Safety Manual

安全のてびき

2022

上智大学理工安全委員会

In case of an accident requiring an ambulance

Occurrence of accident

1 **Call #3000 (Guard Station at Main Gate)** — 24-hour response

Health Center #3396 — 9:00～17:00

Notify the following:

1. Location of accident (XXX Building, Room XXX)
2. Details of accident, degree of injury, number of injured persons

2 Designate attendant/Designate who should wait and who should serve as contact person

Contact information

Contact information	TEL （on campus）	TEL （off campus）
Department office		

3 Designate hospital (hospital to be decided upon consultation with emergency personnel)

Keio University Hospital	03-3353-1211
Tokyo Women's Medical University Hospital	03-3353-8111
Surugadai Nihon University Hospital (Surugadai)	03-3293-1711
Tokyo Metropolitan Police Hospital	03-5343-5611
Japan Community Healthcare Organization Tokyo Shinjuku Medical Center (former Tokyo Kosei Nenkin Hospital)	03-3269-8111
Tokyo Teishin Hospital	03-5214-7111

4 After arrival at hospital, the attendant calls the family and the contact person

5 Post-accident report → Student Center #3523

In case of an accident with relatively mild injury

(injured but able to walk, e.g., small cuts, minor burns)

- Kei-Ai Clinic (Internal Medicine) (Yotsuya 1-chome 20-23 Kei-Ai-Bldg. 3F) 03-5269-2111
- Midori-no-Mori Dermatology Clinic (Yotsuya 1-chome 2-4) 03-3352-4100

Non-office hours: Call emergency room of hospital listed above to receive instructions.

This sheet is located at Cybozu of Faculty of Science and Technology. Provide contact information in accordance with the actual situation of each laboratory and post it at the laboratory entrance, etc.

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Preface

Education and research at the Faculty of Science and Technology encompasses a wide range of experiments and observations, which probably is an obvious fact to students pursuing studies in the Faculty campus. In this regard, we must always keep in mind that there is also a possibility of an accident in every experiment and observation. Moreover, the faculty and staff who are entrusted with the well-being of students engaged in education and research at the University are required to ensure absolute safety to protect both the students and themselves from all types of accidents. It is against this backdrop that the Faculty of Science and Technology has created a "Safety Manual" as part of efforts to raise safety awareness among students, the faculty and staff and to promote safety initiatives.

This Safety Manual was prepared on the premise that "accidents occur inevitably in daily education and research activities," and has the following contents:

■measures to be taken to prevent accidents, and

■responses to minimize damage in the unlikely event of an accident.

This time, we have issued a revised version of Safety Manual with the aim of further strengthening safety measures.

When conducting an experiment, there is nothing more effective in preventing accidents than complying with predetermined procedures and rules. Regardless of whether you are a student, a faculty or staff member, we strongly hope that you will read this manual on a regular basis so that your awareness of safety is maintained at all times. Accidents may occur not only during day-to-day experiments but also in the event of an unexpected natural disaster, such as an earthquake. The Faculty of Science and Technology, which is located in Yotsuya Campus in the heart of Tokyo, bears full responsibility for the impact of damage caused by accidents on the surrounding areas as well. We hope that you will make the most of this manual to prepare yourself so that, in the event of an accident, you will be able to take appropriate action. The use of electricity and heat sources in the laboratory concerns everyone including students and the faculty who are engaged in dry lab research. The Faculty of Science and Technology will make an all-out effort to raise safety awareness by being vigilant in taking measures to prevent accidents due to electric leakage or electric shock.

Finally, we would like to extend our sincerest gratitude to Chairperson Takeshi Hashimoto and the members of the Faculty of Science and Technology Safety Committee for their leadership in promoting safety initiatives at the Faculty, and for their efforts in revising the Safety Manual.

May 2022

Tomoharu Shibuya
Dean
Faculty of Science and Technology
Graduate School of Science and Technology

Introduction

This Safety Manual is a booklet for students and the faculty of Sophia University Faculty of Science and Technology, for whom experiments and practical training are key elements of education and research. We, the members of the Faculty of Science and Technology, handle a variety of equipment, devices, chemicals, high-pressure gases, and biological samples, and at the time of their use, we must consider the fact that over 12,000 students, the faculty and staff members are carrying out activities at Sophia University Yotsuya Campus. Therefore, it is important that experimenters secure safety not only for themselves but also for others around them and act accordingly, while keeping in mind the maintenance of public safety, protection of the environment, and compliance with laws. The Faculty of Science and Technology has been hit by a number of earthquakes, among which the 2011 Great East Japan Earthquake was the largest, and actually experienced troubles such as power outages and water leakage, in addition to fires and accidents involving injuries. The lessons learned from these experiences must be applied as we advance safety measures. On top of that, we must also consider various law amendments, SDG initiatives, and security measures in light of recent social circumstances. Taking into account the changing social environments over the years, we need to continue accumulating the most up-to-date and minimum necessary knowledge of safety and disaster measures at all times. This Safety Manual will be helpful to this end.

In "Chapter 1: Responses and temporary measures at the time of emergency or disaster," we have put together measures against such disasters as a fire and an earthquake. Rules for the management and disposal of chemicals at the University are summarized in "Chapter 2: Safe handling of chemicals." The Faculty of Science and Technology handles extremely large volumes of organic and inorganic waste liquids; therefore, it is necessary to fully understand the contents described in this chapter. "Chapter 3: Safe handling of high-pressure gas" explains how to handle liquid nitrogen and gas cylinders. "Chapter 4: Precautions in use of electricity" and "Chapter 5: Safe use of tools and machine tools" lay out basic items that mainly concern the handling of equipment. "Chapter 6: Safety in other experiments" covers the handling of lasers, radiation, and biological samples; however, because this manual does not provide details regarding their safety control, it is advised that these topics be thoroughly addressed separately in safety courses or by referring to product handling manuals, etc. Finally, references and websites related to this manual are provided in "Chapter 7: List of safety-related materials."

It is important to visualize calmly and seriously what kind of accidents are likely to occur in day-to-day experiments, other than an earthquake or a fire. We need to conduct repeated simulations of how we would deal with such accidents, or what we would do to escape from them. It is our hope that you make good use of this manual to pay utmost attention to how you can conduct experiments in the safest way possible and acquire the habit of thinking how to act calmly so as not to harm yourself or others around you.

June 2022

Takeshi Hashimoto

Chairperson and Chief of the Safety Manual Editorial Committee

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1. Responses and temporary measures at the time of emergency or disaster

1.1 Response at the time of fire

1.1.1 Early report

Report immediately when you detect a fire!

If you notice a fire, shout "**Fire!**" in a loud voice to notify the people around you. Delay in informing may result in failure to escape for some people.

■ Report by a fire alarm system

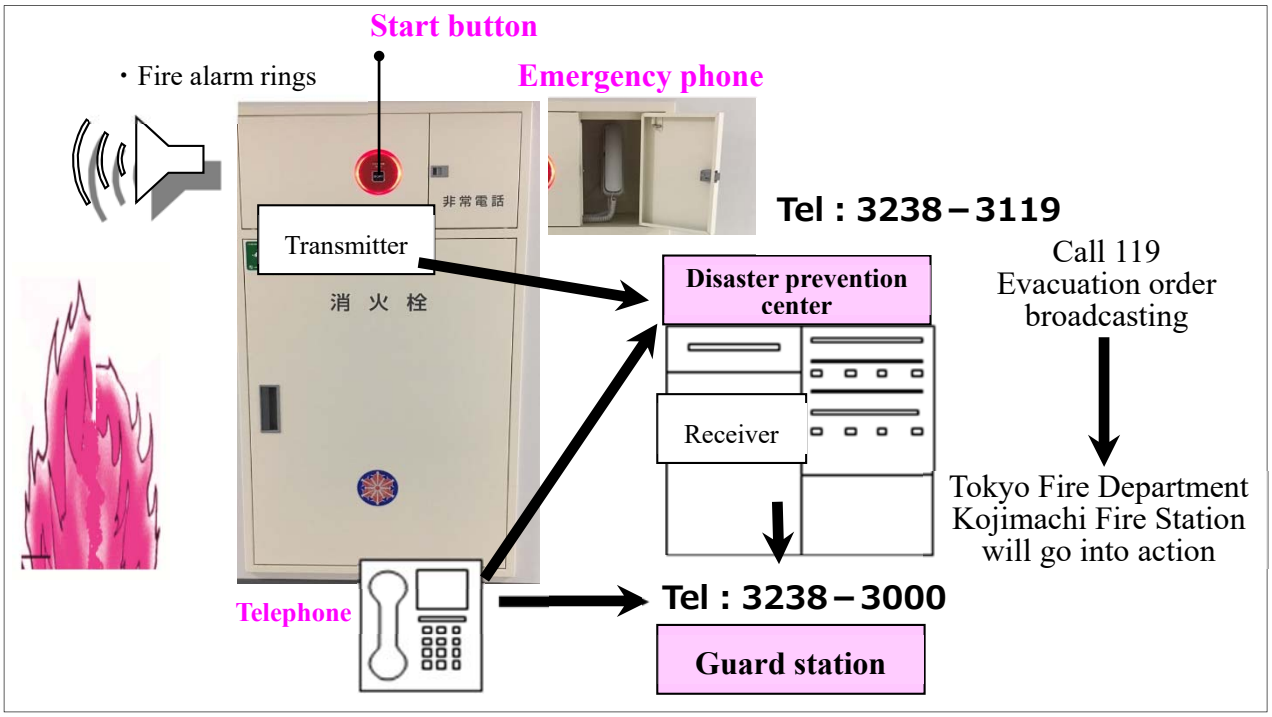
Use a nearby fire alarm system to report a fire.

Push through the plastic cover and press the start button firmly.

Pushing the start button will trigger a fire alarm.

At the same time, the University's Disaster Prevention Center will be able to recognize where on campus the fire has occurred.

Fire alarm rings



■ Report by phone

You can make a call directly to the Disaster Prevention Center by simply picking up the receiver of the emergency fire alarm phone, or call **03-3238-3119** (Disaster Prevention Center) or **03-3238-3000** (Guard Station) and calmly notify the following:

Location: Building/Floor/Room number

Conditions: Burned property, whether there are victims or not

1.1.2 Quick fire extinction

■ How to use a fire extinguisher

① Pull out safety pin. ②Direct hose to the base of the fire. ③Tightly hold the lever.

Extinguish the fire with your back against the emergency exit, and evacuate as soon as you sense danger!

■ The university has the following two types of fire extinguishers installed

Type of fire extinguisher	Suitable for use	Release distance	Release time	Note
(1) Powder fire extinguisher (General fire extinguisher installed in the hallway, etc.)	Ordinary fire Oil fire Electric fire	5 m	15 sec	Once it starts releasing extinguishing agent, it does not stop until all extinguishing agent is used up.
(2) Carbon dioxide fire extinguisher (installed in the laboratory and PC room, etc.)	Oil fire Electric fire	3 m	30 sec	As it extinguishes fire by smothering with CO_2, it does not damage laboratory equipment. However, it should never be aimed at people.

■ How to use a fire hydrant

(1) Pull out the nozzle.

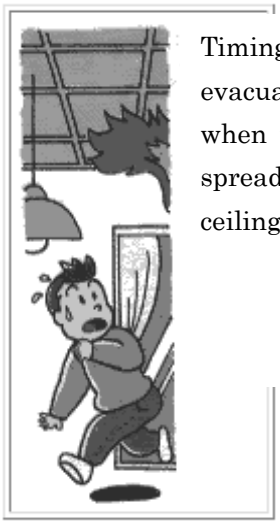
(2) Open the valve.

(3) Grab the end of the hose, approach the source of fire, and turn the nozzle to release water.

This operation is basically carried out by two persons, although it can be done by one person.

- Water will not come out unless the nozzle at the end of the hose is turned.
- Do not use a fire hydrant if there are water-reactive chemicals around the area.

1.1.3 Emergency evacuation



Timing for evacuation is when the fire spreads to the ceiling.

■ Emergency Evacuation Procedures

- ○ Evacuate immediately when the ceiling catches fire. Do not worry about your clothes or belongings and evacuate as quickly as possible.
- ○ When evacuating, close the entrance/exit door. This will shut off air and reduce spread of flames.
- ○ Follow instructions of emergency broadcast, etc., and act calmly. Do not be misled by false rumors. As you exit, stay as low to the ground as possible if there is smoke.
- ○ Cover your mouth with a wet towel or a handkerchief to prevent smoke inhalation.
- ○ Smoke obscures one's field of vision and creates a situation similar to being in complete darkness. To prevent panic, it is advised to check evacuation routes regularly.
- ○ Fire prevention doors may close to prevent the spread of fire. However, these doors can be opened by pushing or pulling.
- ○ Never use elevators. If you are in an elevator, stop and get off quickly at the nearest floor.
- ○ People with disabilities and elderly individuals tend to be slow in escaping; let them evacuate first.

When evacuating from smoke-filled areas, lower your posture as much as possible, and cover your mouth and nose with a wet towel or handkerchief.

Smoke contains toxic gases such as carbon monoxide. The fear in fires is death by asphyxiation from this smoke. More often than not, people die from smoke inhalation and unconsciousness rather than being burned to death.

Heated air quickly fills a room. The air rises at a rate of 3 to 5 meters per second and spreads sideways at a rate of 0.5 meters per second.

■ Everyday measures

- ○ You should know where evacuation tools (e.g., rescue kit) are located and how to use them. However, evacuation tools should only be used as an exceptional measure.
- ○ Try to avoid placing any object that might become an obstacle at the time of evacuation in the hallway or by the emergency exits.
- ○ Check regularly emergency exits in two directions or more in the building that you go into and out of.

1.2 Earthquake response

1.2.1 Immediately after occurrence

First, secure your personal safety. A major earthquake lasts about 1 minute, no matter how large it is.

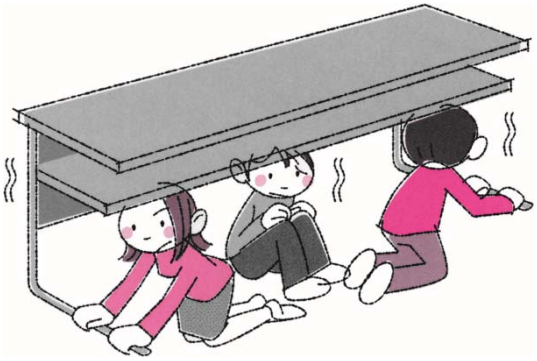
If you are in a classroom

① People near the door should open the door to secure the exit.

② Pull curtains across the windows to prevent scattering of broken window glass.

③ Cover your head with your clothes or personal belongings to protect yourself from falling objects.

④ Move away from the window, crawl under a desk, and hold the legs of the desk to stabilize your posture.



In particular, if you are in the experiment room or laboratory

① Stop working and turn off electrical equipment and devices immediately. If the shock of the earthquake is significant and these tasks are impossible to perform, ensure your own safety first.

② If the fire was caused by mixing and contamination of chemicals, etc., please perform the initial fire extinguishing activity using a nearby fire extinguisher after the earthquake subsides.

1.2.2 Measures after earthquake subsides

■ Evacuation

Please evacuate in an orderly manner by following the instructions of your teacher or the guidance of the evacuation broadcast. Please be careful, as it is highly likely a large earthquake is accompanied by aftershocks.

① Do not rush to the exit when you evacuate from the classroom, but evacuate in an orderly manner.
② Assist people with disabilities and the injured in evacuating.
③ Make sure to use the stairs for evacuation. The elevator should not be used because it is very dangerous.
When outside the building, pay attention to falling objects. There are times when it is better to not go outside in a hurry.
④ Cover your head with your clothes or belongings to protect yourself from falling objects.
⑤ Be careful of falling objects, such as window glass, exterior walls, and billboards.
⑥ Pay careful attention to your step, as there may be cracks or cave-ins on the ground.

■ About evacuation sites

The Tokyo Metropolitan Government has designated the entire Chiyoda Ward as a "Remaining Area within the District," which requires no evacuation, and cancelled its original safety evacuation areas. As the entire ward is a designated Remaining Area within the District, there is no safety evacuation area or temporary gathering place in Chiyoda Ward.

Residents of and those working in Chiyoda Ward, at the time of earthquake, should stay inside their own residences or office buildings rather than immediately start evacuating, grasp the disaster situation, and evacuate to a nearby school or ward facility if there is a sense of danger. You may also notice local residents coming to the campus seeking refuge. Let's take appropriate actions as a member of the community.

■ Routine preparation

Please note the following points in order to prepare for a major earthquake

① Check the evacuation route in case of an emergency
② In preparation for a fire, check the locations of fire extinguishers and fire hydrants, and how to use them.
③ Keep chemicals tidy and in order, and manage them correctly.
④ Lockers and cupboards should be fixed. Do not place anything on top of lockers and shelves.
⑤ Learn how to give first-aid.
⑥ Find an opportunity to actively participate in disaster prevention training and first-aid training.

1.3 Emergency responses

We never know when or where a sudden accident or illness might strike, putting one's life in danger. In such times, those who happen to be around must cooperate with each other to save a person's life.

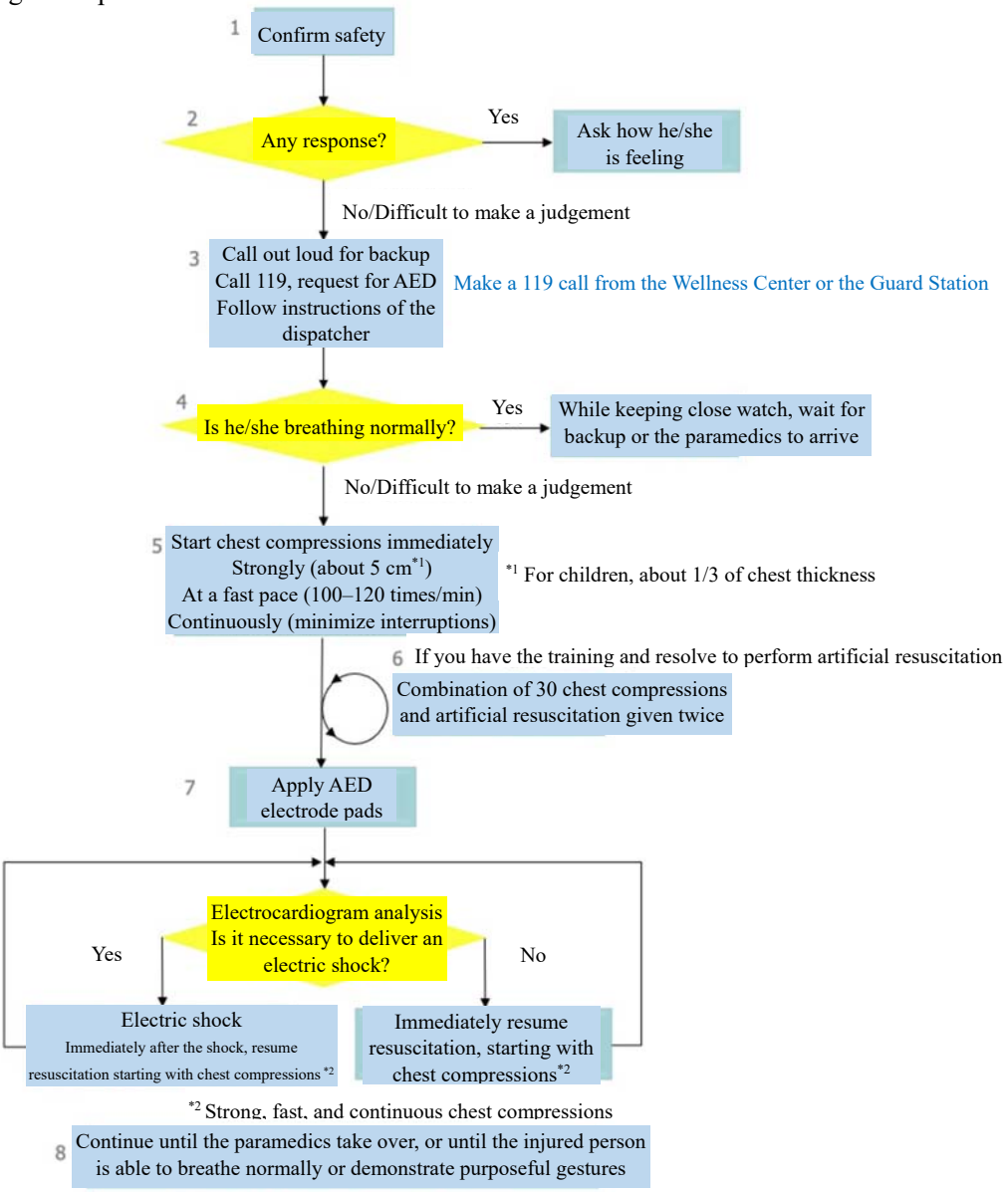
1.3.1 Procedure for emergency medical care

■ Emergency medical care (on campus)

Provide emergency medical care according to the procedure shown below.

Note As a measure against infectious diseases, in some cases, it may be desirable to skip artificial resuscitation.

BLS Algorithm for general public use



Cited from "JRC Resuscitation Guidelines (for general public use) 2020 Online version" ©Japan Resuscitation Council p. 57 with partial modifications

■ If you find someone lying on the floor

(1) Secure safety of surroundings

Quickly assess whether the place where the person is lying is safe. The room may be filled with smoke or gas; secure the safety of the lying person according to the situation. If you deem that safety is not secured, avoid contact with the person and wait for paramedics to arrive. If you are moving the person to a safer place, try to be as gentle as possible when moving or setting him/her down, as there may be fractures.

(2) Check consciousness

Tap his/her shoulders and ask (loudly), “Do you understand?”

(3) Seek assistance

If the person is unresponsive or if it is difficult to make a judgement, call for help and ask someone to come. Stop people nearby and give instructions, such as “please contact the Wellness Center” or “please go get an AED.”

* If the Wellness Center (Ext. 3396) is closed, contact the Guard Station (Ext. 3000).

(4) Check breathing

Quickly check chest and abdominal movements (within 10 seconds). If you do not observe normal breathing or do not feel confident in making a judgment, assume that the person has suffered a cardiac arrest. If the person is breathing, place him/her in the recovery position (roll him/her onto one side) and secure the airway.

(As a measure against infectious diseases) Cover the nose and mouth of the person with a mask, handkerchief, towel, clothes, etc.

(5) Chest compressions

If you do not observe normal breathing or if it is difficult to make a judgement, immediately perform chest compressions 30 times. If you have undergone training and possess the necessary skills and resolve, perform artificial resuscitation* twice following chest compressions.

*Artificial resuscitation should not be performed when there is a risk of COVID-19 infection.

(6) Use of AED

Use AED properly once it arrives.

According to JRC Guidelines 2020 (Japanese version)

■ Making an ambulance or fire call

Be sure to call 119 via the Guard Station (Guard Station at the main gate: Ext. 3000) or the Disaster Prevention Center (Ext. 3119).

1.3.2 Methods of observation

■ **How to check if the person is conscious**

(1) To determine the state of consciousness, first, try
the person's name, etc. by his/her ear.

(2) If the person is able to talk, offer words of comfor
Ask if there are any symptoms or body parts
that hurt, etc.

■ **Check breathing**

***In light of COVID-19, artificial resuscitation, etc. should not be carried out.**

(1) Check if the person is breathing and observe chest and abdominal movements.

(2) It is likely that breathing has stopped if the chest is not moving up and down and if you do not feel the person's breath on your cheek. If this is the case, perform chest compressions 30 times.

(3) If breathing is weak, perform **chest compressions and artificial resuscitation***. If you observe gasping respiration, the victim is possibly having "agonal breathing (near-death gasping)" immediately after cardiac arrest.

(4) Open the mouth and examine the oral cavity for foreign substances, vomit, or blood. If you see a foreign substance in the oral cavity, remove it carefully*.

(5) Next, place one of your hands on the person's forehead and the other on the jaw area, and tilt head backward to lift chin. (head tilt/chin lift)

■ **How to check the pulse**

(1) To check the pulse, place your three fingers (index, middle, and fourth fingers) on the thumb side of the person's wrist (radial artery).

(2) If you cannot feel any pulse there, check the carotid artery.

1.3.3 Chest compressions and Artificial respiration*

* In light of COVID-19, artificial resuscitation should not be performed.

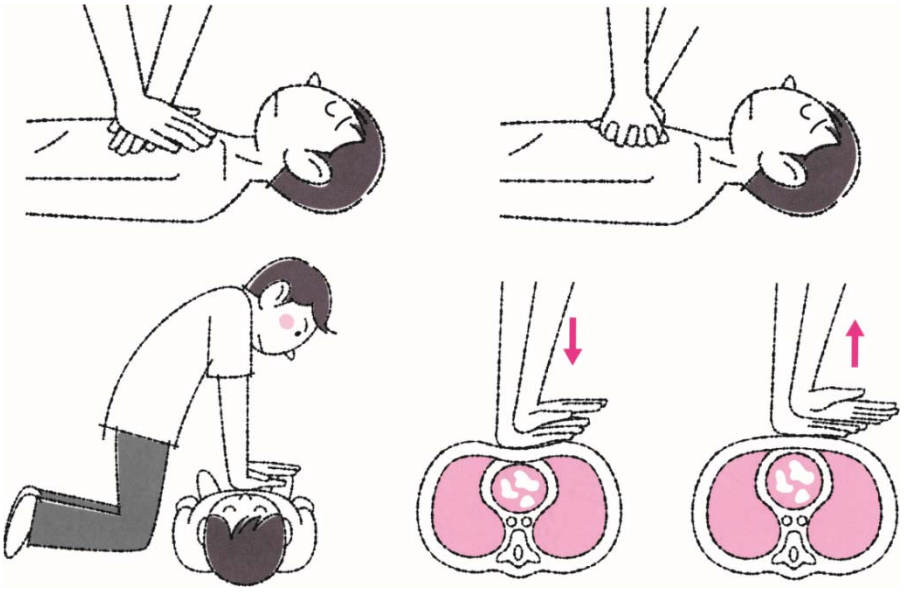
■ Chest compressions

(1) Position yourself at either the left or right side of the victim's chest, put the palms of your hands on top of one another, and place them over the lower half of the sternum.

(2) With both of your elbows straight, thrust downward using your body weight, pressing directly against the victim's chest 5 cm down. Without removing your palms, completely release the force until the chest rises back to the original height. Repeat these motions strongly and quickly at the rate of 100 to 120 times/minute in the same position.

(3) Repeat the cycle of chest compressions (30 times) and artificial respiration (2 times), and check for signs of circulation (breathing, coughing, body movements) within 10 seconds every 4 cycles.

Continue chest compressions and artificial respiration until **(1) breathing and signs of circulation (coughs, body movements, etc.) are confirmed, (2) an AED arrives,** or **(3) a physician or emergency personnel arrive.**



■ Artificial respiration

① While securing the airway, pinch the nose with the thumb and index finger of your hand that was placed on the person's forehead.

② Next, breathe in about twice as much air as normal. Place your mouth tightly on the person's mouth and blow in a big breath lasting about 1 seconds. Check to see that the person's chest rises without resistance, and the breath enters without making any sound.

③ Check to see that breath comes out from the person's mouth after leaving your mouth. After completing the first air breathing, when the chest falls back to the original position, perform the second air breathing.

④ Then, check to see whether the person is breathing on his/her own, if he/she is coughing, or if there is any body movement, even a little. If none of these signs is observed, the person is judged to have cardiac arrest.

1.3.4 How to use an AED

■ Defibrillation using an AED (Automated External Defibrillator)

Survival rate is said to decrease by 10% every minute after a cardiopulmonary arrest. Loss of brain function occurs 3-5 minutes following arrest. After a 119 call, it takes a national average of 8.7 minutes for an ambulance to arrive (Fire and Disaster Management Agency, "The present emergency and rescue situations, 2010 version," December 2010), but by that time, survival/discharge rates would have dropped to roughly 20%. Therefore, it is essential to use an AED as quickly as possible even by 1 minute.

(1) Secure an AED device.
Ask a bystander to get a nearby AED device and perform artificial respiration and chest compressions until the device arrives.
(There are six locations where AEDs are installed in Sophia University Yotsuya Campus, as shown in the figure below.)

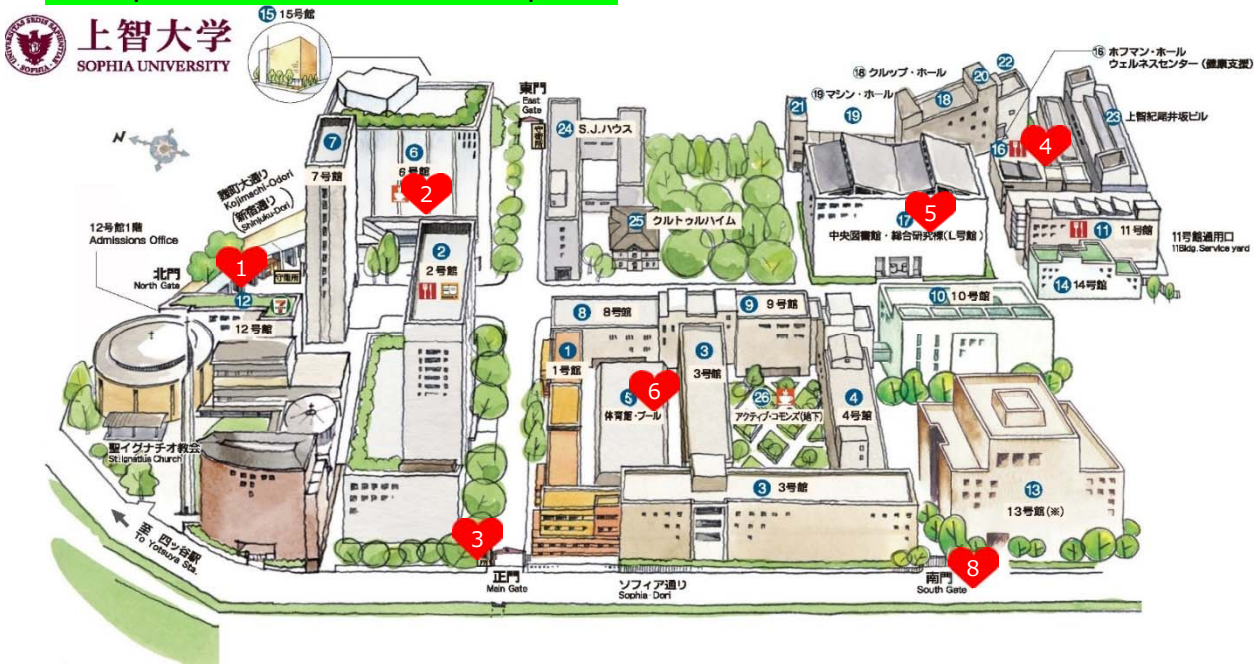
(2) Turn on the AED.

(3) Apply the two AED electrode pads on the victim.
Make sure that the skin area to which the electrode pads are attached is dry. Attach the electrode pads directly to the victim's bare chest, one on the upper right side and the other on the lower left side.

(4) The AED automatically starts analysis.

(5) Use the shock button.
When an electric shock is necessary, the AED will inform you whether a shock is required by a voice prompt, "a shock is required." Check to make sure that no one is touching the victim and then press the shock button.

<<Map of AED locations on campus>>



1.3.5 Emergency measures for injury

(Be sure to wear gloves when providing care!)

A Hemostasis: Stop any major bleeding immediately. If left untreated, the person may die from blood loss.

B Burns: If the person has burns, cool the affected area with cold water.

C Insulation: Cover the body of the person with clothes, a blanket, etc. to keep him/her warm.

■ Cuts, puncture wounds

① In the case of a cut

Cuts are accompanied by bleeding and may be upsetting to some people. **Apply pressure directly on the site of bleeding with a clean gauze or handkerchief to stop bleeding**. If the cut is deep such that bleeding does not stop easily, it is recommended to go to a hospital to seek medical attention.

Panic may ensue because of bleeding. The basic procedure is to **apply firm pressure to the bleeding site** to stop bleeding and **then perform disinfection**, but if the cut is deep and bleeding does not stop easily, it is better to go to a hospital.

② In the case of a large puncture wound

Do not attempt to pull out the material stuck in the wound and go immediately to a hospital. In cases of puncture with contaminated materials, such as an old nail, it is best to go to a hospital as there is a risk of developing tetanus. If you pull out the material from the wound, take it with you to the hospital

■ Burns

In case of a burn affecting only a small area of skin, immediately cool the area with running water (tap water). Cooling will also reduce the pain (cool for at least 10-20 minutes). Do not forcibly take the clothes off; quickly cool the affected area over clothing. Alternatively, a cold towel or ice pack (gel pack) could be used. Then, receive medical treatment in a medical institution

■ Injury due to chemicals

The severity of injury due to chemicals increases with an increase in the time of contact with the human body. The possibility of poisoning due to absorption into the body also increases. Therefore, it is important to remove the chemical as soon as possible

① Contact with chemicals

If the skin comes in contact with an acid or an alkali, immediately rinse off with a large amount of water (tap water is okay) for more than 15 minutes. Flushing with running water can effectively remove the chemical; it also cools the area, thereby suppressing inflammation. One treatment option is to use weakly alkaline solution in the case of acid, or 2-3% acetic acid

solution or lemon juice in the case of alkali, in order to neutralize, but consult a specialist afterward.

If a chemical gets into your eyes, serious damage can be caused, especially in the case of alkaline chemicals and lime (line powder) that penetrate the depth of the eye tissue. In this case as well, flush your eyes with a large amount of water. Use of physiological saline solution is recommended, but tap water is sufficient. After sufficiently flushing your eyes with a large amount of water, immediately seek medical attention from a specialist.

② Ingestion of toxic chemicals

If a toxic chemical is ingested by mistake, induce vomiting by sticking a finger into the throat. If this is possible, immediately transport the victim to a medial institution, as procedures such as gastric lavage and antidote administration are required. In this case, verify what kind of and how much chemical the person has ingested.

■ Emergency shower

Building Nos. 3 and 4 have emergency showers installed (picture on the right) separately for males and females in the bathrooms located by the elevator (1st basement floor to 5th floor, and 6th floor in Building No. 4).

<How to use>

When you pull down the metal chain, 20 L of water is released from the top (water does not stop until the entire amount is released)

- Open the faucet at the bottom, and release water by holding the head of the green part. You can wash eyes by opening the lid of the green part.

1.4 Safety system and past accidents

■ Conducting experiments alone is prohibited

Conducting experiments (research) alone without being able to contact someone nearby may lead to a grave situation if an accident occurs, or when the experimenter suddenly falls ill. You must not conduct experiments alone at night (20:00-8:00) or on holidays.

"When an accident or something unexpected occurs while you are conducting experiments alone, you may not be able to handle it all by yourself. If you get involved in a fire or toxic substance poisoning when conducting experiments alone, no one will come for help. In the worst scenario, you may end up dying in vain. Generally speaking, when you are conducting experiments by yourself, you are either in a hurry or overstraining yourself trying to achieve more than others. Moreover, the risk of an accident increases when you are tired as a result of pushing yourself too hard. Conducting experiments alone on holidays or until late at night may seem hardworking and admirable at first glance, but it is never so, rather, the evaluation you receive is quite the opposite."

(The Chemical Society of Japan, ed. "Safety Guide to Chemistry Experiments, 4th Edition" (Maruzen, 2002) p. 6)

■ Notes on conducting experiments at night and on holidays

① **Experiments must be conducted by two or more persons.**
There should be at least one faculty member or someone with experience (e.g., graduate student) present.

② **Obtain permission from your advisor in advance and receive guidance on safety.**

③ **Submit to the Office of Property a notification of night-time and holiday facility use beforehand.**
If the need for an all-night operation suddenly emerges on the day of the experiment, contact the Office of Property as well as the Guard Station.

④ **Dangerous experiments and experiments never done before should be avoided as much as possible.**

⑤ **When an instrument is left to run overnight**, post a sign (created by the Safety Committee, see figure) at the laboratory entrance clearly describing the content of the experiment, how to respond in case of an emergency, and contact information. When leaving the instrument unattended, make sure it is in a **stable state**.

⑥ **It is prohibited to keep tap water running** (e.g., equipment cooling water) unattended, given the risk of flooding.

■Cases of accidents that occurred at Faculty of Science and Technology in the past.

Type	Cause	Damage, etc.
Water leakage	Cooling device malfunction	Leakage of 2L of water downstairs No damage
Chemical contamination of the eye(s)	After distillation, glassware broke and the solvent got into the eye(s) (no safety glasses worn at the time of accident)	Treated at the Health Center
Burns on fingers	Touched a hot crucible	Treated by a dermatologist
Injury of finger	Cut a finger with a glass tube	Three stitches to close the wound at the trauma department
Burn	Burn with hydrochloric acid	Treated by a dermatologist, minor injury
Unusual odor	Decomposition of low-heat-resistant plastic product that was heated inside the drying oven	
Hyperventilation	Poor health	Detailed examination in an emergency hospital revealed no abnormal findings
Unusual odor	Scattering of chemical due to breakage of reagent bottle	No human casualties
Gas generation	Chemical reaction inside a container due to breakage caused by pressurization of glassware led to hydrogen chloride gas generation; two people complained of throat discomfort	Detailed examination in an emergency hospital revealed no abnormal findings Palm
Palm injury	Cut palm with a broken tool	Treated by a dermatologist
Burns on fingers	Touched heated glassware	Treated by a dermatologist
Low-temperature burn	Liquid nitrogen splashed on right hand with glove on	Treated by a dermatologist
Chemical contamination of the eye(s)	Chloroform got into the eye(s) through the gap of safety glasses while cleaning instrument	Treated by an ophthalmologist
Burns	Oil spilled out of a high-temperature oil bath onto the feet or hands	Treated by a dermatologist (5 people in total, one requiring 6 months to heal)
Leakage of chemicals	Corrosive waste liquid stored in a plastic tank overflowed	Resulted in corrosion of the exterior of the experimental apparatus downstairs

2. Safe handling of chemicals

＝Main rules＝

To prevent an accident resulting in injury or death, fire, and misuse (e.g., crime, terrorism)

Grasp chemical inventory (levels and properties)

Clarify who is responsible and who is in charge of managing chemicals

In recent years, the creation of laws on chemical substances has been promoted out of consideration for their effects on the human body as well as the environment. This also means that there is a need for thorough management of a series of flows starting from development/manufacture to distribution (purchase), storage/use, and disposal. In addition, there has been a growing movement to include students in the targets of the Industrial Safety and Health Act as those who engage in experiments.

With regard to handling of chemical substances, please check the MSDS, etc., and enhance awareness of social responsibility and safety at all times.

For example, methanol (methyl alcohol), a familiar substance, is a chemical that is subject to a number of laws, as follows.

- PRTR Law (Law Concerning Pollutant Release and Transfer Register)
- Fire Service Act (dangerous substances)
- Industrial Safety and Health Act (class 2 organic solvents, etc.)
- Poisonous and Deleterious Substances Control Act
  - non-medical deleterious substances
- Tokyo Metropolitan Environmental Security Ordinance
  - specified chemical substances subjected to proper management
- Air Pollution Control Act - hazardous air pollutants
- Act on Waste Disposal
- Sewerage Act

Methanol 500 mL

“All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy.” (From Toxicology)

SDS (Safety Data Sheet)

Safety Data Sheets (SDSs) provide such information as the properties of chemical substances, etc. and the precautions to be taken in handling them. SDSs are used hand in hand with the PRTR system, and business operators are obliged to provide information regarding such properties as potential damage to human health (hazardousness), chemical substances that are continuously exist in the environment, or those expected to continuously exist in the environment in the future (Class I and II Designated Chemical Substances). When purchasing or using a reagent, each individual is encouraged to make a habit of referring to the SDS, especially the following sections, 2. Hazards identification, 4. First aid measures, 5. Firefighting measures, 7. Handling and storage, 8. Exposure controls/personal protection, 10. Stability and reactivity, 11. Toxicological information.

2.1 Purchase

■ Reagents

① Order

In the laboratory, etc. orders should be placed by a faculty member for the minimum amount required from chemical vendors (registered sellers). With regard to **hazardous, poisonous, and deleterious chemicals**, the name of the responsible user and the delivery location must be notified.

② Delivery from the vendor

Delivered and stored in the specified location. Immediately fill in the prescribed receipt record.

■ Others (e.g., radioactive material, high-pressure gas, narcotics)

With regard to substances that only qualified personnel can handle according to relevant laws, please conform to the university rules and regulations. Qualified personnel in the laboratory, etc., sends an order to a vendor and receives the ordered substances (rules and regulations can be found on Cybozu).

■ Reagent management system

Since FY2017, a reagent management system that uses a server and a terminal with a bar code reader has been in place. Please use this system to register purchased reagents and high-pressure gas immediately after delivery.

2.2 Storage and use

This section describes precautions regarding the storage and use of chemical substances that fall under five categories: 1) dangerous substances, 2) poisonous and deleterious substances, 3) materials under the purview of PRTR Law, 4) organic solvents and specified chemical substances, and 5) narcotics, plants containing narcotic drug materials, psychotropics, and narcotic and psychotropic drug materials. In addition, as an earthquake disaster countermeasure for storing chemical substances, reference information is summarized below.

Reference Storage and use of chemicals

Disaster situation in a chemistry laboratory when a major earthquake occurred directly underneath the Kansai region (Great Hanshin Earthquake of 1995)

- No bottle cabinets fell down
- Two-tier steel shelving units almost completely fell down.
- The lock of a sliding door still functioned (avoid glass doors)
- 50- and 25-g bottles did not fall as easily as 500-g bottles.
- Half-full bottles did not fall as easily as empty or full bottles.
- Empty spaces in the shelf increased damage due to bottles falling.
- Put partitions in. (Depth)/ {√Height (cm)} ≥ 4 was safe.
- An anchor was not effective unless it measured ≥ 8 φ (lead not allowed), and not an L-shaped one but an anchor that allows for some degree of movement was a better choice.
- Many cylinders fell down but did not cause any serious accident. There was no accident at Konan University (with bands securing top and bottom parts, placed in the designated storage space in the hallway with iron plates)
- Equipment: Equipment on the desk fell down (particularly stacked ones)
- Damage to NMR apparatus was significant. ▶ No accident occurred in the case of stands with casters for which power plugs were disconnected before going home.
- It was better to keep piping and wiring loosely fixed. ▶ Oxygen mask: (Konan University) Fire extinguishers and masks were effective. ▶ Window glass: Almost all fell.
- Other: There were two outlets for organic laboratories. The exit door opened outward. An explosion-proof refrigerator was a necessity.

2.2.1 Hazardous materials

Hazardous materials are chemical substances that pose a serious risk of causing and promoting the spread of a fire as specified by the Fire Service Act, and classified as I – IV.

Proper storage is required, and any serious violation will be made public and be subjected to suspension of educational and research activities. On-the-spot inspections is carried out by Kojimachi Fire Station once every three years.

■ Regulated substances

Refer to SDS at the time of purchase. Designated items are listed in the Appendix of the Fire.

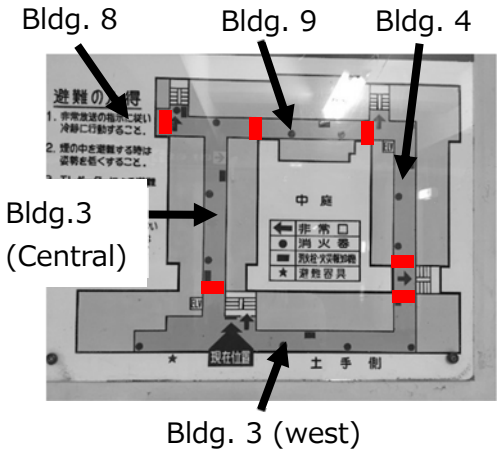
It is recommended to refer to the CRIS system for the determination of hazardous materials.

■ Notes on storage

① Storage quantity

Under the Fire Service Act and the Fire Prevention Ordinance of Tokyo, depending on the fire risk level of a substance, the quantity of the substance allowed for storage in each fire compartment is regulated (less than 0.2 times the designated quantity). In particular, as the university's Department of Materials and Life Sciences handles large volumes of hazardous materials, each laboratory is assigned a quantity within the allowable limit. It is desirable that each laboratory displays the assigned storage volume allowance (*according to the method of each department).

Fire zones: Areas separated by fire doors or other means to prevent the spread of combustion in the event of a building fire. In the case of the Building of our Faculty, there are four zones separated by bold lines in the diagram above).



② Storage location

Small-quantity hazardous material storage

Hazardous materials exceeding the limit for storage in each laboratory can be stored in the following seven small-quantity hazardous material storage location.

(A) Room 4-493B (B) Room 3-533A (C) Room 9-559B (D) Room 9-459B
(E) Room 3-433B (F) Room 3-020B (G) Room 4-071B (as of April, 1, 2022)

Indoor hazardous material storage place (9.4 times the designated amount) is located outside the building between Building nos.4 and 10 (see photos below).

■Items and quantities of substances made known to and approved by Tokyo Fire Department are shown in the table. (As of April, 1, 2021)

Hazardous Materials Category IV				
Special inflammable materials	Class I petroleums (water-insoluble)	Class I petroleums (water-soluble)	Alcohols	Class IV petroleums
200 L	500 L	300 L	800 L	600 L

Photos shown above are the exterior and inside of the indoor hazardous material storage

③ Notes on use of storage place

With regard to the above-mentioned storage place, the Fire Department should be notified of the storage content and quantity, and nothing other than those notified can be stored. Please store the hazardous materials in the designated area of the storage place and fill in the date and yield, etc. in the storage record (deleterious materials should be described in the other storage record as well). Along with this, each departmental safety committee adjusts and determines the quota of each laboratory. The same applies to the use of 3-533A or 4-493A, which is a temporary storage place for waste liquid.

④ General notes on storage

1. Do not handle hazardous materials without fully understanding the danger and toxicity they pose.
2. Store only the minimum amount required. Dispose immediately if no longer needed.
3. Materials with a risk of combustion due to mixing should not be stored in the same place. Mixed loading is prohibited.
4. Always keep measures in the event of an earthquake in mind, such as fall prevention of a chemical storage cabinet.
5. When hazardous materials are missing, immediately notify your advisor, etc.
6. The waste (effluent) of a hazardous material is also a hazardous material. Pay attention to the designated quantity.

2.2.2 Deleterious and poisonous substances (non-medical poisonous substances, non-medical deleterious substances)

The use and control of these substances are strictly regulated by the Poisonous and Deleterious Substances Control Act, and in this university, “Sophia University Non-medical Poisonous and Deleterious Substances Hazard Prevention Control Regulations” have been set forth. On-site inspections of storage management status, etc. are carried out by Chiyoda Public Health Center (Chiyoda Ward).

A total of 532 substances are regulated by the above law and related ordinances (19 specified poisonous substances, 124 poisonous substances, and 389 deleterious substances). As item names may be ambiguous (e.g., nitrates) or there may be some changes, make sure to check SDSs and manufacturers’ websites at the time of use. Refer to the websites of the Ministry of Health, Labour and Welfare, Tokyo Metropolitan Government, pharmaceutical science universities, reagent manufacturers, etc. Specified substances that fall under this category include the following:

① Specified poisonous substances

Among the poisonous substances, specified poisonous substances are those with particularly high toxicity (parathion, monofluoroacetic acid, etc.). As regards possession and use, only individuals who have received permission from the Governor of Tokyo can handle these substances.

② Poisonous Substances

yellow phosphorus, inorganic cyanide compounds (e.g., potassium cyanide), mercury, arsenic, hydrogen fluoride, etc.

医薬用外毒物

医薬用外劇物

③ Deleterious Substances

aniline, ammonia, hydrochloric acid, chlorine, hydrogen peroxide, xylene, cresol, chloroform, ethyl acetate, oxalic acid, bromine, nitric acid, potassium hydroxide, sodium hydroxide, toluene, arbon dioxide, phenol formaldehyde, chromic anhydride, methanol, iodine, sulfuric acid, organic cyanide compounds (e.g., acetonitrile), etc.

■ Storage method

Management should be performed in accordance with university regulations for preventing theft, loss, spills, and leaks.

(1) Storage cabinet

1. Use a designated storage cabinet that is robust and has a lock, and is clearly distinguishable from others.
2. Lock the storage cabinet. In addition, take measures to prevent the storage cabinet from falling.
3. Poisonous and deleterious substances are not to be stored on the same shelf. In addition, chemical substances other than those subject to regulations should be separated.
4. Glass doors are unsuitable as there is a risk of damage and theft.
5. The inside of the storage cabinet should be carefully divided into sections, keeping in mind that contact between chemical substances could cause ignition, etc. in the event of an earthquake.
6. It is mandatory to label the storage locations as “Non-medical poisonous substances” and “Non-medical deleterious substances.” Put labels on the reagent shelves.
7. The Faculty of Science and Technology Safety Committee should always have labels in stock. (Replace unclear stickers whenever necessary.)

(2) Usage record

Prepare “non-medical poisonous/deleterious substance control records” for each chemical substance to keep tabs on the amount received, the amount used, and the amount remaining at all times, and to make sure that no chemical substances have been stolen or lost.

(3) Management record

The person in charge of the laboratory, etc. shall record inspection conditions of the storage cabinet and chemical substances at least twice a year, according to the “poisonous and deleterious substance storage condition check list.” (Appendix, Form 2).

The person in charge shall promptly report to the Faculty of Science and Technology Safety Committee when poisonous/deleterious substances are stolen, lost, or found.

Reference

On strengthening control of chemical substances that can be used as raw materials for explosives

Since the Tokyo 2020 Olympic Games were held, the police have been enhancing measures

against the theft of 11 chemical substances that may be used as raw materials for explosives (potassium chlorate, sodium chlorate, nitric acid, sulfuric acid, hydrochloric acid, hydrogen peroxide, ammonium nitrate, urea, acetone, hexamine, and potassium nitrate) in an effort to take all possible steps to prevent illegal acts, such as terrorism. In the University, laboratories that handle these items are required to adopt the following measures:

(1) Periodically check quantities and ensure responsible management by keeping a record, etc.

(2) Store chemical substances in a cabinet with a locking system, etc. and make sure the cabinet is locked.

2.2.3 Substances subject to the Pollutant Release and Transfer Register (PRTR) system and those included in the Tokyo Metropolitan Government's Proper Management of Chemical Substances

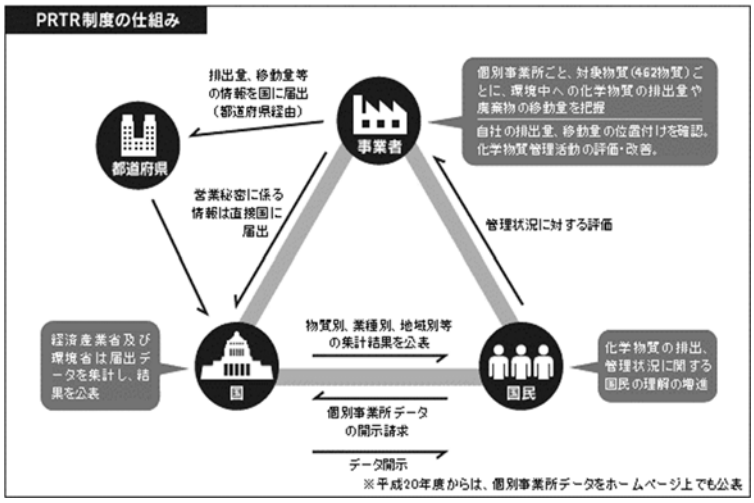
The PRTR system requires businesses to keep tab on and report the amount of hazardous chemical substance released and transferred to the environment (atmosphere, water, soil), and to make this information available to the public.

Among Class I Specified Chemical Substances (462 substances) set forth in the "Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof" (2001-), 15 types of specific Class I Specified Chemical Substances have been found to show carcinogenicity, germ-cell mutagenicity, and toxicity to human reproduction and development. Business establishments that use any (even one) of these chemical substances in an amount of 1 ton or more annually (except for benzene, formaldehyde, chloroethylene, etc., for which the limit is set at 0.5 ton) are required to keep tabs on the amount released, and to notify accordingly.

In a separate move, the Tokyo Metropolitan Government has stipulated the "Improve the Urban Environment and Protect the Health of Citizens" Ordinance, and accordingly, the obligation to report arises when the annual usage amount of 58 chemical substances requiring proper management is 100 kg or more. This university generates (in waste) a total of approximately 8-10 t of chemical substances a year, and reports the amount accordingly.

■ **Refer to:**

- Chemical Risk Assessment Office, Chemical Management Policy Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry
  http://www.meti.go.jp/policy/chemical_management/law/prtr/index.html
- Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment
  http://www.env.go.jp/chemi/prtr/risk0.html
- Toxic Chemical Substance Countermeasures Section, Environmental Improvement Division, Bureau of Environment, Tokyo Metropolitan Government
  http://www.kankyo.metro.tokyo.jp/chemical/control/index.html



The PRTR Law and metropolitan ordinances require that chemical substances that are considered a cause of environmental pollution be actively replaced with alternative substances.

(http://www.meti.go.jp/policy/chemical_management/law/prtr/index.html)

■ Obligation to File a Report

In each laboratory, if more than 0.5 kg of designated substances was handled annually, an investigation form (prescribed form) must be submitted to the Safety Committee by the due date (by mid-May, separately notified). This is managed by the Faculty of Science and Technology Safety Committee.

The Ministry of Economy, Trade and Industry and the Ministry of the Environment (for PRTR), and the Ministry of Education, Culture, Sports, Science and Technology and the Tokyo Metropolitan Government Bureau of Environment (Chemical substances requiring proper management) require that the usage results, etc., from the previous year be reported.

■Results reported for FY2021（2021.4.1～2022.3.31） Unit：kg／yaar

Investigated substance	Name of substance	Annual handling amount	Released amount (into the atmosphere)	Transferred (discharged) amount (into sewers)	Transferred amount (waste)
Tokyo Metropolitan Ordinance	Acetone	948	29	7	911
Tokyo Metropolitan Ordinance & PRTR	Chloroform	512	3	0	509
Tokyo Metropolitan Ordinance	Methanol	1346	11	3	1332
Tokyo Metropolitan Ordinance & PRTR	Dichloromethane	532	14	0	518
Tokyo Metropolitan Ordinance	Hexane	1055	4	0	113
"Tokyo Metropolitan Ordinance"	Ethyl acetate	683	2	1	681
PRTR	Acetonitrile	111	4	0	109

※Some annual handling totals do not equal the sum of emissions + transfer.

2.2.4 Organic solvents and specified chemical substances

Although the Labor Standards Act has been in effect since 1947, the Industrial Safety and Health Act was established in 1972 to improve the working environment of laborers in response to the large number of accidents originating from chemical substances and pollutions during the period of rapid economic growth. Under this Act, various related laws, government ordinances, and ministerial ordinances were subsequently enacted. Whereas faculty members are workers employed by the university, students are not. Still, considering the conditions of use of chemical substances in research, it is common to treat students as workers and to take measures to protect their health. It is also the duty of faculty members to supervise and instruct students on the use of chemical substances.

Ministerial ordinances set forth by the Ministry of Health, Labour and Welfare include the Ordinance on Prevention of Organic Solvent Poisoning and the Ordinance on Prevention of Hazards Due to Specified Chemical Substances, which stipulate the handling of chemical substances related to the Industrial Safety and Health Act. Management methods associated with the use of organic solvents (44 types) and specified chemical substances (72 types) are described in the respective ministerial ordinances. Due to the frequent reports of bile duct cancer in the printing industry, a comprehensive review process was undertaken from 2013 to 2016, and this has led to the transfer of 13 chemical substances, including chloroform and dichloromethane, from the Class 1 Organic Solvents category to the Specified Chemical Substances category. When chemical substances that are subject to these preventive regulations are used, the users (i.e., business owners) are required to ensure management of the working environment, management of operations, and management of health.

In our university, we conduct working environment measurements and special medical examinations twice a year for laboratories and workers (faculty members and students), where and by whom organic solvents or specified chemical substances are used on a regular basis. We are also required to implement risk assessment of SDS substances.

■ Regulated substances

(1) Prohibited substances

Although these substances are not specified by the Ordinance on Prevention of Hazards Due to Specified Chemical Substances, eight substances, including sulfur match, rubber cement containing benzene, asbestos, *β*-naphthylamine, and benzidine and its salts, have been designated as prohibited substances under the Industrial Safety and Health Act. The manufacture, import, transfer, use, and provision of these substances are prohibited.

(2) Specified chemical substances

As of April 2022, 74 chemical substances are subject to regulations and classified as follows:

- **Class 1 chemical substances (7 kinds)**: Dichlorobenzidine and its salts, α-naphthylamine, Be (beryllium) and its compounds, polychlorinated biphenyl (PCB), benzotrichloride, etc. All but PCB are carcinogenic substances.
- **Class 2 chemical substances (59 kinds)**, which are further divided into four categories.

1) **Class 2 specified substances**: Acrylonitrile, vinyl chloride, chlorine, propylene oxide, hydrogen cyanide, methyl bromide, 1,1-dimethylhydrazine, etc. (26 kinds). Weld fume was added in 2021.
2) **Special organic solvents, etc.**: Ethylbenzene, chloroform, carbon tetrachloride, 1,4-dioxane, 1,2-dichloroethane, dichloromethane, tetrachloroethylene, trichloroethylene, etc. (12 kinds). These chemical substances were transferred from the organic solvent category in 2015 and are now subject to mandatory record keeping of information including records of use and health check-up results for 30 years.
3) **Auramine, etc.**: Auramine and magenta (2 kinds)
4) **Class 2 controlled substances:** Substances not classified into the above three categories (18 kinds). These include 13 metal compounds, such as alkyl mercury compounds, indium compounds, cadmium compounds, chromic acid/dichromates, vanadium pentoxide, cobalt and its inorganic compounds, potassium/sodium cyanide, mercury and its compounds, nickel compounds, arsenic and its salts, and manganese and its compounds. Four organic compounds are also included, such as coal tar and *o*-phthalodinitrile. Refractory ceramic fiber (RCF), which is an alternative to asbestos, and substances containing RCF was added to this category in 2016; antimony trioxide was added in 2017.

・**Class 3 substances (8 kinds)**: Ammonia, carbon monoxide, hydrogen chloride, nitric acid, sulfur dioxide, phenol, phosgene, and sulfuric acid. Together with Class 2 specified substances, facility and control standards are set in order to prevent massive leakage accidents from specified chemical facilities.

(3) Organic solvents: These are classified into Class 1 - 3 categories.

・**Class 1 organic solvents**: 92 kinds, including 1,2-dichloroethylene and carbon disulfide

・**Class 2 organic solvents:** 35 kinds, including acetone, methanol, xylene, n-hexane, ethyl acetate, 2-propanol, and tetrahydrofuran (THF)

・**Class 3 organic solvents:** 7 kinds, including gasoline, petroleum ether, and turpentine oil

Refer to the following website for a list of specified chemical substances and organic solvents and their control concentrations

http://www.epc.osaka-u.ac.jp/pdf/sagyoukannkyou.pdf

■ Management methods

(1) **Usage record**: Be sure to record the amount used and the time of use by each user (and for each chemical), and keep these records for a fixed period of time (3 to 30 years).

(2) **Ventilating installation:** Install draft or push-pull type ventilators, etc. to keep concentrations below the control concentrations specified for each chemical substance in the working space, and work with the ventilators on. Protective equipment, such as a gas mask, may be used as needed, but improvement of the working environment by ventilation should be prioritized (rubber gloves and activated carbon masks are almost of no value against special organic solvents, etc.).

(3) **Working environment measurement** In laboratories, etc. where regulated substances are used consistently, working environment measurements by external contractors are carried out twice a year (around May and November in this faculty).
(4) **Special medical examination** Special medical examinations are conducted twice a year for workers (faculty members and students), etc. according to the chemical substances used.

2.2.5 Narcotics, plants containing narcotic drug materials, psychotropics, and narcotic and psychotropic drug materials

Narcotics, plants containing narcotic drug materials, psychotropics, and narcotic and psychotropic drug materials are subject to regulation and control as described below. Accordingly, these compounds should be handled carefully with the following points in mind.

(1) Register as the Operator of a Facility Conducting Experiments or Research Involving Psychotropics. The Faculty of Science and Technology and the Department of Psychology have been registered and licensed. However, note that moving the storage location from one place to another is strictly regulated by law.
(2) Keep the substances in a lockable place within the registered facility mentioned above.
(3) It is prohibited to transfer substances to unauthorized individuals.
(4) When transferring or discarding substances, record the necessary information and keep this record for two years from the date of final entry (depending on the type of substance, this is desirable and not mandatory).
(5) Notification is required if an accident or loss involving an amount that exceeds the specified amount is noted.
(6) When importing, exporting, or manufacturing, record the necessary information and keep this record for two years from the date of final entry.
(7) When importing, exporting, or manufacturing, notify at the time of annual reporting in the end of February.

■ Regulated substances

Refer to the following website for the government ordinance designating narcotics, plants containing narcotic drug materials, psychotropics, and narcotic and psychotropic drug materials as well as the list of compounds.

https://elaws.e-gov.go.jp/document?lawid=402CO0000000238

2.3 Disposal

Waste generated in the university is largely divided into general waste (ordinary garbage), such as waste paper and plastic bottles, and industrial waste, such as experimental effluent and bulk waste. Unlike domestic waste, all university waste is treated as waste from business activities and is subject to the Waste Management Act and the ordinance of the Tokyo Metropolitan Government.

In recent years, “discharger’s responsibility” has gained prominent attention as a way to prevent illegal dumping. This responsibility should be borne by each of us as a member of the university.

2.3.1 4 main rules regarding laboratory waste disposal

(1) Discharger’s responsibility

The president, as well as faculty members and students who use laboratories and research rooms, should bear responsibility.

(2) Source separation

All of those who actually engage in experiments should fully implement sorting of waste.

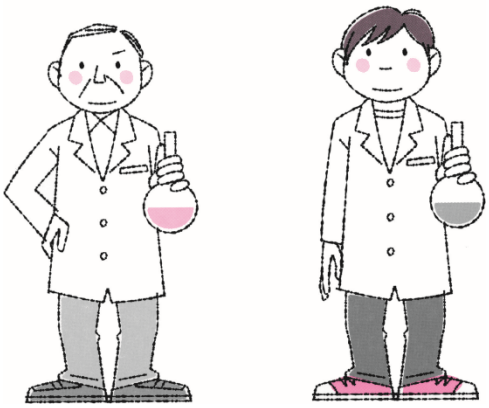
(3) Compliance

The university is a specified business and thus has social responsibility.

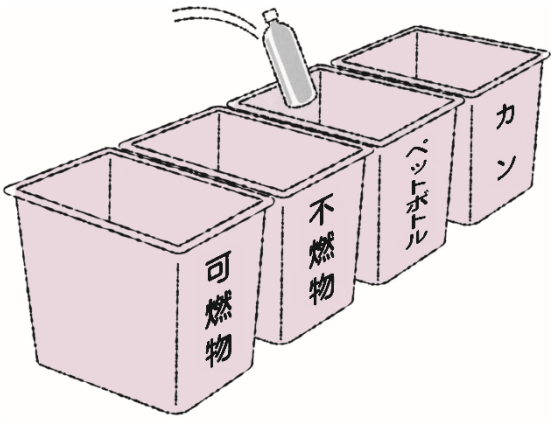
(4) Reduction effort

We should always keep in mind the reduction of waste.

Discharger’s responsibility



Discard empty disposable lunch containers in a plastic (non-combustible) waste bin



Let’s cooperate with sorted collection of waste.

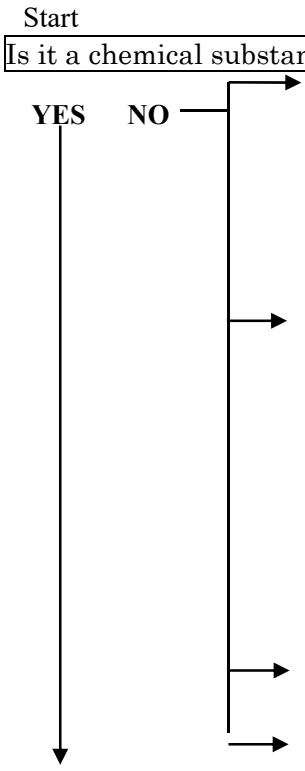
2.3.2 When experimental waste is generated

Separate waste by type, as shown in the figure below. As a general rule, laboratory instruments with residual chemicals should never be discarded in the trash installed in the hallway. Similarly, no waste liquid should be disposed of into the laboratory sink drain.

The disposal of hazardous substances should be entrusted to a waste disposal company, and released into the environment after rendering them harmless through conventional incineration. All faculty members and students should be aware of the fact that the cost of waste disposal is high, and that the environmental load due to this process is never zero.

■ Flow for Waste disposal

* Details of items C-G (red font) that require the Request Form are provided in the following pages.



A. Containers (empty chemical bottle/plastic container, petri dish, etc.)
Discard them in the regular trash installed in the hallway after completely removing the content and residual material and rinsing with water. Affix a label (e.g., "Glass") for glass containers and broken pieces, in order to not endanger staff. (No request form required)

B. Experimental apparatus and instruments (refrigerator, experimental shelf and desk, gas cylinder, battery, etc.)
Contact the Office of Property beforehand.
Some of these might be subject to the Home Appliance Recycling Act or Waste Management Act, so never throw anything away without permission. For registered fixtures, please complete the procedure required for disposal at the same department where the fixtures are registered.
Discard waste in the container located at the bulky waste collection site beside Building No.10. (No request form is required for disposal)

C. PCB-containing materials (PCB waste oil, voltage inverter, transformer)

D. Infectious waste (needles, syringes)

E. Reagents
Processed by an external contractor at the expense of each laboratory.
The manifest is managed by the Office of Property.

F. Experimental organic waste liquid and solid
G. Experimental inorganic waste liquid and solid
Processed by an external contractor. The Office of Property bears the expense and manages the manifest.
When disposing waste liquid containing substances regulated by law, be sure to write down the names of the corresponding substances in the application form.

2.3.3 Disposal

C. Disposal of PCB-containing waste

(1) Disposal date

According to the PCB Special Measures Act (Act on Special Measures concerning Promotion of Proper Treatment of PCB Wastes), etc., business operators shall dispose of the waste by March 2027.

(2) Management

According to the PCB Special Measures Act, management and disposal shall be collectively performed by the university. As notification of the contents and conditions of storage is mandatory, it is required that the Office of Property be contacted immediately when it is discarded as waste. Each laboratory shall be responsible for the cost of transportation to the storage place designated by the university.

(3) Procedures

When disposing transformers and capacitors, a written waste disposal request shall be submitted to the Office of Property after inquiring with the manufacturer whether PCB is contained or not (there is no prescribed form). *The same goes with PCB-containing waste oil. Clearly describe the origin and components of the waste oil.

D. Infectious waste (needles, syringes)

① Disposal date

Collected by the university once at the end of the year (scheduled for early March). Each laboratory is in charge of storing the waste until the collection date.

② Procedure

The Office of Property will send a separate notification regarding the method of disposal. Please follow the instructions.

Disposed of by an external contractor as special management industrial waste.

The Office of Property bears the expense and manages the manifest.

E. Disposal of reagents

① Disposal date

Discard immediately when no longer needed.

② Procedure

Each laboratory bears the expense of disposal. As the manifest is managed by the university as industrial waste (or special management industrial waste), disposal should be entrusted to the external contractor designated by the university (inquire with the Office of Property). Submit the disposal request form (prescribed form) to the Office of Property (attach a copy of the estimate sheet), receive an estimate from the designated vendor, and discard the reagents. Manifest slips, etc., are digitized, but if any documents are received, they should be forwarded to the Office of Property.

Note that the processing cost of unknown chemicals can be high.

F. Experimental organic liquid waste

Flow for organic liquid waste disposal

LAB

- Store in a separate container with a lid.
- Strictly observe the 3 classifications (combustible, halogen-containing, and waste oil). The waste discharger is responsible for recording the disposal date/time and the name and quantity of the substance.
- In consideration of safety during storage and transportation, do not fill up the container to more than 90% of its capacity.
- Regarding hazardous materials, including liquid waste, pay attention to the quantity designated for each laboratory.
- Move excess amount to Room 9-449A。

Temporary storage site (3-533A/9-449A)

- ✓ Use designated separate containers (10 L or 20 L plastic containers).
- ✓ Write down the container number assigned to the person who is requesting the disposal and attach a collection label (specified by the Safety Committee).
- ✓ Do not exceed the amount allocated to each research group.

On the designated days and time (notified by the Departmental Safety Committee, generally, Tuesdays and Fridays at 13:40), waste dischargers from each laboratory meet in front of Room 3-533A and transport the containers to the indoor hazardous material storage site in front of the machine hall via Room 4-493A (laboratories other than those in Building No. 3489 are to transport the containers on their own). Before transporting, make sure that the lids of the containers are tightly closed, the labels are affixed, and the required items are filled in, and use a chemical transport trolley to transport the containers.

Indoor hazardous material storage site in front of the machine hall

Transport waste to the storage site according to the instructions of the Office of Property staff

Receive approval from the dean of the Faculty of Science and Technology, and the chairman of the Faculty of Science and Technology Safety Committee.

Receive approval from the Office of Property manager.

Carrying out of campus (external contractor)

The Office of Property provides information to the external contractor on the basis of the request form, and stores the manifest for 5 years.

*As a rule, waste is transported to a dedicated facility in North Kyushu, where it is processed.

Flow of request form

- **For each container,** fill out the "Experiment and research waste disposal request form [organic]" completely.
- The request form and the entry method can be found on Cybozu.
- Have the request form checked by the person responsible for application and submit it, with the permission stamp affixed..

Hand the request form to the Office of Property staff.

■ Note

① Safety

During waste handling and transporting, pay particular attention to safety. Organic-solvent-compatible rubber gloves are available, so inform the Faculty of Science and Technology Safety Committee if you need those.

② Environment

Hazardous organic substances should never be disposed of into the laboratory sink drain. This university is a specified business that handles organic substances, and if sewer water going out of the university does not meet emission standards, the university may receive an order for suspension of research and educational activities.

■Organic substances subject to water quality inspection in the sewer catch basin on campus

Compound name	Unit	Sewerage Act	Water Pollution Control Act	Environmental Quality Standards
Dichloromethane	mg/L	0.2	0.2	0.02
Benzene	mg/L	0.1	0.1	0.01

※ In the past, we received notices from the Tokyo Metropolitan Government Bureau of Sewerage for exceeding standard dichloromethane emission levels (1998, 2006, 2011). Also, in recent years, an increasing number of cases have been reported in which 1,4-dioxane was detected likely due to contamination from inorganic waste liquid.

■ Collection classification label (three types)

Currently, combustible and non-combustible wastes in this university are classified depending on whether hazardous materials, including halogens and benzene, are released at the time of incineration. This criterion may be subject to modification in the future due to changes in the university's environment and culture.

■Organic liquid waste classification

Classification number, color	Classification	Content of waste
(1)	General organic liquid waste (Flammable liquid waste)	Aromatic, aliphatic, and other general organic solvents (not containing halogens)
(2)	Specified organic liquid waste (Non-flammable liquid waste)	Those containing benzene and organic solvents containing halogens
(3)	Waste oil	Machine oil, cutting oil, mineral oil with ≤10% water content

■Collection labels (general organic liquid waste)

Waste classification number	Organic liquid waste
Department name	
Contact	Room Responsible person
Content	

(specified organic liquid waste)

Waste classification number	Organic liquid waste
Department name	
Contact	Room Responsible person
Content	

G. Experimental inorganic liquid waste

Flow for inorganic liquid waste disposal

Laboratory

- Store in designated containers (10 L, 20 L).
- The waste discharger is responsible for recording the name and quantity of the substance to be disposed.
- In consideration of safety during storage and transportation, do not fill up the container past nine-tenths (the designated line) of its capacity.
- Put into designated containers (1) raw effluent, (2) mercury, hexavalent chromium, and cadmium effluent (up to three washes), and (3) other metals (up to two washes).
- Separate according to the 12 classifications (refer to the next page), fill in the container-specific number, and attach the collection label.

(After hearing from the Office of Property)

The waste discharger transports the containers to the indoor hazardous material storage site in front of the machine hall on the designated days and time (generally, Tuesdays and Fridays at 14:00) and hand them over together with the request form. Before transporting, make sure that the lids of the containers are tightly closed, the labels are affixed, and the required items are filled in, and use a chemical transport trolley to transport the containers.

Indoor hazardous material storage site in front of the machine hall

Carry the containers into the storage site under the supervision of the Office of Property staff.

(E-mail reply)

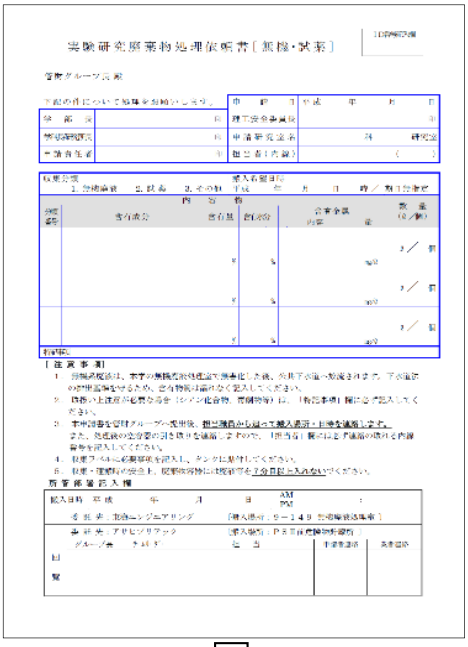
Carrying out of campus (external

The Office of Property provides the external contractor with information based on the request form and stores the electronic manifest (for 5 years).
*In principle, waste is transported to a dedicated facility in Kitakyushu for processing.

Flow of request form

Laboratory

- Fill out the "Experimental and research waste disposal request form [inorganic/reagents]" completely.
- The request form is posted on Cybozu.
- Have the form checked by the person responsible for application and submit it by e-mail (to the person in charge of waste disposal at the Office of Property; cc the Chairperson of the Faculty of Science and Technology Safety Committee and the Department Chair).
- Use the common ID assigned to experimental organic liquid waste.
- Submit the request form with the permission stamp affixed.


実験研究廃棄物処理依頼書［無機・試薬］

Approved unless the Department Chair, the Dean of the Faculty of Science and Technology or the Chairperson of the Faculty or Science and Technology Safety Committee raises an objection within three days of submission

Office of Property (approval and document storage)

For content verification, contact the external contractor. Contact the person responsible for application regarding carry-in date and time.

■ Note

① Safety

For cyanide liquid waste, make sure the details are described in the content column of the label. Keep waste in the alkaline state in order to prevent generation of cyanide gas.

During handling and transportation, pay particular attention to safety. Organic-solvent-compatible rubber gloves are available, so inform the Faculty of Science and Technology Safety Committee if you need those.

② Environment

Disposed liquid is ultimately discharged into the public sewer. We must minimize environmental load off-campus. This university constantly monitors the quality of water in the outlet of the disposal room (9-149) and the sewage inlet right before it is discharged into the public sewer.

■Inorganic substances that are subject to constant monitoring

	Unit	Sewerage Act	Water Pollution Control Act	Environmental Quality Standards
H^+ ion concentration	(pH)	5~9	5.8~8.6	6.5~8.5
Copper	mg/L	3	3	
Lead	mg/L	0.1	0.1	0.01
Cadmium	mg/L	0.03	0.03	0.003
Total chromium	mg/L	2	2	
Total mercury	mg/L	0.005	0.005	0.0005

■ Collection classification label (12 types)

■Inorganic liquid waste classification

Classification number, color	Classification	Content of waste	Special note
1	Mercury waste solution	Organic/Inorganic mercury compounds	1, 2, and 3 should never be mixed.
2	Cyanogen waste solution	Cyanide (complex) compounds	
3	Arsenic waste solution	Arsenic compounds	
4	Heavy-metal-containing waste solution	Lead-containing waste solution	4, 5, and 6 may be mixed.
5	Heavy-metal-containing waste solution	Cadmium-containing waste solution	
6	Heavy-metal-containing waste solution	Copper, zinc, and others	
7	Fluorine waste solution	Fluorine compounds	
8	Photo processing waste	Developing solution, fixing solution	
9	Chrome waste solution	Chromium compounds	
10	Waste acid	Acid waste solution	
11	Waste alkali	Alkali (earth) metals	
12	EDTA-containing waste solution	All containing EDTA	

2.3.4 Sewage discharge standards

In our university, a specific facility (sink) is installed, and we must comply with the following sewage discharge standards. When waste liquid containing these substances is to be discarded, the names of the corresponding substances must be described in the application form.

■ Sewage discharge standards (except dioxins) (within 23 wards of Tokyo)

(As of October 21, 2015)

Regulated substance or item			Operator of specified facility under the Water Pollution Prevention Act		
			Average wastewater volume of 50 m^3/day or more	Average wastewater volume of less than 50 m^3/day	
Hazardous substances	Cadmium		≤ 0.03 mg/L	≤ 0.03 mg/L	
	Cyan		≤ 1 mg/L	≤ 1 mg/L	
	Organic phosphorus		≤ 1 mg/L	≤ 1 mg/L	
	Lead		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Hexavalent chromium		≤ 0.5 mg/L	≤ 0.5 mg/L	
	Arsenic		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Total mercury		≤ 0.005 mg/L	≤ 0.005 mg/L	
	Alkyl mercury		Not to be detected	Not to be detected	
	Polychlorinated biphenyl		≤ 0.003 mg/L	≤ 0.003 mg/L	
	Trichlorethylene		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Tetrachlorethylene		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Dichloromethane		≤ 0.2 mg/L	≤ 0.2 mg/L	
	Carbon tetrachloride		≤ 0.02 mg/L	≤ 0.02 mg/L	
	1,2-dichloroethane		≤ 0.04 mg/L	≤ 0.04 mg/L	
	1,1-Dichloroethylene		≤ 1 mg/L	≤ 1 mg/L	
	Cis-1,2-dichloroethylene		≤ 0.4 mg/L	≤ 0.4 mg/L	
	1,1,1-trichloroethane		≤ 3 mg/L	≤ 3 mg/L	
	1,1,2-trichloroethane		≤ 0.06 mg/L	≤ 0.06 mg/L	
	1,3-dichloropropene		≤ 0.02 mg/L	≤ 0.02 mg/L	
	Thiuram		≤ 0.06 mg/L	≤ 0.06 mg/L	
	Simazine		≤ 0.03 mg/L	≤ 0.03 mg/L	
	Thiobencarb		≤ 0.2 mg/L	≤ 0.2 mg/L	
	Benzene		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Selenium		≤ 0.1 mg/L	≤ 0.1 mg/L	
	Boron and its compounds		≤ 10 mg/L	≤ 10 mg/L	
			≤ 230 mg/L	≤ 230 mg/L	
	Fluorine and its compounds		≤ 8 mg/L	≤ 8 mg/L	
			≤ 15 mg/L	≤ 15 mg/L	
	1,4-dioxane		≤ 0.5 mg/L	≤ 0.5 mg/L	
Environmental items, etc.	Total chrome		≤ 2 mg/L	≤ 2 mg/L	≤ 2 mg/L
	Copper		≤ 3 mg/L	≤ 3 mg/L	≤ 3 mg/L
	Zinc		≤ 2 mg/L	≤ 2 mg/L	≤ 2 mg/L
	Phenols		≤ 5 mg/L	≤ 5 mg/L	—
	Iron (soluble)		≤ 10 mg/L	≤ 10 mg/L	—
	Manganese (soluble)		≤ 10 mg/L	≤ 10 mg/L	—
	Biochemical Oxygen Demand (BOD)		< 600 mg/L (< 300 mg/L)	—	
	Suspended solid amount (SS)		< 600 mg/L (< 300 mg/L)	—	
	n-Hexane extracts	Mineral oil	≤ 5 mg/L	—	
		Animal and vegetable oil	≤ 30 mg/L	—	
	Nitrogen		< 120 mg/L	—	

	Phosphorus	< 16 mg/L	—
	Hydrogen ion concentration (pH)	> 5 - < 9 (> 5.7 - < 8.7)	> 5 - < 9 (> 5.7 - < 8.7)
	Temperature	< 45 °C (< 40 °C)	< 45 °C (< 40 °C)
	Iodine consumption	< 220 mg/L	< 220 mg/L

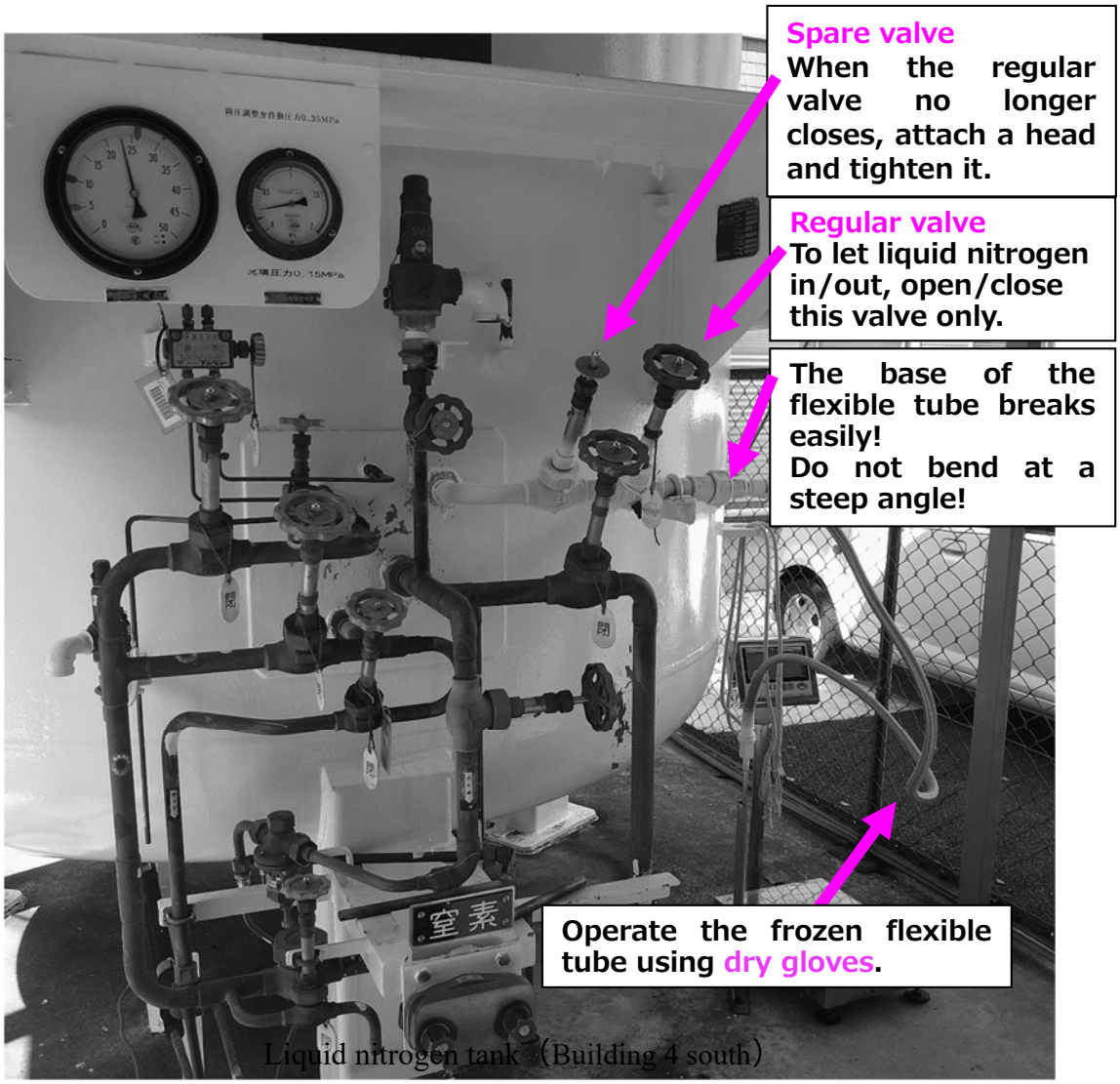
1 With regard to standards for boron and its compounds and fluorine and its compounds, those shown in the upper rows correspond to levels set for discarding into “public sewage systems that discharge into rivers and other public waters,” and those shown in the lower rows correspond to levels set for discarding into “public sewage systems that discharge into sea areas.” (These standards vary depending on the location of business site.)

2 With regard to standards shown in ■, the total chromium standard for operators of specified facilities with an average wastewater volume of “less than 50 m^3/day” applies to those who have factories set up, or those who set up designated work sites after April 1, 2001; the standards for copper, zinc, phenols, iron, and manganese apply to those who set up factories after April 2, 1972, or those who set up designated work sites after April 1, 2001. Here, factories refer to those defined in Article 2, item 7 of the “Ordinance on Environmental Preservation to Secure the Health and Safety of Citizens of the Tokyo Metropolitan Area” (2000 Tokyo Metropolitan Ordinance No. 215), and work sites refer to those defined in item 8 of the same article.

3 Values in ( ) related to BOD, SS, pH, and temperature apply to the manufacturing industry or the gas supply industry.

3. Safety handling of high-pressure gas

3.1 Liquid nitrogen tank



Liquid nitrogen tank (Building 4 south)

■ **Oxygen deficiency**

① Room ventilation

Oxygen concentration in normal air is 21%. It starts to feel abnormal when the concentration drops to 18% or less. Be sure to ventilate when a large amount of liquid nitrogen is used indoors. Please be careful of accidents caused by lack of oxygen.

② Use of an oxygen detector is recommended.

■ Risk avoidance

① To prevent frostbite, work with gloves on when handling a liquid nitrogen tank (see previous page)

② Be sure to stay where you can watch the operation

An unspecified number of people pass by the site. In order to cope with liquid overflow and other unexpected situations, please pay attention.

・・・Please stand as close as possible while watching the operation.

③ A large container should be carried by two people (100 L or more).

There are dangers that cannot be addressed alone, such as when there is a step, especially when getting on and off the elevator, as the container may easily fall. It could be harmful for people around you if liquid nitrogen spills, as it could cause frostbite or suffocation.

④ When the elevator is used

In principle, no passengers other than the persons involved are allowed in.

■ Use of liquid nitrogen

(1) Usage fees

Liquid nitrogen is not free! Purchased liquid nitrogen is stored in a tank on the south side of Building No. 4. Users are charged usage fees, and purchasing fees are proportionally allocated to each laboratory on the basis of the amount used every month.

(2) Usage record

As the amount used is determined on the basis of self-reported usage by each laboratory, be sure to fill in the recording sheet accurately (can be found at the entrance near the tank in Building No. 4). In particular, not entering the name of the laboratory and the amount used (kg) appropriately will lead to inconvenience as it takes time to verify.

(3) Close valve tightly after taking out liquid nitrogen.

Leakage may occur if the valve is closed loosely. The amount of liquid nitrogen lost due to leakage will also be added to your fees!

(4) Education on operational safety

According to high-pressure gas hazard prevention rules, it is compulsory to implement operational safety education once a year. Attendance is mandatory for new users of liquid nitrogen/gas tanks. Operational safety education is scheduled in the end of April or early May every year.

(5) In the case of abnormality and others

Contact the high-pressure gas safety manager or officer whose name is written on the fence of the tank (also shown on the recording sheet).

3.2 High-pressure gas container

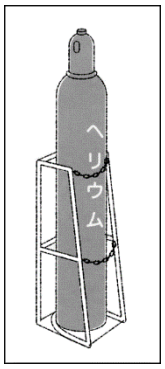
3.2.1 You can tell the type of gas by the color of the container!

Use of a wrong type of gas could yield catastrophic results. There was a case at a hospital in which a patient died because he was connected to nitrogen by mistake, while the intention was to perform oxygen inhalation. To prevent mistakes, the color of the container and the color of the letters are decided depending on the type of gas. "Flammable" for the combustible gas, "poison" for the toxic gas is written on the container.

■Container color and letter color of major gas cylinder

Types of gas	Container color	Letter color	note
Oxygen	black	white	
Hydrogen	red	white	combustible (red)
Nitrogen	gray	white	
Helium	gray	white	
Argon	gray	white	
liquefied carbon dioxide	green	white	
Acetylene	brown	white	combustible (white)

3.2.2 The weak point of the cylinder is its cap!



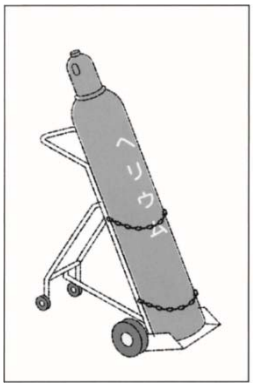
Fix the cylinder securely to prevent it from falling in the event of an earthquake, etc. When the cylinder falls with the pressure regulator attached, breakage of the cap could lead to an accident. **Fix** it to the wall or a dedicated stand using a belt or chains, and put a cover on the cap. Fix the cylinder in two positions, i.e., the bottom and middle parts.

■ Storage

The number of tanks in the laboratory should be kept to a minimum. Make sure to place the cap on the tank when the tank is not in use. In the event of a fire or an earthquake, the damage may increase if the tank explodes.

■ Transport

Be sure to use a cart for cylinder transport.



3.3 Pressure regulator

3.3.1 It should not be shared among different gases!

■ The attachment of the pressure regulator to the cylinder

① Right screw for most gases

② Reverse screw

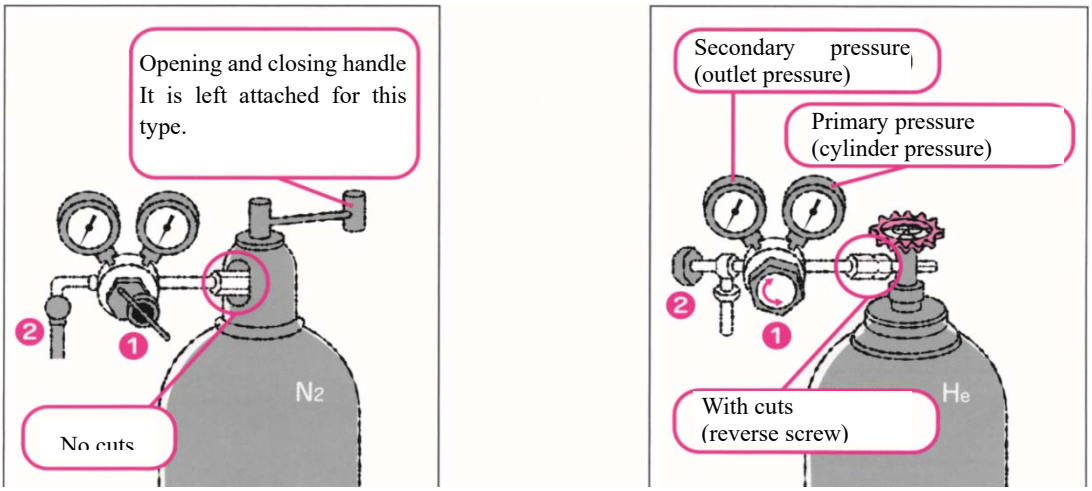
The mounting port is usually a reverse screw in the case of helium and hydrogen gas, etc.

How to identify: a reverse screw has cuts on the cap nut.

Why a reverse screw?

If all regulators were the same, and if the pressure regulator used for a hydrogen gas cylinder was used for an oxygen gas cylinder, not only would the gases mix but there also would emerge a risk of fire and explosion. The idea is to prevent making the **careless mistake** of sharing a pressure regulator used **for combustible gases**, such as hydrogen, and that used for **combustion-supporting** gases, such as oxygen.

■ An example of pressure regulator



3.3.2 Make no mistakes! Valve①

Valve①

To open, turn it clockwise and **push** (the pressure on the secondary side increases).

To close, turn it counterclockwise; it is enough to just **loosen** the valve (if you turn it too much, it might come off).

■ Mistakes often made by beginners

Turning the valve all the way to the right in an attempt to close it --- opening the source valve of the cylinder without noticing could break the pressure gauge (pressure regulator)!!

■ In order to avoid mistakes

When you open the valve of the cylinder head, make a habit of **consciously checking** that the valves (sun) (moon) are closed.

［Other］ In case of oxygen, make sure you use the “oil-free processed” kind.

4. Precautions in use of electricity

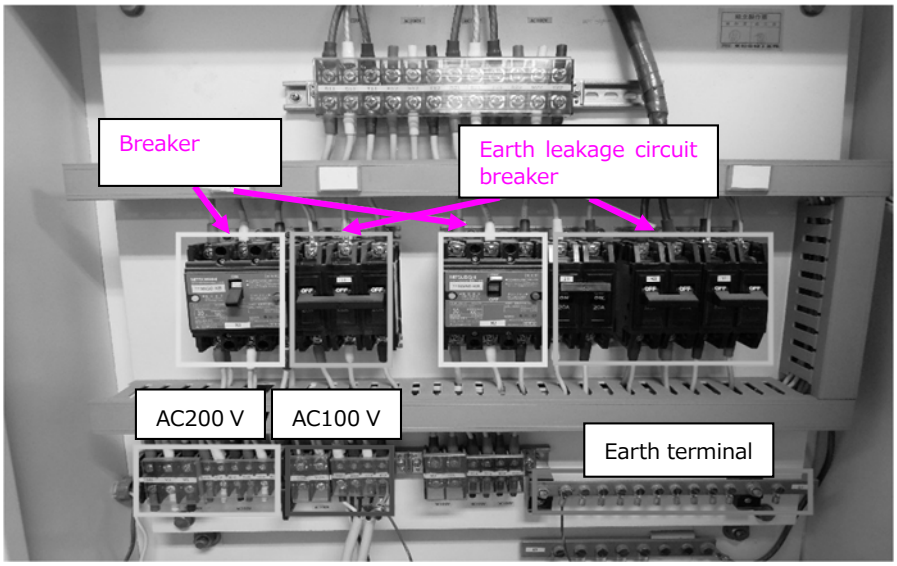
Electricity is indispensable for today's modern lifestyle. However, the use of energy poses several risks, and electrical energy may be as dangerous as other forms of energy. Improper usage may be hazardous to humans, cause fires, or cause radio interference or inductive interference to communication equipment and the like.

In order to prevent accidents and ensure safety, it is essential to know the basics of electricity and properly understand the rules for using electricity. In this chapter, electrical equipment in laboratories and research rooms is explained first, followed by electrical accidents and prevention. Finally, safety precautions to be observed when actually wiring various electric devices are discussed to ensure safe use of electricity.

4.1 Distribution board

Electricity supplied to each research room and laboratory is divided into several passages (circuits) and distributed to each device. All of these circuits are contained in a box called a distribution board (shown in figure below). The distribution board is equipped with an earth leakage circuit breaker (breaker) and an overcurrent circuit breaker (circuit breaker), which are safety devices that automatically break an electric circuit when leakage current of an electric device is detected by any chance, or when excess current (from an overload or short circuit) is detected, respectively.

The distribution board provides one breaker each for AC 200V circuit and AC 100V circuit. The AC 200V supplies three-phase AC (U, V, W) and is connected with three wires. Caution should be exercised when handling rotating machines, such as pumps, because depending on the wiring order, the rotation might be reversed. The AC 100V supplies single-phase AC and is connected with two wires. The green wire of the 3-pin power strip is the earth wire, which is connected to the earth terminal of the distribution board.



Distribution board

4.2 Preventing electrical leakage/shock accidents and electrical overheating

■ Electrical leakage

Indoor wiring and electric devices are "insulated" to prevent electrical leakage; however, when an insulator gets old, damaged or wet, electricity is leaked, causing a short circuit. You have to be cautious about electrical leakage as it can lead to electrical shock or fires. In order to prevent accidents upon electrical leakage, earthing should be done to discharge electricity to ground. The earth terminal is mounted on the distribution board, and you only need to connect the terminal and the electric device by wiring.

Important!!

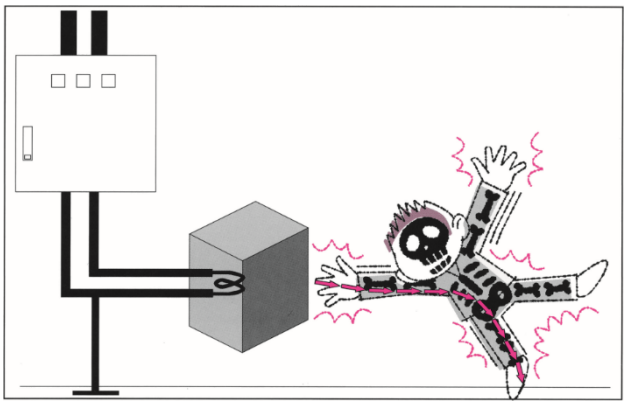
How to prevent electrical leakage

1. By connecting to earth leakage circuit breaker
2. By earthing
3. By inspecting the power supply part from time to time to prevent dust and dirt

■ Electrical shock

When a person comes in contact with a device that leaks electricity, electricity flows through the person's body to the ground. This is called electrical shock.

If a human body suffers from electrical shock, i.e., an electrical signal flows from outside into a human body, the heartbeat is adversely affected. When the electrical shock current or shock duration exceeds a certain value, the heartbeat becomes irregular, causing uncontrolled contraction of cardiac muscles (ventricular fibrillation). Table 1 shows electrical shock currents and physiological responses of the human body.



Electrical shock accident

■**Electrical shock currents and physiological responses of the human body**

Electrical shock current	Response of the human body
0 - 0.5 mA	Below level of perception
0.5 - 5 mA	Produces tingling pain in fingers and arms
5 - 30 mA	Produces cramps, causing inability to let go of electrical equipment. The victim may experience breathing difficulty or blood pressure elevation.
30 - 50 mA	Produces severe cramps. The victim may faint or experience blood pressure elevation. Death may ensue if the victim is exposed to electrical shock for a long time.
50 mA or above	The victim suffers from severe shock and is highly likely to die of cardiac arrest or heavy burns.

The direct cause of electrical shock accident is current rather than voltage; however, when considering the actual protective means, it may be inconvenient in some cases to address current only and therefore, safety voltage is prescribed. Safety voltage is determined on the basis of safety current for, and resistance of, the human body. Resistance of the human body varies depending on the wet/dry condition of skin. Table lists contact situations and safety voltages.

In the case of high voltage, an electrical shock may occur without direct contact due to electric discharge. To ensure safety, you need to be 30 cm or more away for 2.5 kV and 1 m or more away for 50 kV.

■**Contact situations and safety voltages**

Contact situation	Safety voltage
Most of the human body is submerged in water.	Up to 2.5 V
The human body is soaking wet. Part of the human body is in constant contact with a metallic electric device.	Up to 25 V
Any situations other than the above where risk is high when contact voltage is applied to normal human body condition.	Up to 50 V

Measures to prevent electrical shock accident are as listed below:

Important!!

Measures to prevent electrical shock accident

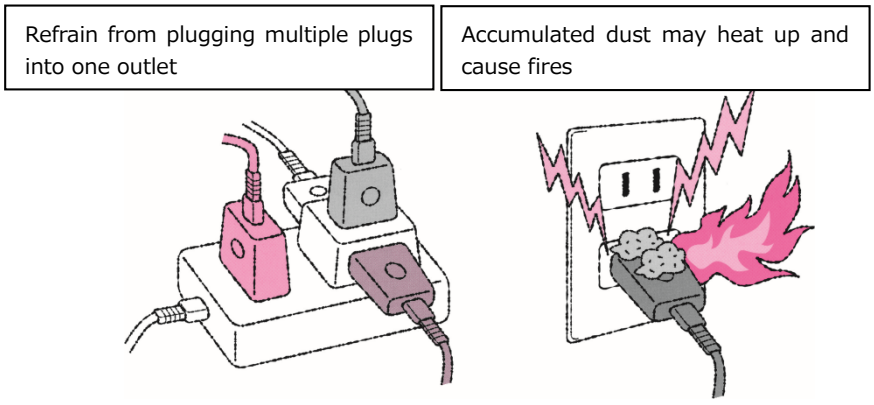
1. Avoid touching electrical equipment with wet hands.
2. Connect to earth
3. In principle, do not touch charged or energized parts in the hot-line (energized) state. Turn off both switch and breaker, make sure that they are not energized, and then touch the charged/energized parts.
4. Block high-voltage devices with insulators and clearly delineate hazard areas.

■ Electrical overheating

When many electric devices are used at the same time or the contact of an outlet or a switch is faulty, the wiring cord heats up, causing the cord coating to melt or burn. Exercise caution to avoid such situations. An electric device is equipped with a fuse that cuts off abnormal current flow. To prevent an accident, it is essential to use the **appropriate fuse for each device**. Even if the connection is normal, the entire device or its specific parts, including cords, might become abnormally hot due to long-time energization. In addition to the rated voltage and current of the device, you should also be aware of the assumed energization time (e.g., continuously, one hour, etc.). It is also necessary to confirm that there is no abnormality in the cooling fan of the device and that no object is placed near the outside-air intake port.

Wall outlets are found in research rooms and laboratories. Normally, up to 15 A electrical supply is available from one outlet. Plugging multiple devices at the same time into one outlet by using a power strip causes overheating of the cords. When the number of **electric devices increases**, it is necessary to wire **from other circuits to ensure safe use of electricity**.

Improper contact between a plug and an outlet may cause unplugging or heating. Make sure to insert a plug into an outlet properly. In many cases, faulty contact of the cord or a loosened screw of a plug is a cause of device failure. Do not pull the cord when unplugging, staple the cord to fix, or bundle the cord. Make sure to **handle the cord and the plug with care**. Dust accumulated around the outlet may heat up and cause fires. Make sure to wipe **clean with a dry cloth** from time to time.



Precautions for electrical wiring

Important !!

How to prevent electrical overheating

(1) Use the appropriate fuse.
(2) Refrain from plugging multiple plugs into one outlet.
(3) Connect plugs and outlets properly
(4) Handle cords and plugs with care.
(5) Avoid accumulating dust
(6) Avoid bundling cord while it is plugged in.

4.3 Wiring to electric devices

When actually connecting electric devices to distribution boards and outlets, electrical wires are used. Among them, cords and cables are generally used. When connecting electrical wires and electric devices, it is important to understand their electric characteristics and tolerable currents. If current exceeding the allowable current flows, wiring will become overheated; this will impair insulation and an accident (fire, electric shock) might occur due to leakage current/short circuit, etc. Care must be taken when selecting wires.

■ Cord

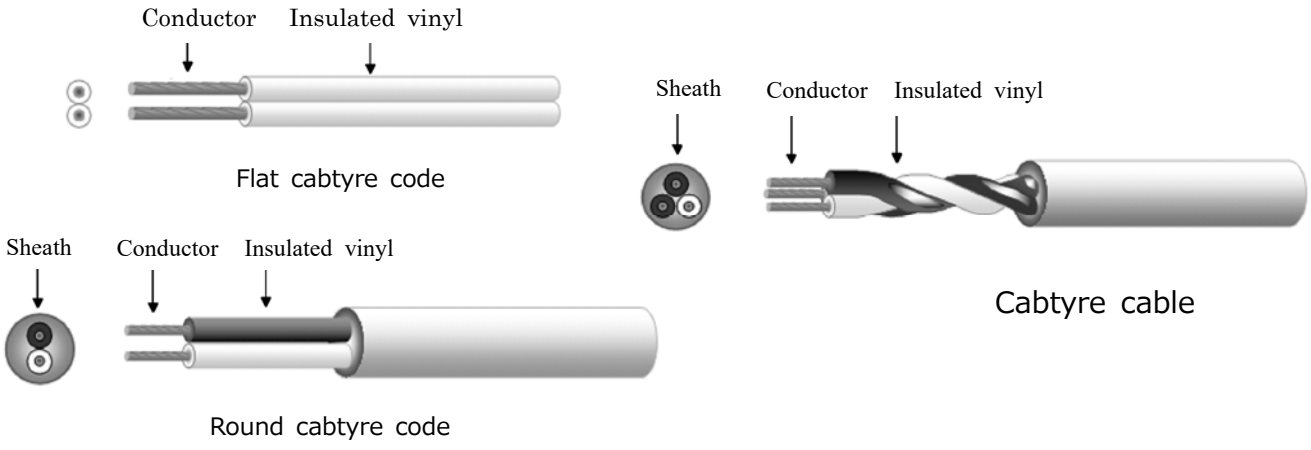
A cord is used as a movable electrical wire that is attached to a portable electric machine or appliance, and is not to be fixed to the wall or floor. The rated current of a typically used flat vinyl cable is 7 A (0.75 mm2 core wire) in general. It is simpler and more flexible than a cabtyre cable.

■ Cable

A cable is covered with an insulator even more securely than an insulated electrical wire that is composed of a conductor covered with a rubber or plastic insulator; in order to protect the insulator and the conductor from external damage, it is again covered with a protective sheath (armor). For indoor fixed wiring, a flat vinyl sheathed cable (F-cable) is typically used. As for the rated current, the tolerable current is 19 A for a vinyl sheath of 1.5 mm thickness, for example.

■ Cabtyre cable

A cabtyre cable is used as a movable electrical wire that is connected to movable electrical equipment (600 V or less) or a similar machine or appliance. It is robust to abrasion, shock, and bending compared to a cord, and is highly waterproof. The rated current varies by thickness and is typically around 15 to 25 A (2 ~ 3.5 mm^2).



Vinyl cord and cabtyre cord

5. Safe use of tools and machine tool

Most of the accidents that occur during handling of tools and machine tools are caused by human factors, including slight carelessness and untidiness. Make sure to use tools and machine tools properly by following the safety precautions for handling, while paying adequate attention to prevent possible accidents.

5.1 Precautions for clothes and work

The machine tools to be used for materials processing include a turning machine, a milling machine, a drilling machine, and a band saw machine. By using these machine tools, you can complete contour processing, end-surface processing, drilling, and threading, for example. Improper use of the machine tools may result in a serious accident, so you have to be alert. The safety precautions at work using machine tools are listed below.

■ The general precautions common to all machine tools

① Wear appropriate clothes

Basically, the clothes during work should be such that they protect you from burn or injury caused by scattered chips. You should dress in such a way that your clothes or hair would not be caught in a rotating object or other equipment. You should avoid loose-fitting clothes, such as a white lab coat, as they can easily get caught; instead, wear well-fitted work clothes properly. Make sure to wear sports shoes and the like instead of slippers or sandals to avoid risk of injury by chips or materials.

Be careful of what you wear

② Avoid wearing gloves when using a machine that performs rotational or high-speed reciprocating motion.

③ Wear protective glasses and other protective gears as needed.

④ It is dangerous to work when you feel ill or while you are lost in thought.

⑤ Make sure that at least two persons are working nearby in order to respond to an emergency.

⑥ Do not touch switches for no reason at all during operation.

⑦

■ The following accidents are anticipated during use of machine tools

a) Getting hit by a rotating part or caught by a driving part

b) Getting injured by scattered chips

c) Getting injured by a broken and scattered turning tool, mill, or workpiece

Use all tools and machines properly and adhere to proper usage methods. People often get unexpected injuries as a result of operating tools/machines from vague memory or due to materials or tools damaged by inappropriate use. It is desirable to receive guidance from a technician beforehand, become familiar with the use of tools and machines, and eliminate unclear points.

5.2 Precautions for machine tools

The precautions at work using machine tools are as listed below.

■Turning machine operation

Work item		Safety precautions
Rotating speed		Calculate the cutting speed using the following equation $V = \pi DN/1000$ V: Cutting rate [m/min]、D: Diameter [mm]、N: Number of rotations [min^{-1}] * Material S45C ① The number of rotations should be determined on the basis of processing material and shape. ② When cutting at high-speed rotation, receive guidance from a technician. ③ When using a high-speed steel turning tool, set the number of rotations so that V is around 15. ④ When using a carbide turning tool, set the number of rotations so that V is around
Cutting conditions	Feeding rate	① When using a high-speed steel turning tool, feeding rate should be around 0.2 [rev/min] for roughing cut, or around 0.1 [rev/min] for finishing cut. ② When using a carbide turning tool, feeding rate should also be 0.2 to 0.1 [rev/min]. ③ When feeding rapidly in automatic feeding, receive guidance from a technician.
	Cutting depth	① When using a high-speed steel turning tool, cutting depth should be 1.0 to 3.0 [mm] in radius for roughing cut, or 0.2 to 0.5 [mm] in radius for finishing cut. ② When using a carbide turning tool, cutting depth should be 0.40 to 3.0 [mm]. ③ An exceedingly large cutting depth in automatic feeding increases risk. Receive guidance from a technician.
Attachment of turning tool		Align the height of the tip to the center and fix the turning tool firmly with two or three fastening bolts. Make sure to fasten the tool rest as well.
Attachment of materials		Set gear to neutral position when attaching or detaching materials. Fasten materials properly in case of attachment. Make sure to remove the chuck handle after use.
General processing operation	Contour processing	Set a long object at the rotating center. Select other turning tools according to shape.
	End-surface processing	Use an offset turning tool for stepped processing or a straight turning tool for plane processing.
	Drilling	After using a center drill, make a hole with a drill. Use one drill for brass. For finishing, use a boring tool.
	Threading	Threading requires high skills. Receive guidance from a technician.
Machine operation	Gear change	Do not change the gear during operation. Rotate the chuck manually to mesh
	Operation switch	Confirm if it is in forward or reverse operation, and do not stand in front of the chuck and workpiece.
	Feeding	Make sure to check carefully before switching the automatic feeding for vertical and horizontal feeding.
	Brake	Step on the brake while holding onto the tool rest after the switch is turned off, or in case of danger.
Safety Precau	Work posture	Stand in such a way that you can operate the handles for horizontal feeding and vertical feeding with your right hand and left hand, respectively. Do not stand in

		front of the chuck and workpiece.
	Chip processing	Do not touch with bare hands while a machine is rotating or even when it is stopped. Make sure to use a chip removing rod.
	Cutting agent	It is not necessary for cast iron, brass, and Bakelite. For others, use the agent as needed.
	Measurement	Do not perform measurement while standing in the rotation direction of the chuck. Make sure to stop rotation before measurement.

Milling machine operation

Work item		Safety precautions
Cutting conditions		Calculate the cutting speed using the following equation: $V = \pi DN/1000$ V: Cutting speed [m/min], D: Milling diameter [mm], N: Spindle speed [min^{-1}] Determine feed per tooth using the following formula: $F = fz \cdot Z \cdot N$. F: Feed per minute [mm/min], fz: feed per tooth [mm/tooth], Z: number of teeth, N: number of revolutions [rpm] Rough processing: 1.5 to 4 mm cutting depth, finish: 0.3 to 0.5 mm cutting depth As the cutting speed and the feed per tooth differ depending on the difference between a front mill and an end mill and the difference in materials (steel material, alloy steel, stainless steel or aluminum alloy), the cutting conditions should be determined after carefully checking the specifications in the tool manual.
Attachment/detachment of tools		When holding teeth during replacement of face mill or end mill, handle with great care to prevent slipping from hands.
Attachment of materials		In principle, perform the setup procedure on the machine vice. For other setup methods, receive guidance from a technician.
Tools for processing	Face mill	Typically used for plane processing (Vertical or horizontal)
	End mill	Used in grooving, step milling, and side milling (Vertical or horizontal)
	Center drill	Used as a guide of the hole center before a drill is used
	Drill	Used for drilling
	Machine reamer	Used when accuracy of drilled holes is required
	Dial gage	Used for centering or paralleling round materials
Machine operation	Conversionof main shaft rotation speed	Change lever position by using the Low/High switch and the rotation speed table. Do not operate during rotation.
	Activation of main shaft	Press black button to activate and red button to stop.
	Cutting direction	Cut workpiece upward (Upward cutting).
	Feeding	Perform manual feeding or automatic feeding according to tool cutting quality.

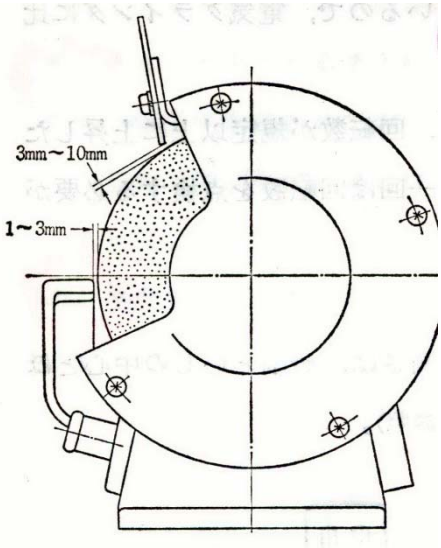
	Fast forward	Use only when cutting operation is not performed.
	Operation	Make sure that only one person operates the machine when work is performed by more than one person.
Safety precautions at work	Work posture	Do not stand in the cutter rotation direction; pay extra attention when using a horizontal milling machine.
	Chip processing	Keep waste cloth away while cutter is rotating.
	Cutting agent	Apply cutting agent on workpiece from the opposite side of the rotation direction by using a brush.
	Chamfering	Make sure to perform chamfering after machining to remove burrs.

Drilling machine operation

<table>
<tr><th colspan="2">Work item</th><th>Safety precautions</th></tr>
<tr><td rowspan="5">Cutting conditions</td><td rowspan="5">Rotation speed</td><td>Calculate the number of revolutions using the following equation: $N = 1000V/\pi D$.
N: Spindle speed [min^{-1}], V: Cutting speed [m/min], D: Drill diameter [mm], S: Feed [mm/rev]
<table>
<tr><th></th><th colspan="2">Steel</th><th colspan="2">Cast iron</th><th colspan="2">Brass</th></tr>
<tr><th>D</th><th>V</th><th>S</th><th>V</th><th>S</th><th>V</th><th>S</th></tr>
<tr><td>2～11</td><td>20～25</td><td>0.1～0.2</td><td>25～40</td><td>0.1～0.2</td><td>50～</td><td>0.05～0.15</td></tr>
<tr><td>12～25</td><td>30～35</td><td>0.25～0.3</td><td>20～30</td><td>0.35～0.6</td><td>50～</td><td>0.3～0.45</td></tr>
<tr><td>26～50</td><td>25～30</td><td>0.4</td><td>20</td><td>1.0</td><td>50～</td><td>0.3～0.45</td></tr>
</table></td></tr>
<tr><td colspan="2">Attachment/detachment of tools</td><td>① Attach 1 to 13 [mm] tool to drill chuck. For tool measuring 14 mm or larger, use sleeves (#2/#3/#3-#4)
② Use an arrow (or a wedge) when detaching the tool.</td></tr>
<tr><td colspan="2">Attachment of materials</td><td>① When drilling a plate material, make sure to use at least two clamps.
② When vertically drilling on a round material, make sure to use a scroll chuck or a V-block.
③ When vertically or horizontally drilling on a polygonal material, make sure to use a vice or a clamp.</td></tr>
<tr><td rowspan="3">Machine operation</td><td>Rotation</td><td>Use a V-belt to switch the bench drilling machine; for others, switch by making a gear change.</td></tr>
<tr><td>Table</td><td>Make sure to fix table when machining height adjustment/centering is completed</td></tr>
<tr><td>Feeding</td><td>In manual feeding, feed intermittently by using a handle. In automatic feeding, make the setting based on the above conditions.</td></tr>
<tr><td rowspan="3">Safety precautions at work</td><td>Gloves</td><td>Do not wear gloves as there is a high risk of the gloves getting caught.</td></tr>
<tr><td>Prepared hole prohibited</td><td>For brass, drill it at once by using a drill of required diameter after using a center drill. (It is dangerous as the drill may bite into a prepared hole.)</td></tr>
<tr><td>Cutting agent</td><td>Refrain from using cutting agent for brass, cast iron, Bakelite, and wood.
For other materials, use as necessary.</td></tr>
</table>

■Bench grinder

Work item		Safety precautions
Setting of work rest		Make sure that the gap between work rest and whetstone is 3 [mm] or smaller. If the gap is large, workpiece may get caught, breaking the whetstone or causing finger injuries.
Setting of adjusting piece		Make sure that the gap between adjusting piece and whetstone is 3 to 10 mm. The adjusting piece is also known as the spark breaker. It is useful to block the red-heated grinding powder, as well as to prevent accidents when the whetstone is damaged.
Safety precautions at work	Whetstone	Do not apply unnecessary force on the whetstone.
	Used surface	Use only the predetermined surface for use. The whetstone cannot withstand force from the lateral direction, so do not use the side.
	Position	Do not stand in front of the machine.



砥石（ワークレスト･調整片）

■Hacksaw machine operation

Work item		Safety precautions
Processing conditions	Cutting speed	Saw frame speed should be around 18 [mm/min] except for special materials. It should not be touched generally.
	Processing dimensions	Width 300 [mm], height 300[mm] or below
Attachment of workpiece		When tightening material whose width is up to 1/2 of the width of the vise, prepare the material in the same width on the opposite side.
Replacement of band saw		When replacing, receive guidance from a technician.
Operation	Dimension adjustment/fixing	Press saw frame lowering button to lower it to about 10 [mm] above the material, determine cutting length, and tighten the material firmly.
	Cutting	Press activation button.
Safety precautions at	Position	Do not stand on the side of the machine during processing.
	Pressure	When the saw is not sharp enough, avoid applying unnatural pressure.
	Cutting agent	Refrain from using cutting agent for brass, cast iron, Bakelite, and wood.

Vertical band saw machine operation

Work item		Safety precautions
Cutting conditions	Cutting speed	Low 15～90 mm/min: Steel materials High 210～1200 mm/min: Aluminum materials, copper, wood ① Make sure to refer to the work selector before machining. ② Confirm the processing material, torque scale, and thickness of material on the head on the front face of the machine before making the setting.
	Processed plate thickness	Plate thickness： t = 1～250 mm、MAX 400 mm
	Selection of band saw	① When processing steel, use a blade with small pitch. ② When processing aluminum material or copper, use a blade with large pitch.
Replacement of band saw		When replacing, receive guidance from a technician.
Operation		① Confirm low-speed and high-speed levers before starting operation. ② Turn on switch, select rotation speed with the selector, and increase rotation speed to target value by turning the handle clockwise. After processing is completed, reduce rotation speed to 15 [mm/min] by turning the handle counterclockwise before turning off the switch.
Safety precautions at work	Material	It is preferable to use a cover plate when pushing materials to keep your hands away from the band saw.
	Feeding	Adjust force for pushing the materials according to the sharpness of the band saw.
	Thin plate	Use plywood or the like under the materials.
	Circular processing	Note that R processing range varies depending on the blade width of the band saw.
	Processed surface	File processed surface to remove burrs, which can be dangerous.

6. Safety in other experiments

Many other aspects require safety considerations when conducting experiments/practical training and research. Among them, safety concerning lasers, radioactive isotopes (RIs), radiation, X-ray, and living organisms is described in this section. The important thing is to follow the instructions of the laboratory managers and avoid peering in out of mere curiosity or putting out your hands in a careless manner.

6.1 Safety concerning laser beams

When using high-power laser devices, the safety of the eyes is the most important issue. Looking directly into the output beam of the laser may lead to serious injury and sometimes to even blindness.

In the laboratory, fine laser beams are always present at various angles in the vicinity of a laser device. These beams are generated due to reflection of the main beam by glossy surfaces, such as the lens and the beam splitter. They are not as powerful as the main beam; nevertheless, they still have sufficient intensity to damage the eyes. Therefore, it is necessary to **alert** those who are likely to be exposed to laser beams that **a laser device is in operation**. All workers must wear **safety protective goggles** to protect their eyes from laser beams.

As for lasers, safety classification has been developed and criteria have been set for **Class 1 (safe)** through **Class 4 (very dangerous)**. However, please avoid looking into a beam inadvertently just because it is classified as Class 1 and is considered safe. Also, be aware that laser output comes in a range of wavelengths from ultraviolet to infrared, and the degree of risk varies depending on the wavelength.

Lasers are also powerful enough to burn the skin, clothing, and paint. Please exercise care.

6.2 Use of radioisotopes and radiation

The purpose of radiation protection is to protect the environment and ensure the safety of people potentially exposed to radiation from harm associated with radiation use. When using a radioactive isotope (RI), a radiation generator, or an X-ray machine, we must comply with regulations stipulated by laws and ordinances. Currently, in our university, we cannot use or store RIs as specified in the Act on Prevention of Radiation Hazards due to Radioisotopes, etc. (RI Act). On the basis of this law, Sophia University has established the “Sophia University Radiation Hazard Prevention Regulations” The radiation protection supervisor oversees safe handling. It is mandatory for users to attend a workshop and **receive safety lecture beforehand**. The curriculum is separately organized.

6.3 Safe handling and knowledge of living organisms

As seen in cases of infections and food poisoning, we are always susceptible to biological hazards (biohazard). In biological experiments, because the danger is increased inevitably, it is important to thoroughly understand the following three points: danger due to living organisms, the concept of safety measures, and experimental guidelines.

6.3.1 Danger due to living organisms

The development of life sciences has led to the understanding that the mechanisms of transmission and onset of diseases are more complex than we had imagined. Furthermore, the effects of drugs and poisons on the living body, gene propagation that occurs between species, and the potential threat of genetically modified organisms are gradually being unraveled. We need to consider carefully whether we are creating hazards in the laboratory unintentionally.

■ **Examples of laboratory biohazards**

(1) Infection inside the body

The most likely cases are those in which pathogens and their toxic substances enter the experimenter's body via aspiration, ingestion, or infection from wounds. Even slight carelessness or operational error could lead to a serious disease.

(2) Contamination inside and outside the laboratory

In addition, neglecting the proper handling and disposal of living organisms could result in the spread of contamination inside and outside the laboratory, beyond the level of individual infection. This too could lead to unexpected damage.

In general, issues that likely arise when considering biohazards are those pertaining to microorganisms. Things not visible to the naked eye tend to receive little attention (of course, safe handling of animals and plants is just as important!)

6.3.2 Concept of safety measures

The cardinal rule of safety in biological experiments is "physical containment." In other words, experimental organisms should be handled only in the restricted area, and the spread of risk factors should be prevented (do not let them leave the laboratory!). Safety rules concerning all biological experiments are created on the basis of this principle.

Compliance with rules not only protects ourselves but also ensures the safety of the laboratory, building, university campus, and people in the region. It will also contribute to the preservation of the ecology and the environment. Once an issue emerges, the seriousness of such an incident is evident from familiar examples.

① As a result of imported pets being irresponsibly released by their owners into the wild, the

survival of native species and the regional ecosystem have been endangered by their breeding in the wild.

② Nosocomial infections by pathogens that have acquired resistance to antibiotics and disinfectants have posed a serious problem in the medical field as a biohazard example where contamination is difficult to prevent.

We accept responsibility to strive for biohazard prevention in exchange for the right to perform biological experiments on our own initiative.

6.3.3 Genetic modification experiments and Animal experiments

In this university, many laboratories carry out genetic modification experiments and animal experiments. Precautions regarding these experiments are summarized in the following.

■ Genetic modification experiments

Experiments in which viruses, microorganisms, plants, and animals are handled using gene recombination technology are referred to as "genetic modification experiments." These experiments can be initiated only after applying to and receiving reviews and approval from the university and the Ministry of Education, Culture, Sports, Science and Technology.

Safety guidelines regarding genetic modification experiments in Japan are based on the "Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms" (the Cartagena Protocol on Biosafety to the Convention on Biological Diversity). All genetic modification experiments conducted in this university are laboratory research (type II use, etc.), and measures (physical containment) to prevent the dispersal of genetically modified organisms (hereinafter, referred to as "modified organisms") are mostly implemented according to "P1-level" light standards.

P1-level experiments conducted in this university are subject to the following measures.

① Close laboratory doors and windows when experiments are ongoing.
② Disinfect laboratory table after finishing experiments.
③ Disinfect experimental instruments and apparatus after finishing experiments.
④ Waste contaminated by modified organisms should be autoclaved.
⑤ When cleaning instruments contaminated by modified organisms, disinfect first before washing.
⑥ Place modified organisms in a container when carrying out of the laboratory so as to prevent their dispersal.

Lab door signage

Other rules include:

⑦ Eating, drinking, and smoking in the laboratory are prohibited.
⑧ For infection prevention, enforce hand washing, etc.
⑨ Display a "P1 level" sign clearly on the laboratory door, and restrict entry to only those involved.

Depending on the type and virulence of organisms, experiments are classified, and detailed rules are applied. For more information, please follow “Sophia University Brief Guide for Experiments Using Genetically Modified Organisms.” Also, in cases where modified organisms are handed over or provided to other organizations by this university, it is required that information regarding the organisms be provided to the recipient, and at the same time, a notification should be submitted to the university’s Genetic Modification Experiment Safety Committee. Regarding the procedure, please follow the Guide.

In recent years, scientific research has drawn scrutiny from the public because of the following:

- Containment measures (measures to prevent dispersion) are inappropriate.
- Application to experiments has been neglected.
- Information provision at the time of transfer, etc. has not been realized.

These violations of laws and regulations are subject to a penalty. The society strongly demands that genetic modification experiments be conducted in an appropriate manner.

■ Handling of organisms obtained by the use of genome editing technology

At Sophia University, organisms derived from genome editing technology are also handled in accordance with “Type 2 Use of Living Modified Organisms”.

■ Studies of laboratory animals

In this university, studies of laboratory animals using vertebrates and reptiles are conducted. These studies are also allowed to be initiated after applying to and receiving the approval of Sophia University Animal Care and Use Committee.

On the basis of the “Act on Welfare and Management of Animals,” a number of guidelines for animal care and use have been drawn up, including “Standards Relating to the Care and Management, etc. of Experimental Animals” (Care and Management Standards), “Fundamental Guidelines for Proper Conduct of Animal Experiment and Related Activities in Academic Research Institutions,” “Guidelines for Proper Conduct of Animal Experiments,” and “Basic Rule for Abandoned Animals and Killing Animals.”

For the care and use of laboratory animals, the safety factors are as follows: 1) to improve care facility, 2) to implement containment, and 3) to perform daily care and experimental procedures with utmost care and attention.

① In animal rearing rooms, take escape prevention measures (e.g., mouse blocks).

② Keep the rearing environment clean. This is not only because the health and physical state of animals affect experimental data, but also because serious infections are more likely to occur in a deteriorated rearing environment, to which animals as well as humans are susceptible.
③ When handling animals such as rodents, wear thick gloves to avoid being bitten.
④ In order to protect laboratory animals and to prevent danger resulting from laboratory animals in case of an emergency, such as an earthquake and a fire, develop emergency action plans in advance.

In addition, as specified in the "Act on Welfare and Management of Animals," what is important in animal experimentation is the aspect of **animal welfare and protection**.

① Use the minimum number of animals in experiments.
② Do not scare animals.
③ Do not cause animals unnecessary pain, and use appropriate anesthetics and analgesics.
④ Pay utmost attention to euthanasia.
⑤ A clean rearing environment not only ensures safety but also conforms to animal welfare and protection.

It is necessary that we preserve awareness regarding bioethics, even under circumstances of innovative life science advances.

7. List of safety-related materials

We sincerely thank the many organizations and people who provided guidance and cooperation during the course of preparation of this manual. We would also like to extend our gratitude to the literature cited and referred to in this manual, as listed below.

◆References◆

- ✓ "Disaster Prevention Guide – First aid"
  Published by Tokyo Fire Department (supervised by EMS Service Section), Public Service Foundation Tokyo Consolidated Fire Protection Association
- ✓ "Safety Notebook 3rd Edition"
  Compiled and published by Tokyo Institute of Technology Safety Management Implementation Committee
- ✓ "Safety Instructions"
  Compiled by Waseda University Okubo Campus Safety and Health Committee
- ✓ "To Safely Conduct Experiments"
  Compiled by Kagaku-Dojin Editorial Department and published by Kagaku-Dojin Publishing Company, Inc.
- ✓ "Principles and Practices of Biosafety"
  Compiled by Biomedical Science Association and published by Mimizuku-sha
- ✓ "Chemical Safety Notebook for Safe Laboratory Management", 3rd edition
  Edited by the Chemical Society of Japan, Maruzen Publishing:

◆Websites◆

[Chemical risk assessment support portal site]

https://www.jcia-bigdr.jp/jcia-bigdr/material/law_matrix

Various kinds of regulatory information, including the Fire Service Act, regarding reagents can be collectively searched. It is recommended that the search be performed using CAS numbers. Searches using the CRIS system, etc., are also possible.

[**PRTR substances**]

1) Chemical Management Policy Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry
   http://www.meti.go.jp/policy/chemical_manegement/law/index.html
2) Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment
   http://www.env.go.jp/chemi/prtr/risk0.html
3) Bureau of Environment, Tokyo Metropolitan Government
   http://www.kankyo.metro.tokyo.jp

[Sewage discharge standards (within the 23 wards of Tokyo)]

Tokyo Metropolitan Sewerage Bureau
https://www.gesui.metro.tokyo.lg.jp/contractor/d4/information/index.html

[Genetic modification experiments / bioethics]

Life Science no Hiroba, Ministry of Education, Culture, Sports, Science and Technology
http://www.lifescience.mext.go.jp/bioethics/index.html

Postscript

This booklet is the 4th expanded and revised edition of the Safety Manual that was first issued in 2005. We have made significant additions and revisions to the text and data mainly in Chapters 1 and 2 to reflect building renovation, changes in emergency safety measures, and law amendments, which have been implemented since the manual was revised in 2017 by Dr. Kuze, then Chairperson of the Faculty of Science and Technology Safety Committee. We have edited the Safety Manual while keeping in mind that our mission is to convey basic and important matters to students at the Faculty of Science and Technology in as simple a manner as possible. Have you ever experienced a scary moment during an experiment or a practical training? It is important to increase safety awareness in order to prevent such near-miss experiences to the extent possible.

In addition, given that laws and approaches regarding safety in the working environment change day by day, the Wellness Center, Dr. Nahoko Okamoto and Dr. Yuka Funaki of the Department of Nursing, the Office of Property, the Center for Research Promotion and Support, and Nikoh Sangyo have been instrumental to revising this manual. I would like to take this opportunity to extend our gratitude for their cooperation.

As experiments in a wide range of areas are conducted in the Faculty of Science and Technology, it is impossible to cover every matter concerning safety in this manual alone. Yet, it is important that each and every one of us possesses a deep awareness of and consideration for safety. We hope that this manual will provide guidance and assistance to that end. At the same time, we will continue to strive to make sure that everyone can perform experiments in the safest way possible.

Safety Manual Editorial Committee

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Seven Serious Offenses

Laboratory accidents are man-made disasters!!

The following “seven serious offenses” are the psychological states that invite accidents.

1. Ignorance

Embarking on experiments without sufficient risk information is like climbing a snow-covered mountain without equipment.

2. No thinking

It is not that an accident “occurs unexpectedly” –it “occurs because you do not think.”

3. No planning

Preventing accidents and measures against disasters in case of an emergency

No regrets about money, time, and trouble

4. Apathy

Proactive intention toward safety

It is important to give up with courage.

5. Unreasonableness

In carrying out an experiment, more haste, less speed.

When things go wrong, make haste slowly.

6. Insensitiveness

Those who lack compassion for others also hurt themselves

7. Indolence

Do not ignore laboratory manners just because you are too lazy.

There are manners to be followed in the laboratory

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