety, and Health Committee, which investigates and deliberates matters relating to the safety of the university staff, health and hygiene, and environmental protection.

The Graduate School of Agriculture has established the Graduate School of Agriculture Environment, Safety, and Health Committee to deal in an integrated fashion with issues concerning environment, safety and health. To support smooth functioning, the Committee has established the Subcommittee on Safety and Health and the Subcommittee on Management of Chemicals.

The Industrial Safety and Health Law requires the establishment of a health committee for each workplace. Each Workplace Health Committee investigates and deliberates measures for the prevention of hazards and health problems in the workplace, which are implemented by the general safety and health manager. The Graduate School of Agriculture is divided into two workplaces, at Yoshida and Uji, and the persons working at each location are independently supervised by their respective Health Committee. The Workplace Health Committee arranges periodic inspection tours by industrial physicians to check the safety and health management systems at each work area. In addition, for each workplace a health officer is appointed, to perform inspections of safety, hygiene and health conditions. Each health officer appointed by the Graduate School of Agriculture makes periodic inspection tours of work areas, points out situations that require improvement or review, and requests appropriate changes, and also serves as a member of the Graduate School of Agriculture Environment, Safety, and Health Committee and participates in its administrative operation. In addition, assistants who are qualified specialists in various areas of health management are appointed to support the health officer in making inspections. Figure 12-1 shows the correspondences between the Kyoto University environment, safety and health management framework and the management system stipulated by the Industrial Safety and Health Law.

Inspection tours by the health officer and assistant health officers are conducted with a checklist format (Table 12-1 is a current checklist), covering the maintenance of safe and healthy work environments and the stimulation of employee awareness of safety and health. The checklist is important as concrete proof, even in the unlikely event of an accident, that constant efforts are made to maintain safety and health. In the Graduate School of Agriculture, the assistant health officers specialized in various fields perform safety and health management inspections based on the checklists every three months, and collate the results for submission to the Environment, Safety, and Health Technology Office of the Graduate School.

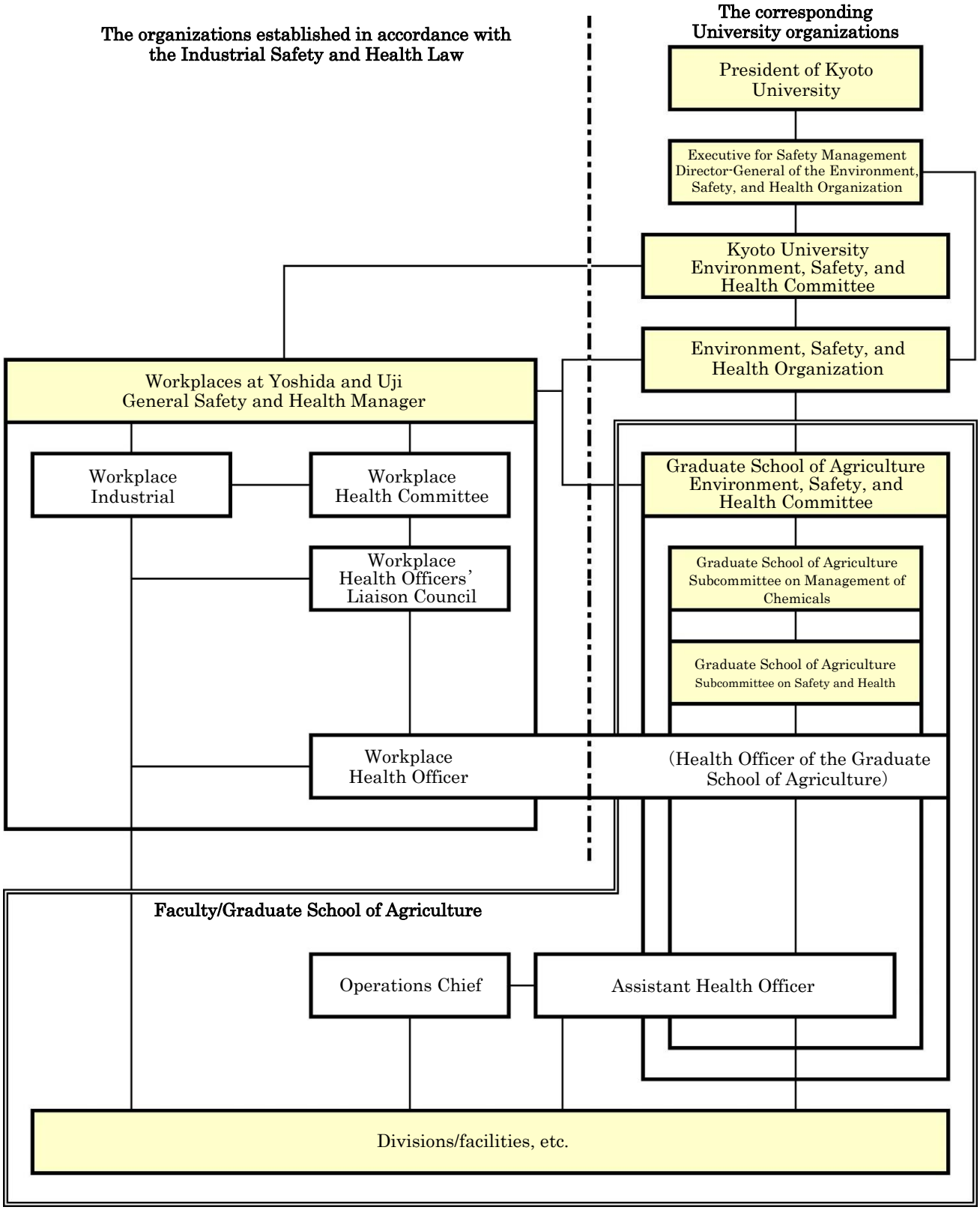


Figure 13-1: The Graduate School of Agriculture's Safety and He alth Management Organizational Chart

Table 13-1 The Graduate School of Agriculture's Safety and Health Inspection Check List

Date of check:

Building name: Division:

Laboratory: Checked by:

Room No. / Name / Item to check						
	Needs improvement	Description	Needs improvement	Description	Needs improvement	Description
Safe passage						
Regular pedestrian walkways	No / Yes		No / Yes		No / Yes	
Evacuation routes	No / Yes		No / Yes		No / Yes	
Indoor lights and daylight	No / Yes		No / Yes		No / Yes	
Ventilation	No / Yes		No / Yes		No / Yes	
Electrical						
Wiring (indoors)	No / Yes		No / Yes		No / Yes	
Wiring (outdoors)	No / Yes		No / Yes		No / Yes	
VDTs in use						
Location	No / Yes		No / Yes		No / Yes	
Work posture, etc.	No / Yes		No / Yes		No / Yes	
Room order and organization	No / Yes		No / Yes		No / Yes	
Faculty and student clothing	No / Yes		No / Yes		No / Yes	
Shoes	No / Yes		No / Yes		No / Yes	
Protective equipment	No / Yes		No / Yes		No / Yes	
Order and organization of laboratory facilities	No / Yes		No / Yes		No / Yes	
Work spaces	No / Yes		No / Yes		No / Yes	
Draft chamber present	No / Yes		No / Yes		No / Yes	
Exhaust gas treatment	No / Yes		No / Yes		No / Yes	
Gas cylinders properly secured	No / Yes		No / Yes		No / Yes	
Registration of gas cylinders with KUCRS	No / Yes		No / Yes		No / Yes	
Being used as a living space	No / Yes		No / Yes		No / Yes	
Corridors clear and tidy	No / Yes		No / Yes		No / Yes	
Registration of chemicals with KUCRS	No / Yes		No / Yes		No / Yes	
Power tools, etc. in use	No / Yes		No / Yes		No / Yes	
Chemicals in use	Storage Use		Storage Use		Storage Use	
Poisonous and deleterious substances	No / Yes / No / Yes		No / Yes / No / Yes		No / Yes / No / Yes	
Specified chemical substances	No / Yes / No / Yes		No / Yes / No / Yes		No / Yes / No / Yes	
Other organic solvents	No / Yes / No / Yes		No / Yes / No / Yes		No / Yes / No / Yes	
General chemicals	No / Yes / No / Yes		No / Yes / No / Yes		No / Yes / No / Yes	
Other hazardous substances	No / Yes		No / Yes		No / Yes	
Special notes						

Literature

Chemicals

KAGAKUDOJIN	:	"How to Conduct Experiments Safely"
	:	"A Sequel to How to Conduct Experiments Safely"
SANKYO PUBLISHING	:	"Preventing Hazards in Chemical Laboratories"
	:	"Pollution and Poisonous/Hazardous Substances – Inorganic Substances"
	:	"Pollution and Poisonous/Hazardous Substances – Organic Substances"
MARUZEN	:	"Safety Guidelines for Chemicals 2nd Edition"
	:	"Chemical Handbook – Advanced Application"

Biochemistry

KAGAKUDOJIN: "Biochemistry Guide 5 – Biohazard Prevention Act (1986)"
FUJITA KIKAKU SHUPPAN: "Sterilization and Disinfection Manual (1982)"

Disaster mitigation

SOGO BOUSAI SHUPPAN: "Fire Protection Guidelines I & II"

Radioisotope hazard prevention

MARUZEN: "Isotope Handbook (New Edition)"
Ohmsha: "The Radioisotope Handler's Companion"

Waste disposal

Kyoto City Sanitation Bureau: "Guide to Proper Disposal of Medical Waste (1994)"

High-pressure gas

Kyoto Prefecture: "Kyoto Prefecture Guidelines for High-Pressure Gas Container Safety Measures (June 2008)"

Comprehensive disaster mitigation

"Kyoto University Safety and Health Management Guidelines (Standard) Revised Edition (2016 ed.)"
"Kyoto University Chemical Substance Measurement Regulations and Implementation Guidelines (Established in February, 2007)"

Fieldwork

Tokyo University Division for Environment, Health and Safety:
"Guidelines for Fieldwork Safety and Health Management & Accident Prevention at Universities and Research Institutions (April, 2011)"

Reference: Examples of Accidents and Injuries on Campus

A person opened a hydrogen sulfide gas cylinder to start an experiment. Because he/she failed to follow the proper procedure before opening it, gas leaked from the pipe joint.
☞ The shutoff valve had been left open in the previous experiment to purge the pipe. The person opened the gas cylinder without closing the shutoff valve (or checking to make sure the shutoff valve was closed). This allowed the hydrogen sulfide gas on the primary pressure side to flow into the pipe line. A check valve was installed downstream from the cylinder's shutoff valve, as a preventive action.

A person was heating and melting agar media in a narrow-mouthed bottle using a microwave oven. He/She took the bottle out of the oven. When he/she attempted to shred the agar, the contents burped violently out of the vessel and burned his/her thigh.
☞ Uniform heat distribution is difficult to achieve in a microwave oven. The cause of this accident was the great temperature gradient that existed between the bottle's surface and the center of the agar.

While 1-propyl-3-methylimidazolium chloride and anhydrous hydrogen fluoride were allowed to react in a fluoroplastic reaction tube, the reaction progressed so rapidly that the pressure in the tube rose sharply. This disconnected the joint of the tube and the chemical (the reaction liquid) splashed into the face and onto the thighs of the experimenter.
☞ There was a manometer in use. However, this accident happened because a valve somewhere along the pipe was closed, so abnormal pressure built up in the tube.

A large volume (500 ml) of lithium aluminum hydride was brought into a draft chamber. While the solution was being divided into smaller containers, a small amount was spilled in the draft chamber and was allowed to contact water droplets, causing vapor to be released. No injuries occurred in this instance.
☞ Lithium aluminum hydride falls under the category of water-reactive substances, which are Class 3 hazardous substances as stipulated in the Fire Service Law, and it is violently reactive with water.

A person fell 18 meters from a meteorological tower during observations overseas and suffered a severe injury.
☞ Fall-prevention (non-slip) plates were not attached to the scaffolds of the tower and no other safety measures were taken. The person fell while walking down the stairs for a break, with the safety belt lock released.

In an attempt to open a glass desiccator, a person applied extra force to the lid. The lid flew off and broke on the table and his/her left hand was injured.
☞ Those who handle desiccators must familiarize themselves with how to handle them properly.

When a person tried to remove a Dimroth condenser (a glass tube) from a rubber tube, the nozzle of the condenser broke. He/She suffered a cut on his/her hand.
☞ Take care during all operations in experiments.

While operating a grass mower in the hot sun, a person suffered heat stroke.

☞ Frequent drinks of water and salt supplementation are required in a hot environment.

While cutting weeds with a sickle using his/her right hand and while wearing cotton work gloves, a person accidentally cut his/her left index finger with the sickle blade.
☞ The person probably swung the sickle too hard, because he/she had a false sense of security from the facts that he/she was wearing gloves and he/she was familiar with the work.

While conducting field research on birds in Indonesia, a person fell sick with a high fever. He/She was diagnosed as a result of a blood test as having dengue fever.
☞ Dengue fever is a transient febrile disease, which is a viral infection transmitted by the *Aedes aegypti* mosquito. Dengue fever is endemic to Southeast Asia, India, and Central America. Before going on a research trip, it is necessary to gather necessary information and knowledge about the country or region where the research is to be conducted.

A person heated a platinum tube to 900°C during an experiment. After turning off the heater switch, he/she attempted to straighten out a bend in the tube. He/She touched the tube with his/her bare hands before it cooled down sufficiently, and suffered a burn.
☞ Attention must always be paid to the temperature of objects in the experimental environment.

A person found xylene leaking from an alcohol tank. To prevent xylene gas from flowing into another room, he/she closed all the windows and doors of the room, and turned on the fan. While collecting the leaked xylene, he/she developed a headache and nausea.
☞ The cause of the leak was that the container was not appropriate for the application. Sufficient ventilation must be provided in a room where organic solvents are used.

A person was cleaning and polishing a mill roller for a plastic-forming experiment, and he/she was wearing cotton work gloves. He/She by mistake pressed the wrong switch so that the roller started to turn in the reverse direction. His/Her fingers got caught in the roller and he/she suffered crush fractures.
☞ One mistake was that he/she was wearing gloves. However, the more serious mistakes were that he/she flipped the wrong switch and failed to double-check before operating it.

A person stung his/her finger with a syringe needle by mistake when he/she recapped it after use.
☞ Syringe needles should not be recapped but be immediately put into a special disposal container.

A fire started probably due to an electric immersion heater left on a wooden shelf with its power on. No one was injured in this accident.
☞ It is highly recommended to avoid as much as possible using electric immersion heaters which cannot adjust the temperature and have a danger of overheating. Instead, it is advised to use ready-made water baths with safety functions such as interrupting electric current when overheated, for instance. Also and in principle, experiments must be conducted by two or more persons and, every time leaving the room after experiments, they must carry out multiple safety checks such as whether the power supply is shut off, chemicals are not left outside shelves and the like.

In addition to these examples, similar accidents have frequently occurred due to mere carelessness. As a result, some have had chemicals splashed into their eyes or onto their face. Some have gotten cut hands while working with glass that broke or got a piece of broken glass stuck in their hand. In most cases, the injured person failed to wear protective glasses, gloves, or other appropriate personal protective equipment.
It is very important to be fully aware of **the necessity of wearing personal protective equipment**.

During a mouse experiment in the laboratory, a researcher was bitten while holding mice by their tails.

☞ Pay more attention while handling laboratory mice; also hand protection must be worn as the need arises.

A fire started in a beaker with reagents in a safety cabinet, and the flames spread through the safety cabinet and ignited a researcher's clothes. It is thought that the fire was due to combustion of paraffin, which was being melted in the beaker on a hotplate stirrer, and it overheated.

☞ Heated stirrers must have a temperature sensor and temperature setting function. Alternative heating methods that do not require gas must be adopted. Also, researchers must recheck the directions for using heating equipment and precautions, and the director must provide training on how to respond in the unexpected case of combustion and flames.

There is a fire that was caused by spontaneous combustion of reacting palladium alloy nanoparticles in the presence of methanol in an unattended fume hood, and the fire spread to dry filter papers in funnels attached to a tank for hydrous organic waste treatment.

☞ Pay attention to both handling and disposal methods of materials associated with a fire risk. In the case of solid wastes with an intrinsic fire risk, avoid contact of these chemical materials, dispose individually, and fully seal waste to be disposed, in order to avoid desiccation.

Experiments involving heating with a reflux system were carried out unattended throughout the night, and the connection between the cooling pipe and the cooling water hose came loose. Consequently, water leaked onto the floor, a corridor, and into a laboratory downstairs as well.

☞ When leaving experiments unattended in the laboratory, do not set up heating reflux experiments using tap water. Instead, consider using a closed circulation system for cooling water.