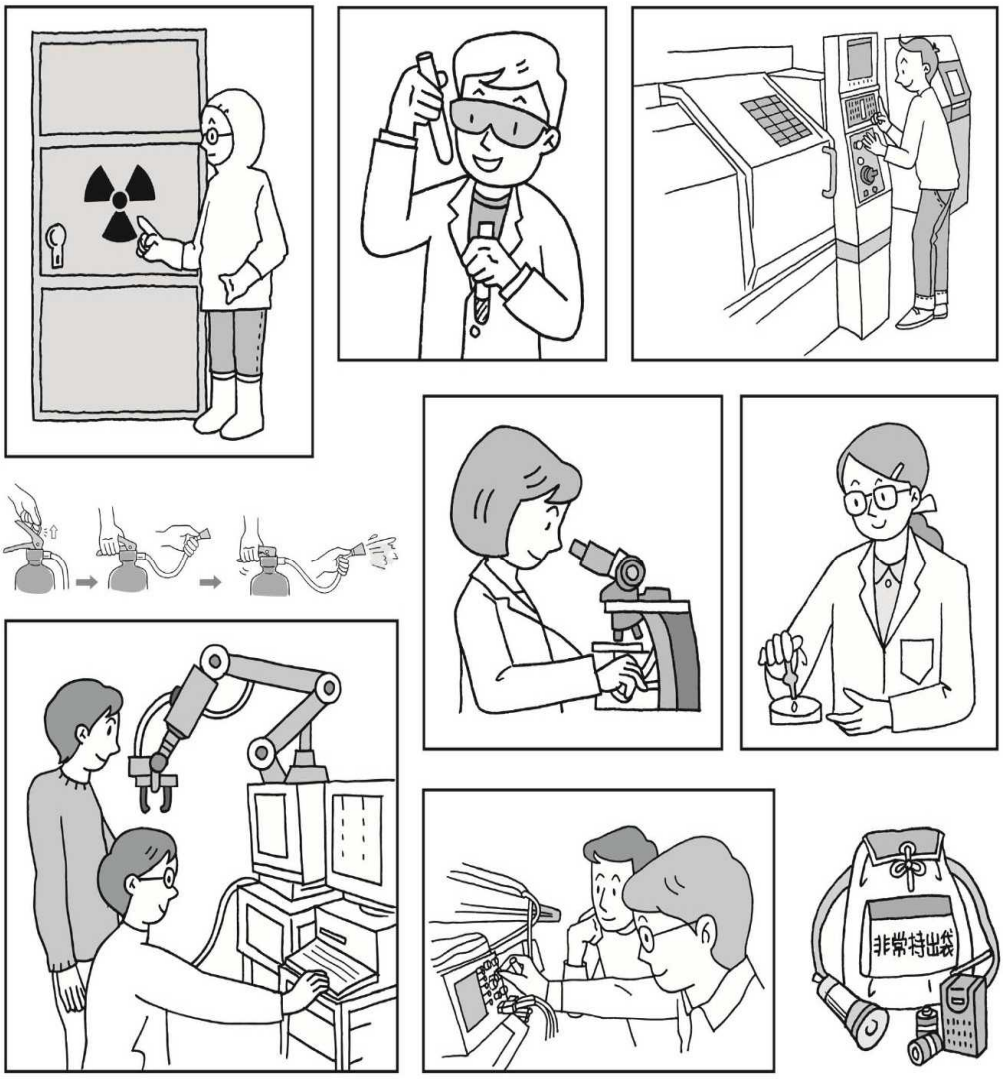
Safety Manual

for Experiments and Practical Training



2026

Faculty of Engineering, University of Yamanashi

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1 Basic Requirements for Safety Education

Safety in experiments and practical training in university education and research is maintained by adhering to the basic requirements described below. When conducting experiments and practical training, you must follow the instructions of your supervising faculty member and proceed with caution.

Thorough Preparation

- Keep laboratories, training rooms, and research rooms organized and tidy.
- Put away unnecessary equipment, reagents, etc. and keep things organized.
- Prepare experimental procedures and inspect/maintain equipment and chemicals.
- Wear appropriate lab coats, work clothes, footwear, hard hats, safety glasses, and gloves for experiments.
- Be in good physical and mental condition when participating in experiments and training.
- Confirm evacuation routes and the locations of fire extinguishers.

Sufficient Knowledge

- Read the textbook thoroughly in advance and understand the content of the experiment or training.
- Acquire preliminary knowledge about the usage and dangers of necessary instruments, equipment, and reagents.

Attitude Toward Experiments and Training

- Conduct experiments with appropriate alertness and a serious attitude. However, excessive tension can cause loss of overall awareness, so be careful.
- Be punctual. Enter the laboratory 5 minutes before the start time and complete advance preparations.
- Listen carefully to the instructor's explanations and do not hesitate to ask questions.
- During experiments, place only necessary items (chemicals, instruments, equipment, notebooks) on the lab bench.
- Smoking, eating, and drinking during experiments are strictly prohibited.
- Do not leave the area during experiments or training. If you must leave, promptly notify the supervising faculty member.
- Experiments alone at night, on holidays, or overnight are prohibited in principle.
- Confirm emergency contact methods in advance in case of an accident.

Fire Handling Precautions

- Keep the area around open flames organized and tidy.
- Confirm that fires are extinguished after use.
- Check gas main valves after experiments are completed.
- Keep flammable and explosive materials away from fire.

Precautions Against Water Leakage

- Secure water hoses to faucets with metal fittings.
- Periodically check areas where water leakage is expected, such as deteriorated rubber hoses and connection points.
- When running vacuum pumps or other experimental equipment unattended with cooling water, use circulating cooling water systems.

2 What to Do in an Emergency?

2.1 Contact Methods

When an accident occurs, announce it loudly to alert those nearby and immediately report to your supervising faculty member. Furthermore, the person responsible for the laboratory concerned must, regardless of the severity of the accident, prepare an Accident Report Form (p.4) within one week after the accident and submit it to the Dean of Engineering.

[1] In Case of Personal Injury

a. If someone collapses due to sudden illness, do not move them from their position and immediately contact the Health Care Center. Turn their face to the side.

b. In case of injury from hazardous materials, move the injured person to a safe location away from the accident site. Take measures to prevent further accidents. Depending on the severity of the injury, contact the Fire Department (ambulance) or the Health Care Center.

c. The Health Care Center can handle cases such as glass puncture wounds limited to veins, and burns on hands and feet. For burns to the face or eyes, chemical exposure, or severed fingers/arms, administer first aid and seek immediate medical attention.

Contact	Phone	Purpose
1. The laboratory manager		Report / Notify Prepare & submit Accident Report
The Head of the Course		Report / Notify
2. Health Care Center	055-220-8080 or 8081	Request emergency treatment
3. Fire Department	119	Request ambulance
General Information Counter	055-220-8032	Request ambulance guidance
4. Other: Go to hospital		

[2] In Case of Fire (See Section 3: Preparing for Earthquakes and Fires, p.10)

a. If there are injured persons, immediately move them to a safe location and administer first aid.

b. Press the fire alarm button in the hallway.

c. Contact the Fire Department and other relevant parties.

d. If initial fire suppression is deemed possible, use a fire extinguisher. The standard extinguisher in the Faculty of Engineering is an ABC dry chemical extinguisher with a range of 3-6m, discharge duration of 13 seconds, releasing 60g of CO2. Since it contains no liquid, it can be used for all types of fires including electrical fires. Note: extinguisher locations are shown in the appendix diagrams.

***** WARNING: Life safety must always take priority over fire suppression! If flames reach the ceiling, immediately abandon firefighting and evacuate. *****

e. Since the buildings are made of reinforced concrete, smoke is the greatest hazard during a fire. Crawl along the floor to avoid inhaling smoke containing toxic gases. Cover your mouth and nose with a wet handkerchief.

f. Do NOT use elevators.

Contact	Phone	Purpose
1. Fire Department	119	Report the fire
2. General Information Counter	055-220-8032	Request fire truck guidance
3. Health Care Center	055-220-8080 or 8081	Request emergency treatment
4. The laboratory manager		Report / Notify Prepare & submit Accident Report
The Head of the Course		Report / Notify

[3] In Case of Earthquake (See Section 3: Preparing for Earthquakes and Fires, p.10)

a. First, ensure your own safety.

b. After the shaking subsides: Secure an exit. Turn off fire sources and experimental equipment. Attempt initial fire suppression (if not possible, evacuate).

c. Do NOT use elevators. If in an elevator, get off at the nearest floor.

d. Move to a safe evacuation site. (On-campus evacuation sites: Kofu Campus East Ground, Kofu West Campus Disaster Prevention Plaza (space in front of the General Research Building), Courtyard (space in front of the University Co-op))

[4] In Case of Gas Leak

a. Gently open windows and doors to ventilate.

b. Gently close appliance valves and main gas valves.

c. All flames, no matter how small, are strictly prohibited. Turning ventilation fans on or off is also dangerous.

d. If the situation is beyond your control, contact the Engineering Domain Support Division General Affairs Group (055-220-8403), who will contact the gas company.

事故報告書

工学部長・工学専攻長宛

西暦　　年　　月　　日 届出

報告者
職名：
名前：

事故発生日時：　　西暦　　年　　月　　日（）　　時　　分頃

事故発生場所：

事故の当事者：学籍番号
所属学科等名
氏名

事故発生原因

事故被害状況

今後の対策

【作成・提出手順】
①クラス担任・指導教員による聴き取り・メモ作成
②クラス担任・指導教員から学生主任・学科長等に情報共有
③学生主任から学生委員長に情報共有し、1週間以内に事故報告書を提出（工学域支援課教務G　　へ同報）
YINS-DOCS　ホーム＞共有フォルダ＞共有用フォルダ＞工学部＞工学部事務部＞工学部教務グループ＞学生委員会＞事故報告書様式
https://docs.yamanashi.ac.jp/login.php?url=bG9naW4yLnBocD9hZGR0YWI9MTI2NzYw

Accident Report Form

Accident Report

To: Dean of Engineering / Head of Engineering Program

Date of Report:	Year _____Month _____Day _____
Reporter:	Position: _____ Name: _____
Date/Time of Accident:	Year ___Month ___Day ___( ) ___Hour ___Min
Location of Accident:	_____
Person(s) Involved:	Student ID: _____Department: _____Name: _____
Cause of Accident:	(describe)
Damage/Injury Details:	(describe)
Future Countermeasures:	(describe)

Preparation and Submission Procedure:

- 1) The class advisor / supervising faculty member conducts an interview and prepares a memo.
- 2) The class advisor / supervising faculty member shares information with the Student Affairs Officer / Department Head.
- 3) The Student Affairs Officer shares information with the Student Committee Chair and submits the Accident Report within one week (cc: Engineering Domain Support Division Academic Affairs Group).

2.2 First Aid

2.2.1 Common Procedures

a. Quickly rescue the injured person and lay them down in a safe place.

b. Quickly observe the injured person's condition:

- Call out to the injured person to check for consciousness.
- If conscious, reassure them that help is on the way and keep them calm. Two or three people should stay and encourage them, but avoid making excessive commotion.
- If there is no response, place your palm near the mouth or nose to check for breathing. If breathing has stopped, secure the airway and perform artificial respiration.
- Check for pulse with your fingertips or place your hand on the injured person's chest to check for heartbeat. If the pulse has stopped, perform chest compressions.

c. Check whether the injured person is bleeding. Also check for lacerations, contusions, or fractures. If bleeding, control the bleeding (apply direct pressure); if fractured, apply a splint.

d. Remove clothing and check for abnormalities on the body, and whether foreign objects or chemicals are attached (check by color and smell). Remove if present.

e. Make the injured person's breathing easier. Maintain normal body temperature; if body temperature is low or ambient temperature is cold, wrap in blankets to keep warm.

2.2.2 Chest Compressions

Chest compressions is a vital life-saving method that sends blood to all organs in the body on behalf of a heart that has stopped, preventing organs from ceasing to function due to oxygen deprivation.

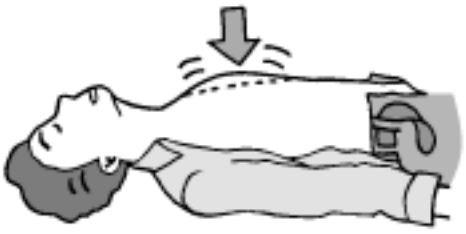
Place the heel of your overlapping hands on the center of the fallen person's chest, and with your elbows straight, push straight down firmly (until the chest sinks more than 5 cm). When repeating compressions, do not lift your hands from the chest. Continue this at a rate of at least 100 times per minute.





If the person is having difficulty breathing or has stopped breathing, artificial respiration must also be performed simultaneously.



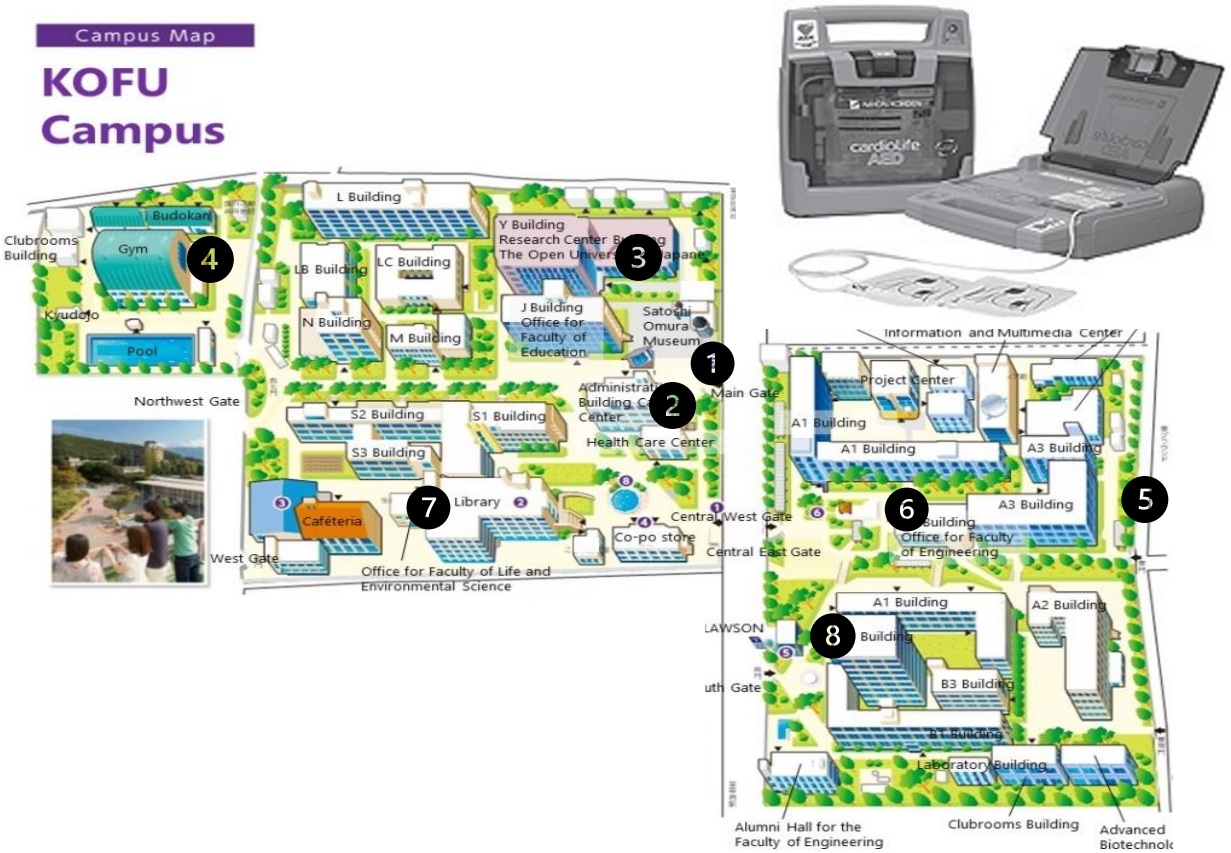


2.2.3 Automated External Defibrillator (AED)

When the heart rhythm is abnormal, in addition to CPR (including chest compressions), it is necessary to use a device called a defibrillator to deliver an electric shock to the heart as quickly as possible to restore normal heart rhythm and resume blood flow carrying oxygen throughout the body. One such device, the Automated External Defibrillators (AEDs), are available at various locations across the campus, including the Health Care Center, and should be deployed immediately in emergencies.

AED Installation Locations:

- 1. Main entrance of General Information Center
- 2. Health Care Center reception
- 3. Open University entrance (owned by Open University)
- 4. Gymnasium entrance
- 5. West Ground Cultural Club Building entrance
- 6. A-2 Building entrance
- 7. Faculty of Life and Environmental Sciences office building entrance
- 8. West Entrance, T-1 Building
- 9. Crystal Science Research Center entrance
- 10. Hydrogen & Fuel Cell Nanomaterials Research Center 1F office
- 11. Komagari Farm
- 12. Takashi Ground Equipment Storage
- 13. Wine Science Research Center entrance



2.2.4 Bleeding

When an artery near the skin surface is severed, bright red pulsating blood gushes out, while bleeding from a deep artery is a continuous linear flow. An adult human has approximately 5,700 mL of blood. Loss of up to 10% has little effect, but beyond 10% the patient goes into shock, and loss exceeding 50% can be fatal. Therefore, for major bleeding, priority should be given to compressing major blood vessels rather than treating the wound itself.

a. To stop bleeding, compress the artery with fingertips at pressure points closer to the heart than the bleeding site. Most bleeding can be stopped this way. For limbs, tightly bind the area near the pressure point with a triangular bandage or regular bandage to block blood flow.

b. If compression is insufficient, it only causes venous congestion and may actually increase bleeding.

c. Do NOT use thin cords to stop blood flow, as this can cause lacerations of muscles, nerves, and tissue. Also, blood flow blockage must not continue for more than 2 hours, as it can cause tissue necrosis.

d. If the skin is wet from bleeding, fingertip or rubber tube compression may slip, so use wide cloth. A thin stick can be used like a tourniquet. However, once bleeding stops, do not tighten further.

2.2.5 Trauma (Wounds)

a. For trauma with major bleeding, perform the above blood-stopping procedures before treating the wound.

b. Examine the wound. For wounds under clothing, tear or cut open the clothing to check.

c. If glass or metal fragments are present, remove those that can be easily removed from the wound. Leave those deeply or complexly embedded for a doctor.

d. If the wound is contaminated with dirt or oil, rinse with plenty of tap water.

e. Apply sterile gauze to the wound and bandage to control minor bleeding.

f. If debris enters the eye: if on the eyelid, remove with moist clean gauze wrapped around a stick. If stuck to or embedded in the cornea, leave it and see an eye specialist.

2.2.6 Fractures

a. Confirm the fracture location, apply a splint to prevent movement and relieve pain. Leave further treatment to a doctor.

b. The splint must be long and wide enough to extend beyond the fracture site. Use boards, sticks, umbrellas, etc. as emergency splints, securing with towels or bandages. Always immobilize the adjacent joints above and below.

c. Severe pain from fractures can trigger shock, so treatment for shock is also needed. Placing a towel, cloth, or felt between the splint and skin can be effective.



2.2.7 Burns

Burns become deeper the higher the temperature and the longer the exposure to heat. Burns are classified into three degrees:

• **1st Degree:** Mild damage to the epidermis only; capillary dilation, redness, swelling, heat sensation, and mild pain.

• **2nd Degree:** Damage extending to the dermis beneath the epidermis; redness, heat, blistering, and severe pain around the burned area.

• **3rd Degree:** Damage extending through the epidermis, dermis, and into subcutaneous tissue, leading to necrosis. Burns covering more than 1/3 of total body surface area were once considered fatal, but today with proper treatment, survival is possible even with approximately 80% burns.



a. Cool the burned area as quickly as possible with tap water, cold water, or ice water.

b. The earlier cooling begins, the more effective it is. Cool for at least 30 minutes, preferably 2-3 hours until pain is no longer felt.

c. For 1st degree burns with small area, disinfect after cooling and cover with clean gauze or a compress. For 2nd degree or higher, cool while leaving further treatment to a doctor.

2.2.8 Electric Shock

Electric shock can cause ventricular fibrillation and cardiac arrest. High voltage can cause respiratory arrest.

a. Separate the victim from the power source (turn off the power switch). The rescuer must be careful to avoid secondary electrocution.

b. If there is no spontaneous breathing or pulse, immediately perform chest compressions and artificial respiration. Electric shock may cause body rigidity, which can be mistaken for rigor mortis, leading to abandonment of treatment. If cardiac or respiratory arrest has occurred, chest compressions and artificial respiration must be performed. AED can also be used.

2.2.9 Acute Poisoning by Chemicals

Acute poisoning from chemicals varies in toxicity and irritation depending on the type of chemical, and occurs when chemicals enter the body or come into contact with skin or mucous membranes. The basic treatment is to expel the chemicals from the body.

(1) Skin Contamination

a. First, wash off substances adhering to the skin with large amounts of water. Be careful not to rub the contaminated area vigorously.

b. If clothing is also contaminated, immediately remove it and rinse the skin with water. Use a shower if available.

c. Note that some chemicals such as hydrofluoric acid, glacial acetic acid, and hydrogen peroxide cause delayed pain.

d. If large amounts of sulfuric acid contact the skin directly, quickly wipe off the sulfuric acid with cloth first, then wash with large amounts of water. Washing with water while large amounts of sulfuric acid remain can worsen the burn.

(2) Eye Contamination

a. If chemicals enter the eye, immediately open the eyelids and wash with low-pressure tap water for about 15 minutes. Too-strong water pressure can damage the cornea. Seek ophthalmological treatment promptly.

b. It is also effective to repeatedly dip your face into a basin of clean overflowing water while blinking.

(3) If Inhaled

a. Move the victim to fresh air as quickly as possible, keep them at absolute rest, and begin oxygen administration as soon as possible. Do NOT enter areas filled with toxic gas without protection.

b. If oxygen is not available and breathing is difficult, perform artificial respiration. Be careful not to inhale harmful substances yourself.

c. When chemicals have been inhaled, seek medical treatment as quickly as possible.

(4) If Swallowed

a. Remove unabsorbed chemicals from the digestive tract as quickly as possible. Give large amounts of lukewarm water and stimulate the throat to induce vomiting.

b. If large amounts of acid or alkali have been swallowed, give large amounts of water, milk, or raw eggs (about 1 dozen). This treatment is urgent.

c. Do not discard remaining chemicals, bottles, or contamination evidence - show them to the doctor.

3 Preparing for Earthquakes and Fires

3.1 Earthquakes

[1] When an Earthquake Occurs

PHASE 1 Immediately After Earthquake	PHASE 2 After Shaking Subsides	PHASE 3 Once Calm (1)	PHASE 4 Once Calm (2)
Protect yourself Stay where you are **Is your location safe?** YES -> Stay put NO -> Move to evacuation site	**Confirm family safety** Use NTT Disaster Message Dial Service: **171** Check surroundings Attempt fire suppression (if impossible, evacuate) Assist injured persons	**Can you walk home?** YES -> Go home NO -> Go to an evacuation site	**Report to university** Safety confirmation email will be sent to your registered address. Reply with your status.

Phase 1 - Ensure Immediate Safety:

- Stay away from hazards (bookshelves, lockers, glass)
- Protect yourself from falling objects (under desk, use helmet)
- After confirming safety: check fire sources, stop equipment
- Open doors to secure evacuation exits
- Wait for shaking to fully subside

Phase 2 - After Shaking Subsides:

- Watch for aftershocks; check surrounding conditions
- Attempt initial fire suppression (if impossible, evacuate)
- Assist injured persons; call for rescue if needed
- Evacuate: use stairs (NOT elevators), walk, carry minimum belongings
- Collect accurate information (beware of rumors and misinformation)

NTT Disaster Message Dial Service: 171

To record: Press 1 -> area code + home phone number

To play back: Press 2 -> area code + phone number of person in disaster area

Above is for landline phones. For mobile/smartphone services, see Section 3.1 [3].

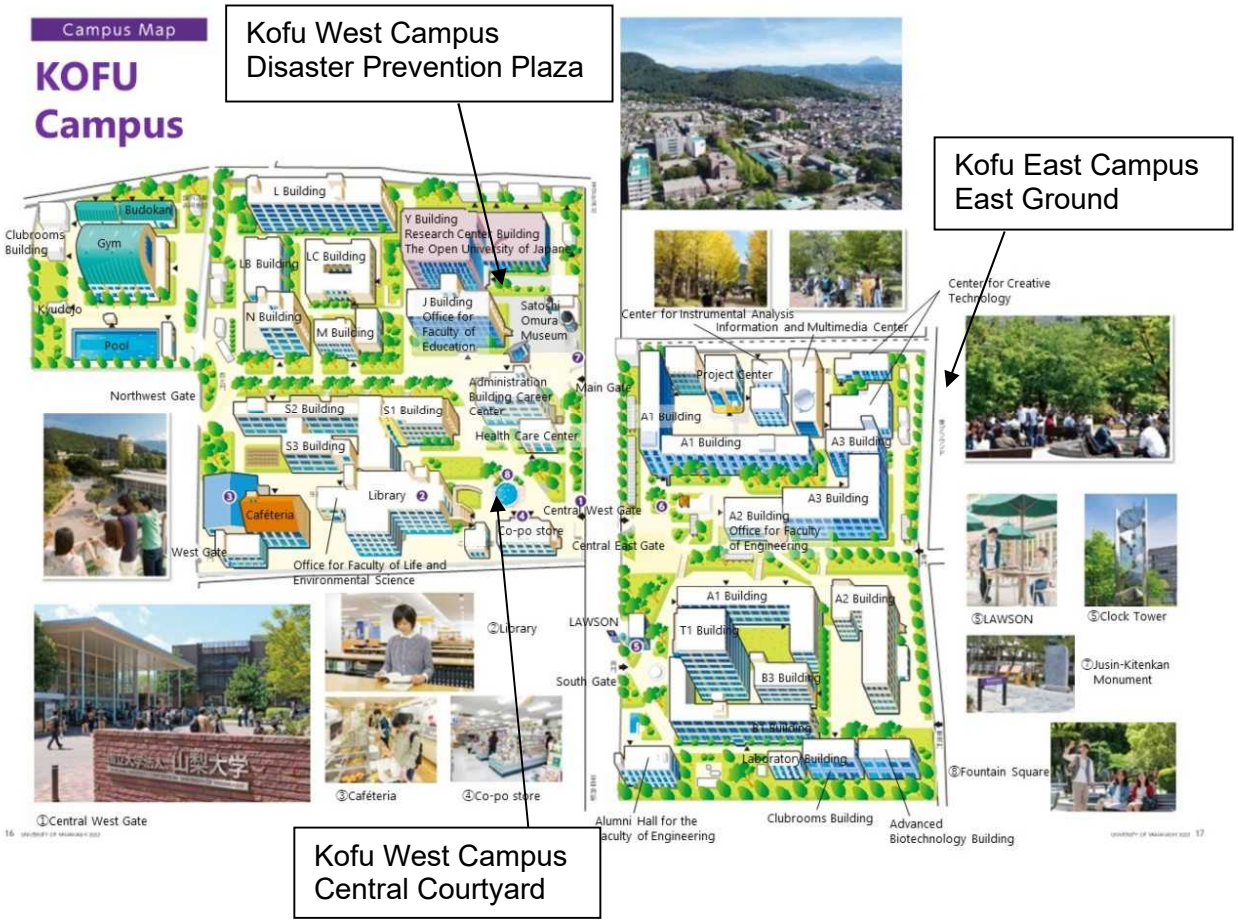
Reporting safety to the university:

When a disaster occurs, a safety confirmation email will be sent simultaneously to pre-registered email addresses. Follow the instructions in this email to reply with your status. Pre-registration is required. Check YINS-CNS for registration: https://cns.yamanashi.ac.jp/anpi/

[2] Nearest Evacuation Sites

The map below (from the original Japanese manual, p.10) shows the campus evacuation sites.

- **Kofu Campus East Ground** (Kofu Kyanpasu Higashi Guraundo)
- **Kofu West Campus Disaster Prevention Plaza** (Kofu Nishi Kyanpasu Bousai Hiroba) - space in front of the General Research Building
- **Kofu West Campus Courtyard** (Kofu Nishi Kyanpasu Nakaniwa) - spac in front of the University Co-op



In preparation for earthquakes occurring while outside the university, confirm the evacuation sites near your home and along your commuting route in advance.

Reference: Evacuation sites near the university:

- Attached Elementary/Junior High School Grounds (Kofu-shi Kitashin 1-4-1)
- Kofu Municipal Kitashin Elementary School (Kofu-shi Kitashin 1-5-1)
- Kofu Municipal Aikawa Elementary School (Kofu-shi Kofuchu-machi 1501)
- Kofu Municipal Hokuto Junior High School (Kofu-shi Ote 2-4-18)

[3] Carrier Disaster Message Dial Services

NTT docomo	http://dengon.docomo.ne.jp/top.cgi	
KDDI au	https://dengon.ezweb.ne.jp/	
SoftBank Mobile	http://dengon.softbank.ne.jp/J	
Rakuten Mobile	https://network.mobile.rakuten.co.jp/service/disaster_board/	

[4] Daily Preparations

■ Secure furniture, take measures to prevent toppling, confirm emergency evacuation items
■ Confirm evacuation sites (near university, near home)
■ Confirm family contact methods and meeting places
■ Confirm and register for carrier disaster message services (pre-registration required)
■ Confirm route home and travel time
■ Create and fill in an emergency contact memo
■ Confirm information gathering methods and emergency evacuation sites (on campus, commuting route, etc.)

[5] Emergency Evacuation Items

■ Cash / coins
■ Health insurance card
■ Student ID, driver's license
■ Hand-crank charging radio/light
■ Tissues / wet wipes
■ Emergency thermal aluminum sheet
■ Address book (family, friends)
■ Mobile charging USB cable
■ Permanent marker
■ Chocolate, candy, etc.
■ Rain gear (poncho, etc.)
■ Polyethylene garbage bags

[6] Useful Items in Emergencies

■ Emergency drinking water
■ Personal seal (inkan)
■ Athletic shoes
■ Portable stove
■ Spare batteries
■ Disposable chopsticks
■ Backpack
■ Candles
■ Toiletries
■ Work gloves
■ Whistle
■ Savings passbook
■ Regular medications and prescriptions
■ Slippers
■ String / rope
■ Lighter
■ Extra clothing, underwear, socks
■ Flashlight
■ Can opener / bottle opener
■ Disposable hand warmers
■ Face mask

[7] Equipment Placement and Preservation in Laboratories

■ Secure bookcases and equipment shelves to prevent toppling; do not place heavy objects on top.
■ Fix high-pressure gas and cryogenic liquefied gas cylinders with double chains.
■ Store chemical reagents in locked chemical cabinets; position them to prevent falling.
■ Secure evacuation routes in laboratories: arrange equipment and wiring so they do not obstruct evacuation.
■ Confirm the locations and operation of fire extinguishers and emergency alarms.
■ Confirm how to use emergency staircases, fire shutters (they open outward, some have small passages), and evacuation bags (chutes).
■ To prevent fires, do not accumulate large amounts of combustible materials or place them near heaters. Keep the area organized. Do not place objects near fire shutters or doors.
■ Keep flashlights readily available and check battery levels.

Emergency Contact: Fire Department (Tel: 119), University of Yamanashi General Information Center (Tel: 055-220-8032)

Evacuation Sites: Kofu Campus East Ground, Kofu West Campus Disaster Prevention Plaza (space in front of the General Research Building), Courtyard (space in front of the University Co-op)

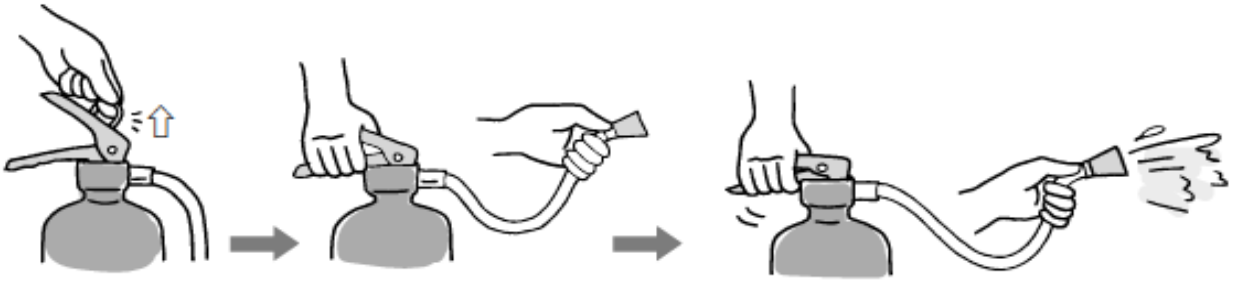
3.2 Fires

[1] If You Discover a Fire

• Shout loudly to alert those around you.
• Use the fire alarm to notify everyone.
• Attempt initial fire suppression. However, in rooms where chemicals are stored, use appropriate extinguishing agents.
• If suppression is impossible, evacuate, call 119, and contact the University of Yamanashi General Information Center (Tel: 055-220-8032).
• If fire spreads to the ceiling, evacuate without hesitation.

[2] How to Use a Fire Extinguisher

• Pull out the yellow pin.
• Remove the hose and aim at the burning object (not the flames).
• Squeeze the lever firmly



[3] When Evacuating

- Stay low, cover mouth and nose with a wet handkerchief or towel to avoid inhaling smoke.
- If possible, bring useful emergency items (see Section 3.1 [6]).
- Do NOT use elevators.
- Close doors and windows to slow the spread of fire. Do NOT lock them. (In case of earthquake-related fire, do not close doors.)
- Once evacuated, do NOT re-enter the building.

[4] Daily Preparations

- ■ Do not place flammable materials near fire sources.
- ■ Confirm the usage and locations of fire extinguishers, fire hydrants, and fire alarms.
- ■ Establish at least two evacuation routes in different directions.
- ■ Do not place objects that obstruct evacuation in hallways, entrances, or stairways.
- ■ Confirm emergency carry-out items and their locations.
- ■ Do not place equipment or luggage near firefighter entry points.
- ■ Always close gas main valves when not in use.
- ■ Confirm fire suppression methods in laboratories where chemicals are stored.

4 Safety Manual for Mechanical Engineering

Things You Must Not Do / Things You Must Do

1) Do not touch or operate machinery without permission or instructions from supervising faculty.
2) Do not operate dangerous machinery alone, especially at night or on holidays.
   Always have at least 2 people present when using machine tools.
3) Post appropriate warning signs at hazardous locations visible to everyone.
   Install barriers to prevent access to dangerous areas.

4.1 Basic Precautions for Experiments

(1) Clothing

a. Wear appropriate work clothes for experiments. Wear form-fitting, easy-to-move-in clothes that won't get caught in operating machinery.

b. Wear shoes that protect against electric shock, falling objects, and slipping. Safety shoes are recommended. Sandals are strictly prohibited.

(2) In Laboratories with Computer-Controlled Machinery

a. When operating machinery (robots, etc.), thoroughly read the instruction manual and receive sufficient guidance from staff. Do not inadvertently touch buttons or switches - the machine may start.

b. Strictly observe the following in the laboratory:

- Do NOT bring liquids such as tea or coffee.
- Do NOT bring magnets or magnetic objects.

c. Keep laboratories clean and free of dust or metallic debris, which can cause machine malfunctions.

d. While completed machines have thorough safety measures, those in R&D; or prototype stages may not. Keep this in mind.

(3) Precautions for Special Light Sources and Lasers

a. Directly looking at strong or short-wavelength light from mercury lamps, Xe lamps, lasers, etc. can cause blindness. Always wear protective glasses, shield unnecessary areas from light, and install light traps for powerful beams.

b. Infrared laser beams are invisible, so unexpected reflections from metal surfaces may go unnoticed. Exercise extreme caution.

(4) Use of Hoists and Cranes

a. Only qualified persons (those who have completed slinging skill training and received special education as specified by labor regulations) may use power-operated lifting equipment such as hoists and cranes. However, operating equipment with a lifting capacity of 0.5 tons or less is exempt from formal licensing requirements, provided that permission and usage instructions are obtained from the supervisor.

b. Never stand directly under hoists, cranes, or other lifting equipment. Wear a helmet.

4.2 Basic Precautions for Machine Operation

(1) Safety Measures Before Machine Operation

a. Study the machine's structure and operation beforehand - Read the instruction manual thoroughly before listening to staff or seniors. Different machines from different eras may have different operating methods. The same applies when performing maintenance.

b. Do not inadvertently press switches - Uninformed persons pressing switches out of curiosity have caused major accidents.

c. Night/holiday operation - Do not operate dangerous machines when alone. Always have at least 2 people for machine tools.

d. Stay away from danger - Install guard rails and ropes at dangerous locations to prevent accidental approach.

e. Install debris protection walls - Place sturdy protection walls (copper plates, thick wooden boards, plastic boards, fine metal mesh) where fragments may scatter. Protective glasses are effective against fine cutting chips.

f. Remove obstacles - Floor obstacles or overhead obstructions can cause falls into machinery. Check that no objects are left in moving parts of machines.

g. Clothing precautions - Keep long loose hair, long sleeves, etc. away from moving parts. Avoid slippery-soled shoes. Sturdy leather shoes with protected toes are preferable. Lab coats and gloves can be dangerous.

h. Securing tools and test pieces - Even when securely attached, vibration can loosen them. Tighten carefully and check periodically. Clean surfaces before securing.

(2) After Machine Operation Begins

a. Call out before starting - When operating with others, call out before pressing the button to ensure no one is in a dangerous position. Even alone, calling out (like a train driver) reduces errors. Confirm the emergency stop switch location.

b. Stay away from danger - Do not approach or reach into moving parts or areas where debris may scatter. Use thick plastic shields for observation.

c. Stay alert with eyes and ears - After starting, remain vigilant. If you see, hear, or smell anything abnormal, stop immediately. Report abnormalities to the supervisor.

d. Turn off main switch - After the experiment, turn off the main power switch to prevent accidents if someone accidentally presses the start button.

e. Clean up - Put away all tools, test pieces, and other items. This is not only to prevent loss but to avoid hazards for the next user.

(3) Other Precautions

a. Secure heavy objects placed high up or tall heavy objects to prevent them from falling or toppling.

b. Do not bring unnecessary dangerous items (blades, explosives, poisons) into laboratories. Do not carry them in your pockets.

c. In case of an accident, follow the procedures in Section 2: 'What to Do in an Emergency?' Read that section thoroughly.

5 Safety Manual for Electrical Engineering

Things You Must Not Do

1) Touching electrical equipment with wet hands or splashing water on it -> Electric shock prevention
2) Octopus wiring (overloaded power strips) -> Prevent overcurrent, overheating, fire
3) Wiring and piping on the floor -> Prevent disconnection accidents; if unavoidable, fix/cover/mark
4) Leaving exposed wiring or terminals connected to power, causing short circuits -> Prevent burnout

Things You Must Do

1) Use four senses (sight, hearing, smell, touch) to detect abnormalities early
   -> Unusual sounds, smells, or tingling suggest leakage, overheating, or equipment malfunction
2) Double-check wiring before turning on the power

5.1 Protecting Against Electric Shock

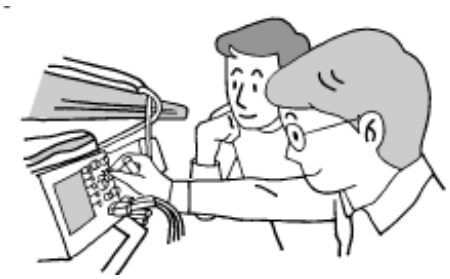
Danger: Understand the dangers of electric shock and take preventive measures.

- The inside of the human body is a good conductor.
- When current through the body reaches 10-15 mA, muscles spasm and voluntary movement becomes difficult.
- When current (mA) x duration (seconds) exceeds 30, it becomes life-threatening.

Muscle spasm onset current values:

- Adult males: from 9 mA (average 16.0 mA)
- Adult females: from 6 mA (average 10.5 mA)

Prevention: Always wear rubber-soled shoes during experiments.



[1] Causes of Electric Shock

- Direct contact with power sources, charged parts, or wires. Capacitors may still be charged even after power is off.
- Leakage: Even without touching a power source, equipment leakage can cause electric shock. If you feel a tingle, suspect leakage.
- Leakage can affect not only the experimenter but also others. Use grounding to prevent leakage.

[2] Effects on the Human Body

a. Effects of Electric Current on the Human Body

・When electric current flows through the human body, it can have serious effects on the nervous and muscular systems and may even result in death.

・When electric current flows only along the surface of the body, it may cause burns or severe pain.

・Relationship between the physiological effects of electric shock and current magnitude: Although the effects vary depending on factors such as physical condition, body weight, and sex, a standard example for an adult male is shown in the table below. When the current reaches approximately 10 to 15 mA, muscle spasms occur, making voluntary movement impossible.If a person grasps or touches an energized part, they may become unable to release it by their own effort.

Table: Effects of Electric Current on the Human Body (50-60 Hz AC)

Current (mA)	Duration	Physiological Effect	Danger Level
0 - 1	Regardless of duration	Above perception threshold	No direct danger to life
1 - 3	Regardless of duration	Mild stimulation	No direct danger to life
3 - 10(15)	Regardless of duration	Pain felt. Can release grip	Almost no direct danger to life
10(15) - 30	Within minutes More than minutes	Muscle spasm. Cannot release grip Blood pressure rise, breathing difficulty	Danger to life exists
30 - 50(75)	Within ~1 min More than ~1 min	Respiratory arrest, irregular pulse Blood pressure rise	Death possible
50(75) - 250(300)	Within ~1 sec More than ~1 sec	Strong shock, no ventricular fibrillation Ventricular fibrillation, fainting	Death possible Fatal
250(300)+	Within ~1 sec More than ~1 sec	Cardiac arrest, burns, fainting, death, current marks	Fatal
4(5) A+	Body area not vital	Internal tissue burns, current marks, fainting	Life-threatening

b. Skin Electrical Resistance

The body's electrical resistance depends mainly on skin resistance. Dry skin has resistance of tens of kilo-ohms or more, but when wet with water or sweat, it drops to several hundred ohms or less. At 100V, this means a current of over 100 mA can flow, which can be fatal. At high voltages, even dry skin can undergo dielectric breakdown. When working with high voltage, wear rubber insulating shoes and gloves.

[3] Causes of Electric Shock and Countermeasures

a. Defective wiring and equipment

Cause: Loose screws on switches/plugs, poorly tightened terminals, unstable equipment placement.

Countermeasure: Carefully inspect experiment circuits and equipment, replace defective parts as needed.

b. Insulation failure

Cause: Deterioration over time, moisture absorption, wet or dirty insulation surfaces.

Countermeasure: Regularly inspect, maintain, and keep equipment dry and clean.

c. Inadequate grounding

Cause: Unexpected high voltages appear; causes insulation breakdown, electric shock, and leakage.

Countermeasure: Ensure reliable grounding of all grounding terminals.

d. Leakage

Cause: Caused by degraded insulation, poor grounding, or circuit contact.

Countermeasure: Carefully maintain insulation, grounding, and circuits.

e. Misuse and insufficient ratings

Cause: Overlooking ratings of resistors, wiring, capacitor voltage, etc. Unexpected high voltages in rapidly changing circuits.

Countermeasure: This can cause circuit burnout, insulation breakdown, electrical fires, and shock.

f. Capacitor handling

Cause: High-voltage capacitors can recover voltage from absorbed charge even after short-circuiting.

Countermeasure: Always keep high-voltage capacitor terminals short-circuited and grounded when not in use.

g. Exposed charged parts

Cause: Accidental contact with exposed charged parts.

Countermeasure: Cover with insulating tape or covers. Mark with warning signs and mount on insulating stands.

h. High voltage

Cause: Insufficient safety clearance. Dielectric breakdown and discharge around circuits.

Countermeasure: Keep 30 cm distance at 2.5 kV, 1 m+ at 50 kV. Always experiment in teams.

i. Static electricity

Cause: Shocks above 1.5 kV body voltage. Can cause falls, dropped objects, gas explosions, semiconductor damage.

Countermeasure: Hold a metal object (key) to touch grounded metal first, avoiding direct fingertip discharge.

5.2 Effects of Large Currents, Magnetic Fields, and EM Waves



a. Power equipment (motors, transformers) draw large momentary currents at switch-on, and the associated magnetic fields may affect pacemakers. Confirm no pacemaker users are nearby when energizing.

b. High magnetic fields can affect pacemakers regardless of frequency. Pacemaker users must not enter restricted areas during high magnetic field device operation.

c. Even healthy individuals may be affected by prolonged exposure to high magnetic fields. Avoid extended stays in restricted areas.

d. Strong electromagnetic waves may cause thermal effects on the body. Avoid entering restricted areas during transmitter operation.

5.3 Rotating Machines

a. Motors, generators, vacuum equipment, and drill presses all contain electric motors with significant mechanical energy. Be mindful of clothing to avoid entanglement: do not wear long lab coats, ties, cardigans, or unbuttoned coats. Keep your head away from rotating parts. Also keep nearby objects organized to prevent them from being caught.

b. When conducting joint experiments, call out to all members and confirm before operating switches or starting equipment.

c. Operate switches completely. A half-open switch can be activated by vibration or accidental contact.

5.4 Laser Light

Things You Must Not Do

1) Looking directly at laser light

2) Entering the laser control area without permission

Things You Must Do

Use protective glasses appropriate for the laser wavelength and intensity

(Even with protective glasses, never look directly at laser light)

Danger: Laser light can cause eye and skin damage, and in severe cases, blindness or burns. Unlike normal light, laser light concentrates optical power on a tiny spot on the retina, making it extremely dangerous. Infrared and ultraviolet lasers are invisible, and unexpected reflections from metal surfaces or personal accessories can cause accidents.

Prevention Methods:

- 1) Never look directly at laser light.
- 2) Wear protective glasses appropriate for the wavelength and intensity.
- 3) Set laser beam paths so they never pass at eye level.
- 4) Design beam paths to be as short and straight as possible with minimal bends.
- 5) Remove watches, rings, and other accessories before entering the room.
- 6) Wear work clothes that minimize skin exposure.
- 7) When adjusting optical systems with laser light, use the minimum output necessary.

• 8) Do not use laser devices with their cases or covers open.

• 9) Handle laser devices in well-lit environments when possible.

• 10) Laser managers must: delineate and mark laser control areas; install electrical safety circuits and mechanical safety devices.

5.5 Other Precautions

a. Perform pre-operation inspection before each experiment.

b. Do not begin experiments until safety is confirmed. Especially confirm the location of distribution board and desk main switches.

c. Turn on main switches only after confirming others' safety. Confirm desk main switches are off before turning on distribution board switches.

d. Arrange experiment apparatus in a rational layout. Complex arrangements and wiring not only produce poor data but can cause errors and accidents.

e. Do not touch others' experimental equipment without permission.

f. After experiments, always coil cords neatly. Trailing cords can cause equipment damage or injuries if tripped over.

g. After each experiment, turn off all equipment switches and desk main switches. Confirm once more when leaving.

h. When experimenting with high voltage, dry your hands and work with one hand (dominant hand) when possible.

i. For high-capacity power supplies, set a limiter or add resistance to prevent excess current flow.

j. For large capacitors, connect a 500 k-ohm or higher resistance in parallel to prevent prolonged charge retention. Do not touch immediately after discharging.

k. Connect electrolytic capacitors with correct polarity. Reverse polarity can cause explosion.

l. When equipment fails or fuses blow, understand the cause and do not repeat the same mistake.

m. In case of power outage, immediately turn off all equipment and main switches.

n. Damp gloves are more conductive than bare hands. Use only dry gloves.

o. In case of fire or explosion, always notify the supervising faculty member - do not attempt to handle it alone.

p. Do not leave assembled circuits with exposed wiring or place them on bags or metal surfaces. Organize wiring after experiments to prevent short circuits.

q. Do not wear metal rings when handling electricity.

r. When using a soldering iron, beware of burns. Cool under running water and see a dermatologist. Also take care not to scorch other objects.

6 Safety Manual for Chemistry

6.1.1 Lab Coat, Protective Glasses, and Clothing

Things You Must Not Do

1) Conducting experiments without prior knowledge of chemicals

Before conducting experiments, research the properties, handling methods, and hazards of the reagents to be used, using safety data sheets (SDS) and other resources. Pay special attention to highly toxic substances, highly volatile and flammable chemicals, and strong acids and bases.

2) Mixing or heating all at once

When mixing reagents or solutions, or when heating, do not do it all at once. To prevent sudden boiling due to rapid chemical reactions, mix gradually and heat slowly while stirring. Also, when disposing of experimental solutions, do not pour them all at once into the waste tank. Keep your face away from the tank's opening while pouring.

3) Careless cleanup after experiments

Do not leave the equipment used in experiments unattended; clean them immediately after use. Also, separate waste chemicals, combustible and non-combustible waste, etc, into detailed categories and dispose of them in designated containers

Things You Must Do

1) Pre-experiment check of reagents, equipment, and devices

Before conducting experiments, check the reagents, equipment, and devices to be used. Ensure that there are no contaminants, cracks, or other damage to glassware and equipment. Also, check for any malfunctions or damage to devices beforehand. Thoroughly review emergency procedures for chemical spills and fires with your supervisor. In case of an accident, do not attempt to handle it by yourself; always contact your supervisor.

2) Post-experiment cleanup and organization

Organize and clean up the reagents, equipment, and devices used in the experiment.

6.1 Before Starting Experiments

1) Wear modest clothing under the lab coat with minimal skin exposure and no accessories.

2) Wooden clogs and sandals are strictly prohibited. Be careful not to track in outdoor dirt.

3) Tie back long hair or cover with a lab cap.

4) Always wear protective glasses in the laboratory.

5) Wear appropriate protective equipment when handling reagents. Be familiar with accident response procedures.

6.1.2 Checking Equipment and Chemicals

1) Clean lab benches and equipment; confirm no contamination or cracks.

2) Check for spilled chemicals and verify labels are intact and legible.

6.2 During Experiments

6.2.1 When Taking Chemicals

1) Experiments involving acid vapor, organic solvent vapor, or toxic gases must be performed in a fume hood. If the lab becomes contaminated with vapors, use the ventilation fan.

2) When mixing or reacting chemicals, do so slowly in small amounts while observing. Rapid mixing of large quantities can cause exothermic reactions or explosions.

6.2.2 When Heating



1) Be careful of burns, bumping, sparks, and fire.

2) For burns, immerse the area in running water for at least 10 minutes.

3) Do not heat sealed containers. Avoid sudden heating.

4) Heated glass may look cool but can still be hot.

5) Do not heat cracked containers - they may break.

6) Do not look into beakers or flasks during reactions or heating - chemicals may splash.

7) When heating solutions, add boiling stones or stirrer chips for uniform heating.

8) Check for gas leaks when using gas burners.

9) Keep combustibles away from burner flames. Be especially careful with flammable organic solvents.

10) Extinguish match remnants with water before disposal. Do not discard in trash cans.

11) Do not leave a lit burner unattended. Nearby reagent shelves may also become hot.

12) Always use crucible tongs for heated crucibles.

13) Pay close attention to temperature control to avoid unexpected situations in high-temp/high-pressure or vacuum experiments.

6.2.3 Other Operations

1) Do not point test tube openings at others when heating. Do not leave broken glassware unattended.

2) Do not place items with flammable organic solvents in oven-type electric dryers.

3) When collecting a sample by mouth using glass pipette, do not draw solutions into your mouth. Use safety pipettes for concentrated acids, alkalis, and corrosive/toxic/irritating liquids.

4) When diluting concentrated sulfuric acid, add the acid slowly to water (NEVER water to acid) along a glass rod while stirring and cooling the container. Adding water to concentrated sulfuric acid causes violent bumping and is extremely dangerous.

6.2.4 When Using Equipment and Instruments

1) Handle all equipment carefully to prevent damage and malfunction, which can cause serious injuries or accidents.

2) When using UV or other radiation lamps, use paper, cloth, or other shielding to protect eyes and skin.

3) Dispose of all broken glass fragments in the designated glass waste container. Never leave them on the lab bench.

6.2.5 When Using Glass Equipment

1) Visually check for scratches or cracks before heating glass equipment.

2) When inserting glass tubes into rubber stoppers, hold near the tip, moisten with water, and push in slowly while turning. Gripping too far from the stopper applies excessive force and can break the glass, causing injury. Using work gloves or a towel is also helpful.

3) Cut glass tube ends and broken glass edges are sharp - handle with care.

6.2.6 When Using Chemicals

1) Do not touch chemicals directly or smell them directly. Use spatulas for solids, pipettes for liquids, and hand-fanning for gas odors.

2) Chemicals in the eyes can cause blindness. Alkaline solutions are particularly dangerous. Immediately wash gently with large amounts of water (high-pressure water can damage the eyes).

3) While toxic substances on skin can be washed off, ingestion can be fatal. Wash hands before eating or drinking outside the lab.

4) Handle strongly odorous substances (pyridine) and fuming substances (chlorosulfonic acid) in a fume hood.

6.2.7 When Disposing of Waste

1) Do not inadvertently mix experimental waste liquids or pour them down the drain.

2) Dispose of heavy metal ions and harmful anions as heavy metal waste. Organic solvents and acetone wash liquids go in designated organic solvent waste containers. Do not mix water-based waste into organic waste.

3) Render highly reactive waste harmless before disposal. Pouring directly down the drain is strictly prohibited.

4) Neutralize acids and alkalis before flushing with large amounts of water.

5) Do not pour solids down the drain as they clog pipes.

6) Place solid waste from liquid processing in designated containers.

7) Sort waste into combustible, non-combustible, glass fragments, and match remnants. Confirm matches are extinguished.

6.3 After Experiments

6.3.1 Equipment Cleaning

1) Immediately wash used glassware thoroughly with tap water after experiments.

2) Organize cleaned equipment back to pre-experiment condition.

3) Confirm water and gas valves are closed.

6.3.2 Chemical Handling

Organic solvents are classified as dangerous materials under the Fire Service Act, and some are highly toxic. Before use, research their properties in chemical handbooks, the Merck Index, or Safety Data Sheets (SDS), and exercise great caution.

Table: Major Organic Solvents - Flash Point, Ignition Point, and Toxicity

Solvent Name	Hazmat Classification	Flash Pt (°C)	Ignition Pt (°C)	LD50 (mg/kg)	Muta-genicity
Acetonitrile	Flammable liquid	6	552	2730 (rat)	
Acetone	Flammable liquid	-18	465	3000 (mouse)	
Ethyl acetate	Flammable liquid	-4	427	5620 (rat)	
Diethyl ether	Flammable liquid	-39.6	180	1215 (rat)	
1,4-Dioxane	Flammable liquid	8	180	5700 (mouse)	Yes
1,2-Dichloroethane	Flammable liquid	13	413	670 (rat)	Yes
Petroleum ether	Flammable liquid	-18	246	-	
Tetrahydrofuran	Flammable liquid	-14	321	1650 (rat)	
Toluene	Flammable liquid	4	116	636 (rat)	Yes
Carbon disulfide	Flammable liquid	-33.9	100	3188 (rat)	Yes
Hexane	Flammable liquid	-4	225	28710 (rat)	Yes
Benzene	Flammable liquid	-11	293	4700 (mouse)	Yes*
Methanol	Flammable liquid	11	446	5628 (rat)	Yes
Chloroform	Toxic substance	Not Applicable	Not Applicable	908 (rat)	Yes
Carbon tetrachloride	Toxic substance	Not Applicable	Not Applicable	2530 (rat)	Yes

*Note: LD50 = dose at which 50% of test animals die after oral administration. Mutagenicity = property of causing DNA mutations, suggesting potential carcinogenicity. * Benzene has confirmed mutagenicity.*

Other commonly used chemicals include potassium permanganate (Class 1), metallic sodium (Class 3), and nitric acid and sulfuric acid (Class 6). Some of these have corrosive properties and must be handled with great care.

References

- Aono, Y., et al. (Eds.). *Collection of Experimental Mistakes to Avoid* (*Kagaku no Jikken*, Special Issue No. 309). Kyoritsu Shuppan, 1973.
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- Tokyo Chemical Industry Co., Ltd. *Lab Guide for Handling Hazardous Reagents*. Kodansha Scientific, 1989.
- The Chemical Society of Japan (Trans. and Ed.). *Guidelines for Laboratory Waste Disposal*. Maruzen, 1977.

7 Poisons, Deleterious Substances, and Hazardous Materials

Things You Must Not Do

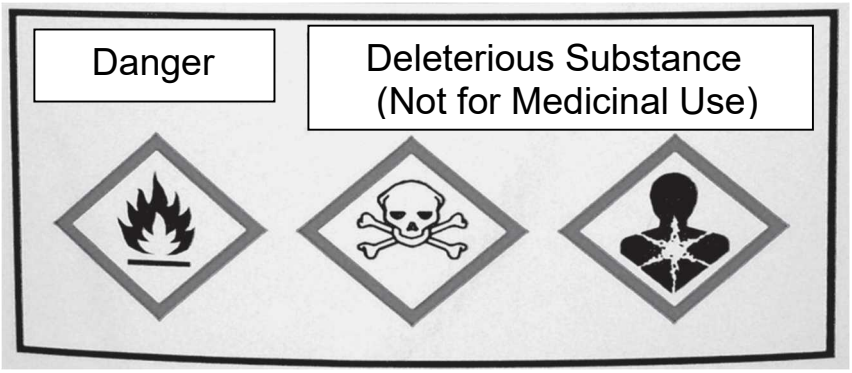
1) Do not leave toxic/deleterious reagents unattended on lab benches
2) Do not pour waste down the drain
3) Do not store reagents designated by the Fire Service Act in excess of specified quantities
4) Do not use open burners when working with flammable solvents

Things You Must Do

1) Lock storage cabinets for poisons/deleterious substances; be alert for theft
2) Accurately record remaining quantities of poisons/deleterious substances after each use
3) Prepare Safety Data Sheet (SDS) files for frequently used chemicals
4) Predict disasters and implement sufficient protective measures when using hazardous materials
5) Confirm accident response procedures

7.1 General Precautions for Handling Chemical Substances

1) Investigate the hazards and toxicity of any substance being handled for the first time. Safety Data Sheets (SDS) are available. The university's chemical management system (http://reagent.yamanashi.ac.jp/iasor7/fw/FW0000/) contains accumulated data. Print and file SDS for frequently used chemicals. Chemical bottles also display toxicity symbols and handling precautions.



2) Store harmful substances (poisons/deleterious substances) in locked chemical cabinets with appropriate labeling. Manage usage quantities through the university chemical management system.

3) Handle regulated substances with extreme care following applicable laws. Use local exhaust ventilation (fume hoods) for volatile chemicals, dusts, and substances subject to the Organic Solvent Poisoning Prevention Regulations or Special Chemical Substances Prevention Regulations.

4) Anticipate disasters and plan sufficient protective measures. Prepare to minimize damage in case of accidents.

5) Dispose of used substances in accordance with regulations. Pay particular attention to wash water.

7.2 Hazardous Materials

Precautions for handling chemicals, categorized by class, are listed below.

Class 1 - Oxidizing Solids

- Keep away from fire and heat sources; store sealed in cool, dark places; avoid impact.
- Do not mix with easily oxidized substances or allow contact with acids or water.
- Do not store unstable substances for extended periods.

Class 2 - Combustible Solids

- Keep away from fire and heat sources; store sealed in cool, dark places; avoid contact with oxidizers.
- Phosphorus sulfide and metal powders: especially avoid water contact.

Class 3 - Spontaneously Combustible and Water-Reactive Substances

- Seal spontaneously combustible compounds to prevent air contact; store away from combustibles. For those submerged in water or petroleum protectants, use outer containers to prevent breakage.
- Seal water-reactive substances to prevent moisture contact; store in dry, cool, dark, elevated locations.
- Monitor evaporation of solvent-diluted substances.

Class 4 - Flammable Substances

- Divide highly flammable substances into small portions; store in well-ventilated locations away from fire; ensure no vapor leakage from containers.

Class 5 - Self-Reactive Substances

- Keep away from fire; store in well-ventilated, cool, dark places; avoid impact and friction.

Class 6 - Oxidizing Liquids

- Store in acid-resistant containers; avoid fire and direct sunlight; prevent contact with combustibles, organics, and water.

7.3 Harmful (Toxic) Substances

Details regarding the toxic substances can be obtained from online sources or the previously mentioned SDS.Precautions for handling hazardous substances during experiments are listed below.

1) Store poisons/deleterious substances in sealed, labeled, locked cabinets. Labels: "Non-Pharmaceutical Poison" (white text on red), "Non-Pharmaceutical Deleterious Substance" (red text on white). Manage through the chemical management system; record each use.

2) Use fume hoods or local exhaust for volatile or dust-producing toxic substances.

3) Toxic substances absorbed through skin/mucous membranes may have delayed symptoms. Wash hands and gargle after use.

4) Prepare and wear protective clothing, goggles, gas masks, and gloves. Select appropriate adsorbent for gas masks and monitor absorption capacity.

7.4 Carcinogenic Substances

Precautions for handling chemical substances suspected of being carcinogenic are listed below.

1) Cancer often develops long after exposure. Thoroughly investigate the carcinogenicity of chemicals before handling.

2) Where possible, reduce risk by using substitutes (e.g., replace benzene with toluene).

3) When substitution is impossible, use contamination prevention sheets, fume hoods, protective gloves, goggles, and gas masks to prevent exposure and dispersion.

4) The Industrial Safety and Health Act mandates environmental measurement and long-term health monitoring for certain chemicals such as benzene and asbestos.

5) Ensure carcinogenic substances do not spread via body, clothing, or equipment. Clean and manage waste.

References

 The Chemical Society of Japan (Ed.). *Safety Guidelines for Chemical Experiments*. Maruzen. ISBN 4-621-04576-8.

 Editorial Department of Kagaku-Dojin (Ed.). *For Safe Conduct of Experiments*. Kagaku-Dojin. ISBN 9784759818338.

 The Chemical Society of Japan (Ed.). *Chemical Safety Notebook*. Maruzen. ISBN 9784621077849.

8 Safety Manual for Biological Sciences

Important Precautions

1) Perform all tasks in a clean environment

In biological experiments, it is essential to avoid contamination by microorganisms that are not the target of the experiment. Therefore, it is necessary to work in a clean environment. Clean work practices also help prevent infections.

2) Be cautious of burns and fires

High temperatures are sometimes used for sterilization. Be very careful when handling related equipment and devices to prevent burns and fires.

3) Prevent infection and spread of microorganisms handled in experiments

Pathogenic microorganisms may be handled intentionally or unintentionally. Since microorganisms are invisible to the naked eye, they can cause infections or environmental contamination without being noticed. Additionally, cultures contain microorganisms at high concentrations, so they must be handled carefully and appropriately.

4) Obtain permission and undergo training for genetic recombination experiments and experiments using research microorganisms

When conducting genetic recombination experiments and experiments using research microorganisms, you must follow the "University of Yamanashi Safety Management Regulations for Genetic Recombination Experiments and Experiments Using Research Microorganisms" and obtain permission from the experiment supervisor as well as undergo relevant safety training.

8.1 General Precautions

1) Keep laboratories, lab benches, instruments, and equipment (clean benches, safety cabinets, etc.) clean at all times.

2) Wear lab coats during experiments to prevent contamination of clothing. Wear rubber gloves, masks, and protective glasses as needed.

3) Keep laboratory windows and doors closed during work to prevent microorganism dispersal. Always perform transfer/inoculation in a clean bench or safety cabinet.

4) When using gas burners for aseptic technique, exercise caution against burns and fire.

5) After work, wipe used equipment with 70% ethanol or quaternary ammonium disinfectant, and wash hands with disinfectant solution.

6) Do not carelessly remove microbial cultures or experimental organisms from the laboratory.

7) Autoclave equipment with microbial cultures before washing or disposing.

8) Use autoclaves under faculty guidance, with full attention to safety, as they operate at high temperature and pressure.

9) Minimize aerosol generation in all operations.

8.2 Genetic Recombination and Research Microorganism Experiments

Genetic recombination experiments normally conducted in the Faculty of Engineering are at P1 and P2 levels. Research microorganism experiments primarily handle P2-level microorganisms. In addition to the general precautions above, comply with the following requirements for each level. Permission from the supervising faculty member (as defined in the "University of Yamanashi Genetic Recombination and Research Microorganism Safety Management Regulations") and completion of safety education/training are required.

P1 Level - Additional Requirements:

a. May be conducted in a standard biology laboratory.

b. Use mechanical pipettes; do not pipette by mouth.

c. Avoid using syringes when alternatives exist.

d. Recombinant microorganisms must not leave the laboratory. If necessary, obtain faculty permission and seal in sturdy, leak-proof containers.

P2 Level - Additional Requirements:

a. Experiments may only be conducted in approved P2-level laboratories.

b. Wear dedicated clothing (dedicated lab coat) inside the laboratory; remove when exiting.

c. Do not allow entry to persons unfamiliar with the experiment without faculty permission.

d. Post a sign indicating 'P2 Level Experiment in Progress' at the laboratory entrance during experiments.

e. Label freezers/refrigerators storing recombinant or research microorganisms.

f. Perform transfer/inoculation work only in a safety cabinet.

g. Use mechanical pipettes.

h. Avoid using syringes when alternatives exist.

i. Recombinant and research microorganisms must not leave the laboratory. If necessary, obtain faculty permission and seal in sturdy, leak-proof containers.



9 Safety Manual for Field Training and Surveys

Important Precautions

1) Follow the instructions of the accompanying teachers and teaching assistants (TAs) during field training

In field training where teachers or TAs accompany you, thoroughly understand and follow the instructions and precautions given in advance. Additionally, always be mindful of your own safety according to the situation on site.

2) Do not act alone

In the event of an accident, prompt first aid and communication with companions or supervising teachers are necessary. Always work in groups to prepare for any emergencies.

3) Make a well-considered plan with safety in mind

When conducting surveys or other activities, it is important to work calmly with safety in mind. Therefore, make a well-considered plan in advance and proceed with the work according to this plan. Especially for field activities conducted solely by students, such as graduation research or graduate studies, thoroughly consider specific details such as date, location, and methods of survey or observation. Based on the results, undergraduate students should submit an off-campus study notification, and master's and doctoral students should submit an off-campus research notification to their supervising teacher and obtain permission in advance.

4) Prepare contact information and methods in case of an accident

In the event of an accident, promptly contact your companions and supervising teacher, and respond appropriately while seeking instructions as necessary.

9.1 Situation-Specific Precautions

Field surveys and observations vary widely in terms of the scope and duration of activities, and the types of potential accidents are equally diverse. In addition to the four items mentioned above, the following points should be noted depending on the specific circumstances.

1) Wear appropriate work clothes, work shoes, and work gloves.

2) Pay full attention to traffic safety during travel and when working on roads.

3) Monitor weather conditions; beware of flash floods, high waves, lightning, and avalanches. Be mindful of heatstroke, frostbite, and other health concerns. Do not take reckless action.

4) When working near water (coasts, rivers, lakes), be vigilant against drowning. Use life jackets when necessary.

5) In mountains and near rivers, beware of cliff and slope fall accidents.

6) When surveying local residents, protect personal information, obtain consent, and behave courteously. Avoid privacy violations, being mistaken for a suspicious person, or involvement in criminal incidents.

7) When conducting disaster surveys, follow instructions from the relevant administrative authorities.

8) Act with common sense and avoid reckless actions or judgments.



10 Handling of High-Pressure Gas

Accidents involving high-pressure gas can include gas ejection/leakage from toppled or damaged cylinders, followed by fire, explosion, or poisoning. Handling of high-pressure gas cylinders is strictly regulated by the High Pressure Gas Safety Act. First-time users must attend the regularly held High Pressure Gas Safety Training to fully understand the dangers and proper usage.

Key Points: No open flames! No direct sunlight! Prevent cylinder toppling!

10.1 Legal Definition of High-Pressure Gas

1) Gaseous substances: Gauge pressure of 1 MPa (10 kgf/cm^2) or higher.

2) Liquid substances: Pressure of 0.2 MPa (2 kgf/cm^2) or higher.

3) Exceptions: Acetylene gas at 0.2 MPa or higher. Hydrogen cyanide, methyl bromide, ethylene oxide, etc. at atmospheric pressure or higher.

10.2 Pre-Use Verification

Verify the stamp markings on the cylinder shoulder: gas name, internal volume, pressure test date, maximum fill pressure, etc.

Gas Types and Cylinder Colors:

Gas Type	Cylinder Color
Argon, Nitrogen, Oxygen	Black
Hydrogen	Red
Carbon Dioxide	Green
Ammonia	White
Chlorine	Yellow
Acetylene	Brown
Methane, LP Gas, Carbon Monoxide, Phosgene, Ethylene, etc.	Gray

• Flammable gases are marked with "Flam" (燃), toxic gases with "Toxic" (毒).

10.3 Proper Installation of High-Pressure Gas Cylinders

1) Place in a well-ventilated location below 40°C, away from direct sunlight.

2) Stand cylinders upright and secure with chains at two points (top and bottom) to prevent toppling. If cylinders must be used horizontally (not allowed for liquefied gas or acetylene), always use roll stops.

3) Maintain a strict no-flame zone within 2 meters of the cylinder.

4) Separate full and empty cylinders in different locations.

5) Do not store oxidizing gases (like oxygen) together with flammable or toxic gases.

6) Promptly dispose of cylinders more than 15 years old.

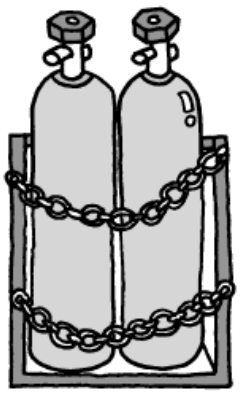


Fig. 1 Gas Cylinder Stand

10.4 How to Use High-Pressure Gas Cylinders

1) Gas outlet threads come in left-hand and right-hand types. Compressed gases: hydrogen and helium use left-hand threads; others use right-hand. Acetylene has no thread. Hydrogen and helium have slightly different port diameters.

2) Perform monthly self-inspections of cylinders and accessories.

3) First-time users must receive guidance from experienced personnel or faculty (especially for valve operation).



Figure 2. Cylinder Valve Types:
(Left) Valve Stem Type,
(Right) Handle Type

4) Pressure regulators must only be used if they are compatible with the type of gas. Special attention should be given to oxygen, hydrogen, and acetylene: After replacing a cylinder, check the regulator connection for leaks using soapy water. Ensure adequate ventilation.

- Oxygen: Contact with flammable substances (such as oil and grease) can lead to combustion or explosion.
- Hydrogen: Even at low concentrations, it can easily form explosive mixtures. Sudden release can cause ignition and explosion even without a source of fire.
- Acetylene: It can explode even without the presence of air. Metals such as copper and brass should not be used in areas that come into contact with acetylene.

5) Record all cylinder usage in the High Pressure Gas Container Management Log (retain for 2 years).

6) When transporting: wear safety shoes and gloves, attach valve protection cap, and use a dedicated hand cart. If no cart is available, tilt slightly and roll on the bottom edge. Do not drag, drop down stairs, or roll horizontally.

7) Always use liquefied gas and acetylene cylinders upright.

8) If toxic gas leaks, immediately evacuate upwind while shouting warnings. Follow faculty instructions for subsequent measures.

11 Handling of Radiation

Things You Must Not Do

1) Removing radioactive materials from the facility (endangers yourself/public; illegal)
2) Lending/borrowing personal dosimeters (glass badges, etc.) or not wearing them
3) Deliberately exposing or shielding personal dosimeters

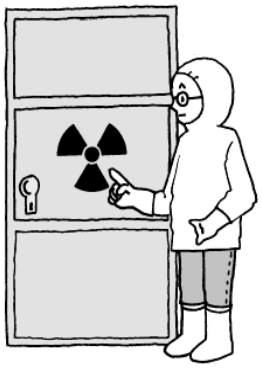
Things You Must Do

1) Follow the three principles for reducing external exposure from electromagnetic radiation:
   Shielding: Place barriers between the radiation source and the worker
   Distance: Dose is inversely proportional to the square of distance; stay as far away as possible
   Time: Dose is proportional to time; minimize exposure duration
2) Undergo education/training and health examinations as required by the Radiation Hazards Prevention Act

11.1 Purpose of Radiation Protection

While radiation use contributes to scientific advancement and industrial development, it also carries the risk of radiation injury to humans.

- When activities involving radiation exposure provide clear benefits, ensure human safety without unduly restricting those activities.
- Prevent the occurrence of deterministic effects in individuals.
- Take all reasonable measures to limit the occurrence of stochastic effects.



11.2 Types of Radiation

- Electromagnetic radiation (X-rays, gamma rays)
- Alpha and beta rays from radioactive isotopes (RI)
- Electron beams from accelerators, etc.

11.3 Radiation Injury from Excessive Exposure

- **Early effects:** Deterministic effects appearing promptly in the eyes, skin, blood, etc.
- **Late effects:** Stochastic effects such as cancer and genetic damage appearing years later.

11.4 Three Principles of Radiation Protection

- **Justification of practices:** No activity involving radiation exposure shall be adopted unless it produces a net positive benefit.
- **Optimization of protection:** Even for justified activities, exposure must be kept as low as reasonably achievabl.
- **Individual dose limits:** Dose limits that must not be exceeded are established for cumulative individual exposure from various sources.

[IMPORTANT] Dose limits for the general public: 1 mSv per year

Reference: Dose limits for radiation workers: average 20 mSv per year over 5 years; no single year may exceed 50 mSv.

11.5 Compliance with Radiation Hazards Prevention Act

- Unsealed isotopes cannot be used at the Kofu Campus.
- Understand the properties of radiation from the sources you use, provide adequate shielding, and follow usage guidelines.
- Use radiation within controlled areas under the direction of the radiation management supervisor.

11.6 Radiation Hazards Prevention Education and Training

- Improper use can cause serious radiation contamination affecting not only the user but the environment.
- Undergo education and training as required by the Radiation Hazards Prevention Act.
- Those who have not received this training cannot enter controlled areas, whether on or off campus.

New user training: Attend the education/training held around April each year at the Medical School Campus. Without this, radiation use and controlled area entry are not permitted.

Continuing user training: Attend the education/training held around June each year at the Kofu Campus.

11.7 Health Management

- Monitoring of exposure doses during use and periodic health examinations for radiation workers (separate from general health checkups) are mandatory.
- Follow the instructions of your supervising faculty member and radiation management supervisor.

11.8 Radiation-Generating Equipment and RI Instruments

1) X-ray equipment, etc.

2) Gas chromatograph Electron Capture Detector (ECD)

3) Sealed sources

4) Electron beam accelerators, etc.

11.9 Precautions for X-ray Equipment Use

- Conduct X-ray experiments only after receiving instruction from the supervising faculty member.
- X-rays are harmful; exposure can cause dermatitis, hair loss, reproductive disorders, etc.
- Primary X-rays (direct beam) are intense and exist along a limited path.
- Secondary X-rays (scattered) are orders of magnitude weaker but exist near the primary beam path and can leak through gaps as small as 1 mm if shielding is inadequate.

To prevent exposure, observe the following:

■ No unauthorized entry while X-ray equipment is in use.
■ Place X-ray shields in the direction of the direct beam.
■ Do not stand for extended periods in the direct beam direction, even with shields.

■ Strictly follow X-ray equipment procedures.

■ Close the X-ray shielding cover before opening the X-ray shutter.

■ Do not look into the X-ray window when the equipment is powered on.

■ During joint work with 2+ people, call out and confirm X-ray irradiation with each other.

■ If an exposure accident occurs or equipment abnormality is detected, immediately turn off the power and contact the equipment management supervisor.

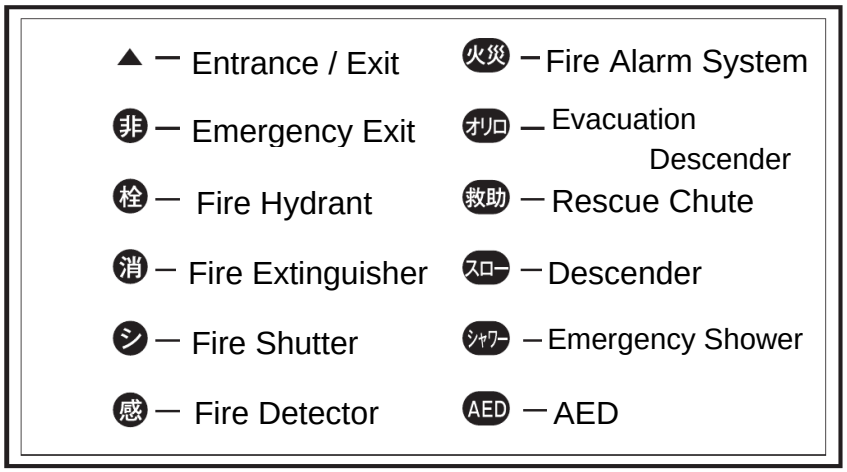
11.10 Precautions for Using External Radiation Facilities

• First receive radiation worker education/training and health examination at this university, obtain worker authorization, and then apply for authorization at the external facility.

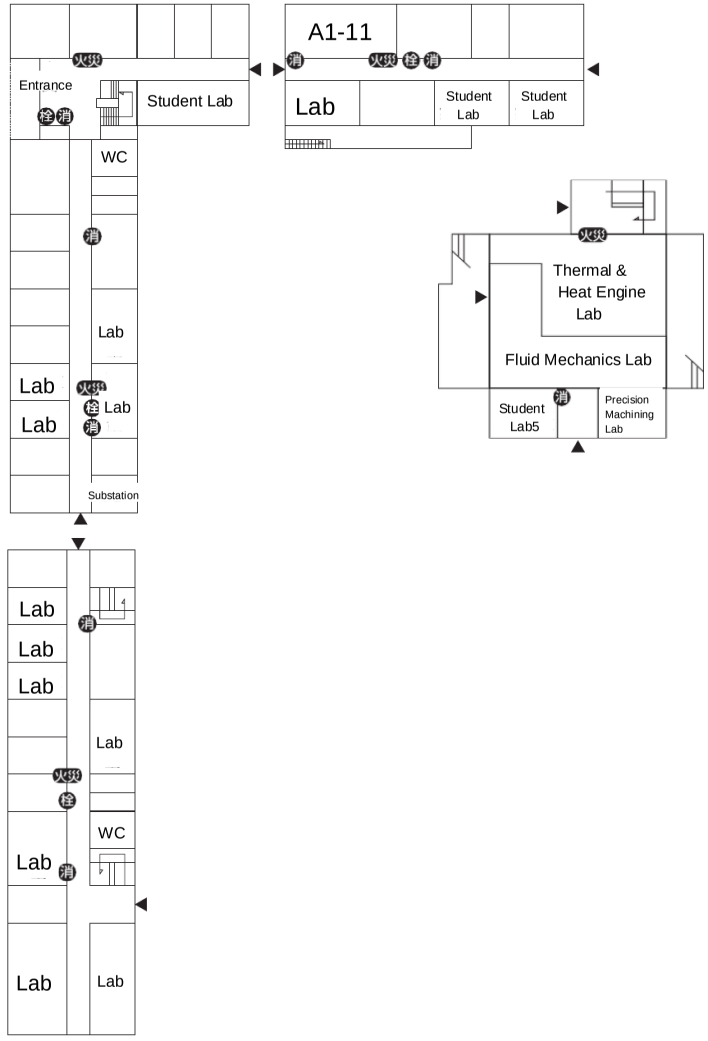
• Complete the external facility's education/training and follow their guidelines.

• In many shared facilities, it is mandatory to wear the radiation dose monitor of each facility under the health management of our university (wearing a radiation dose monitor and undergoing regular health check-ups).

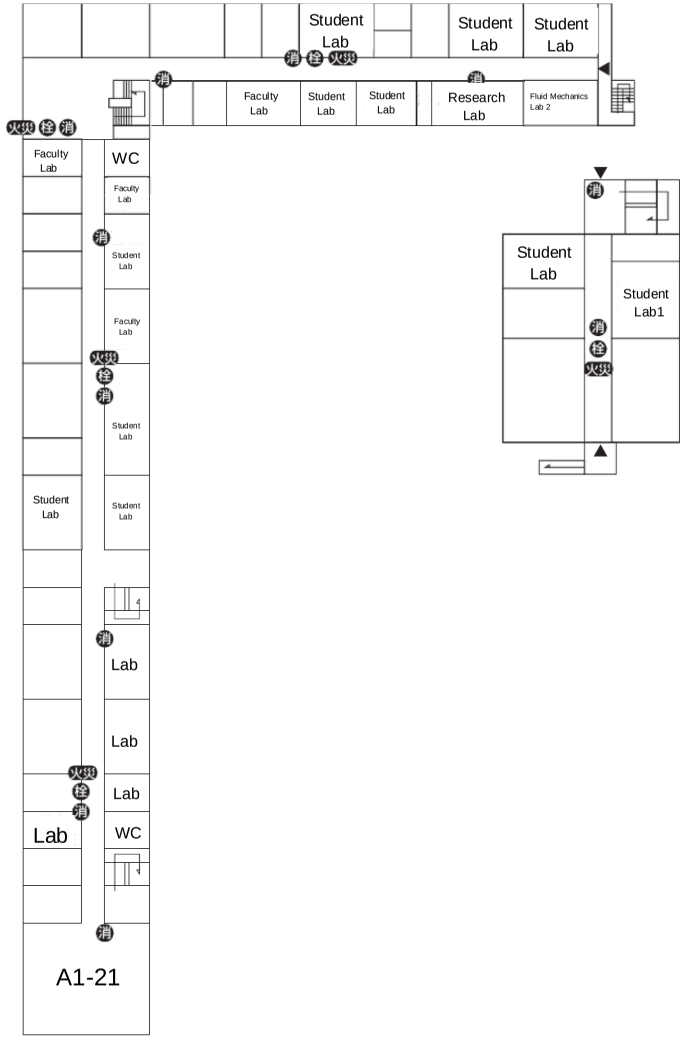
Fire Prevention Equipment Installation Diagram



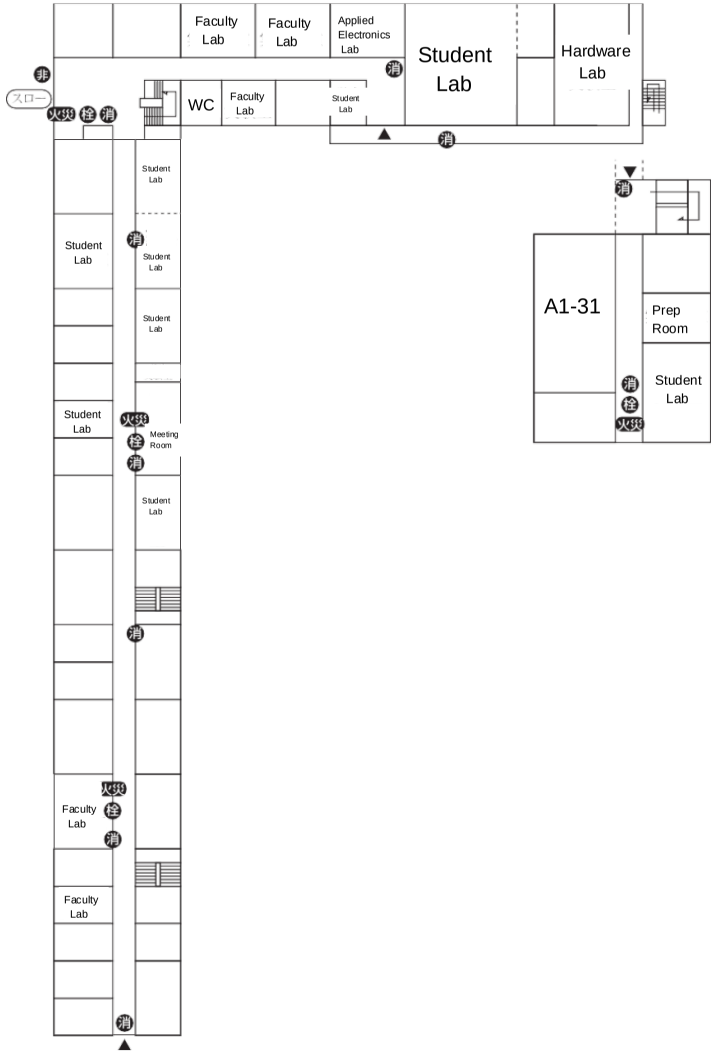
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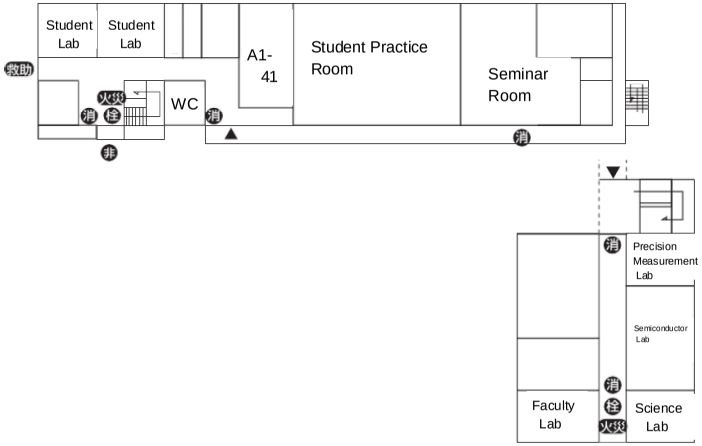
Building A1 2nd Floor



Building A1 3rd Floor

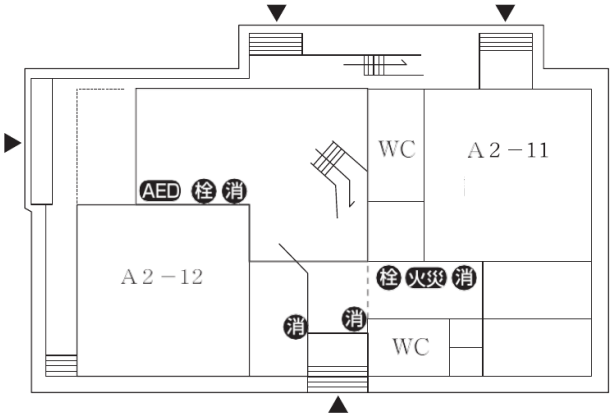


Building A1 4th Floor

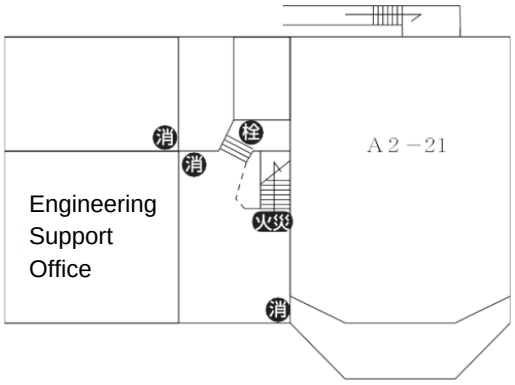


Building A2

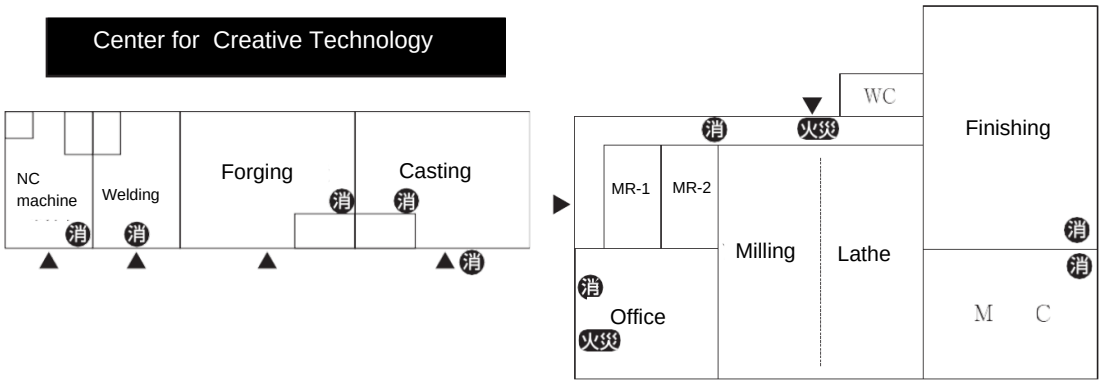
1st Floor



2nd Floor



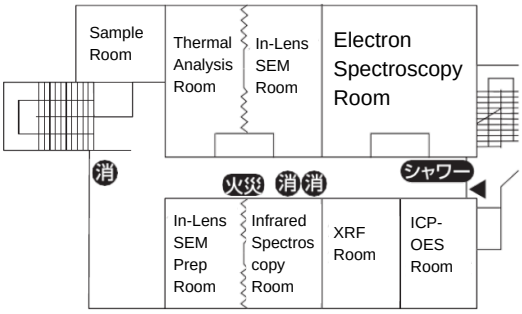
Center for Creative Technology



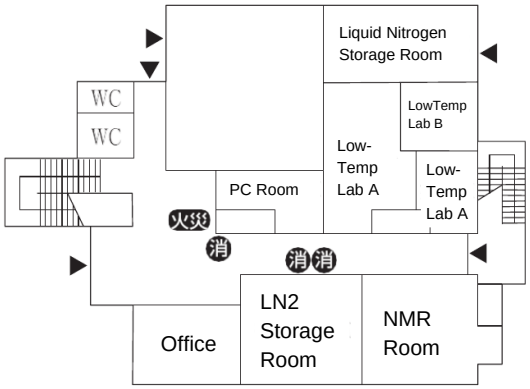
Center for Instrumental Analysis

New Building

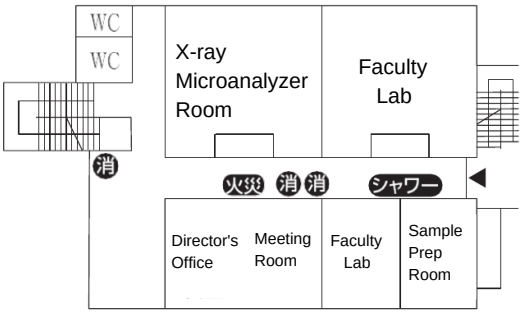
3rd Floor



1st Floor

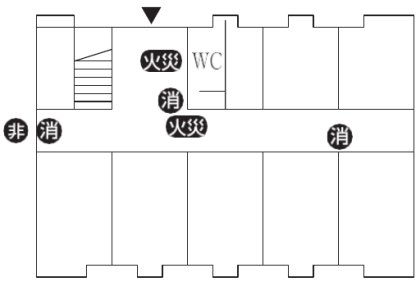


2nd Floor

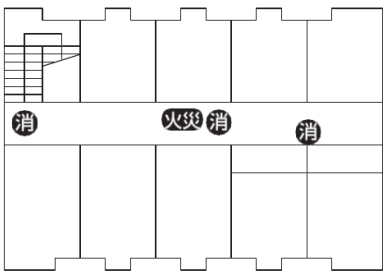


Old Building

1st Floor

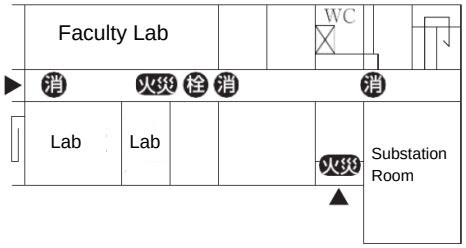


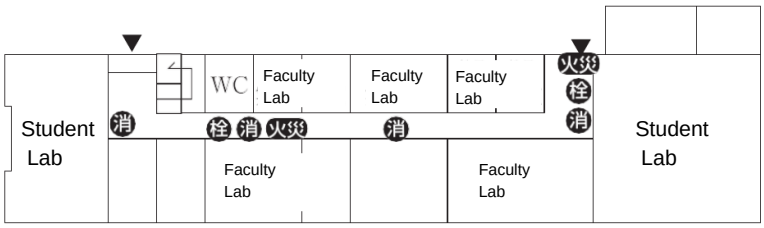
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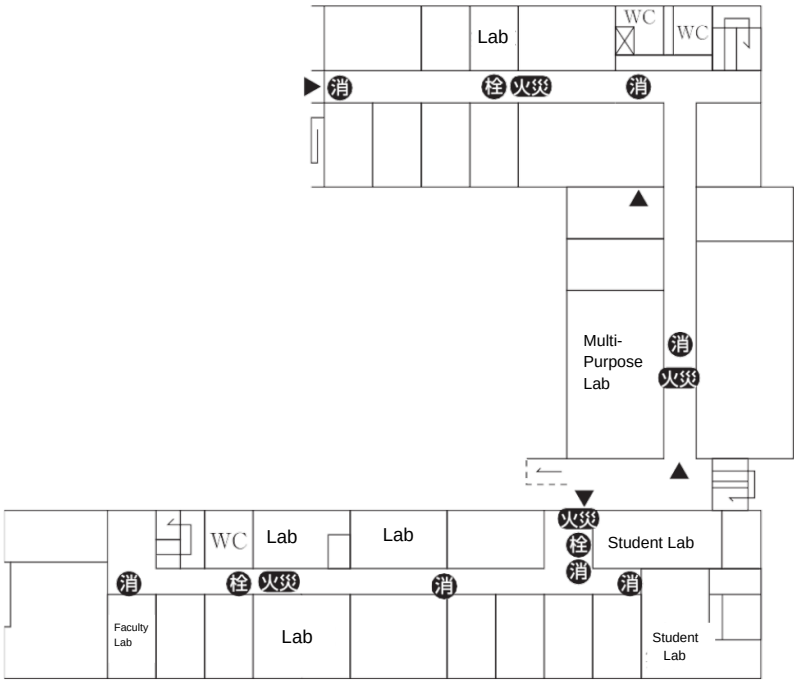
Building A3

1st Floor



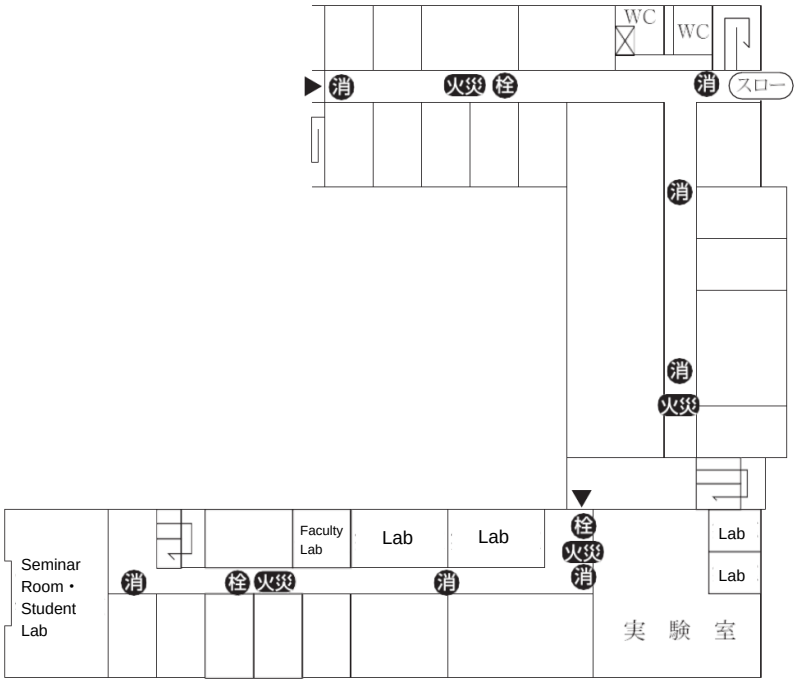


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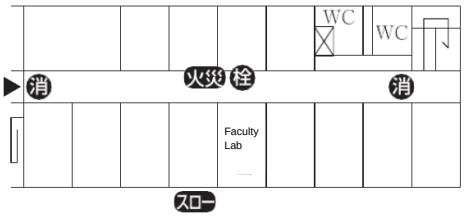


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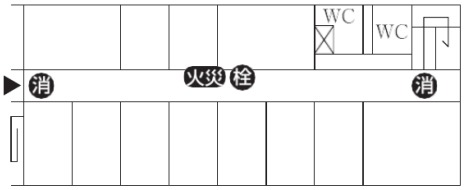
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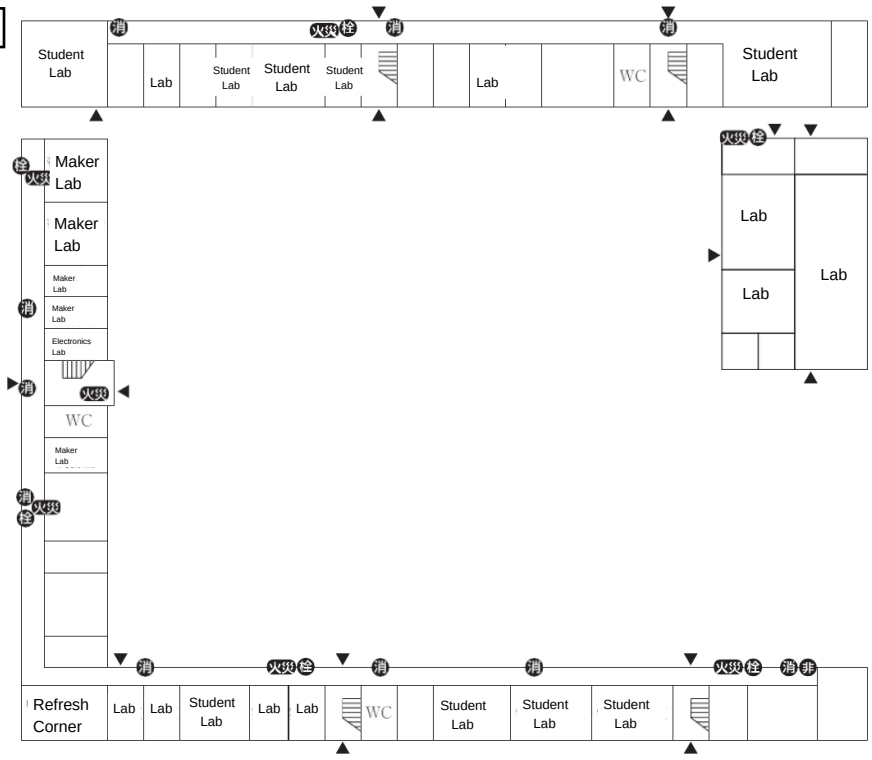
4th Floor



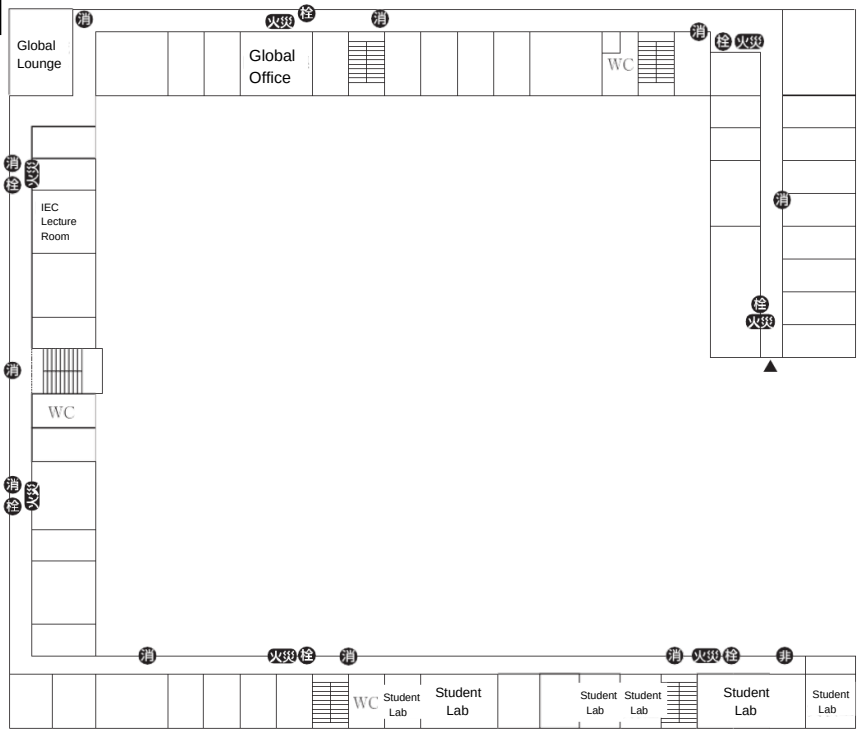
5th Floor



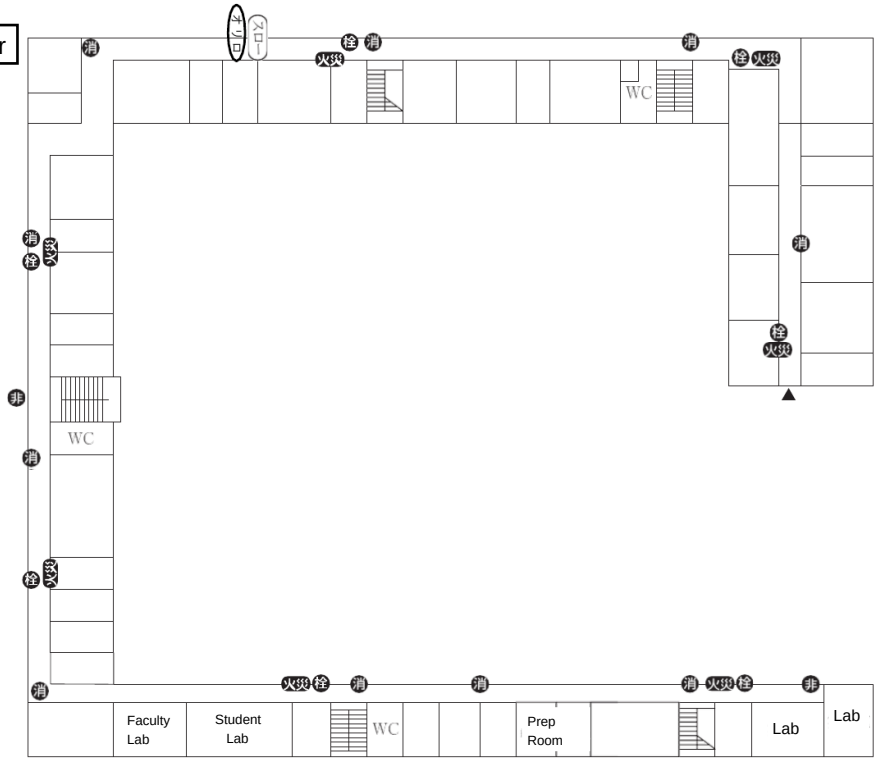
Building B1 1st Floor



Building B1 2nd Floor

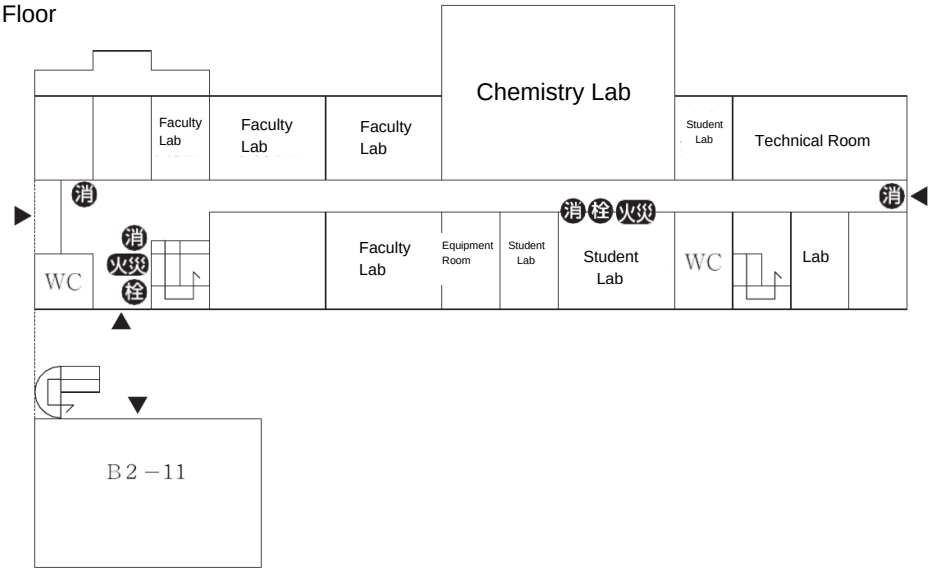


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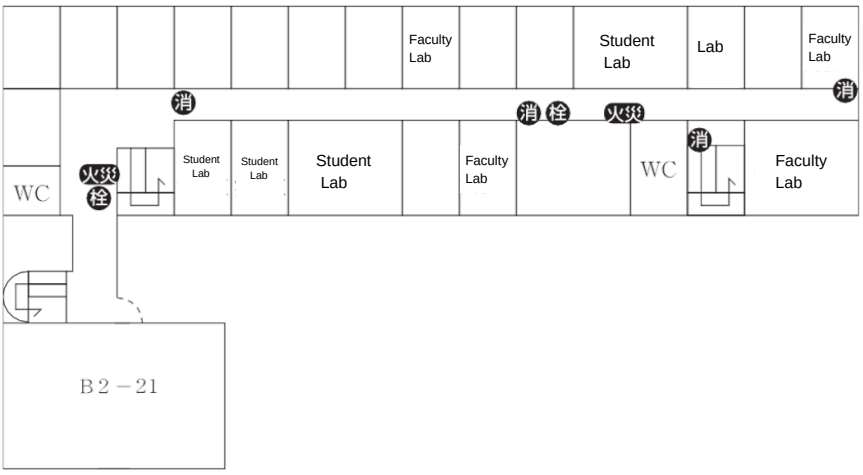


Building B2

1st Floor

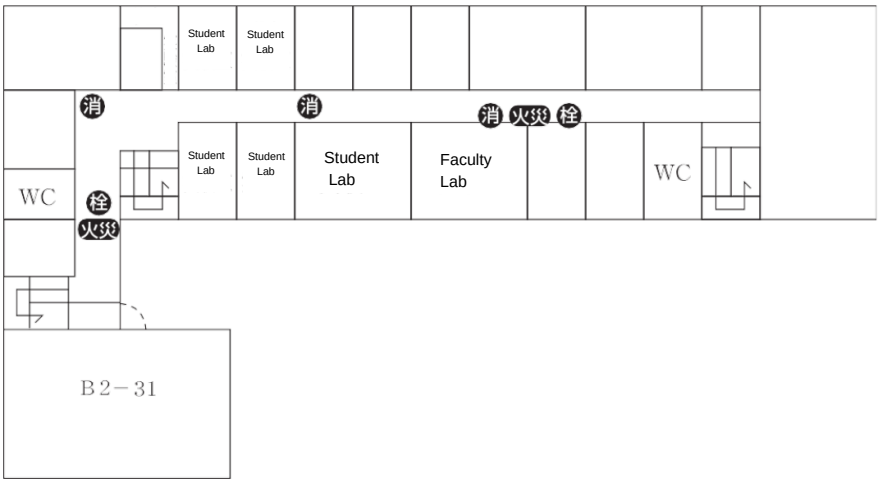


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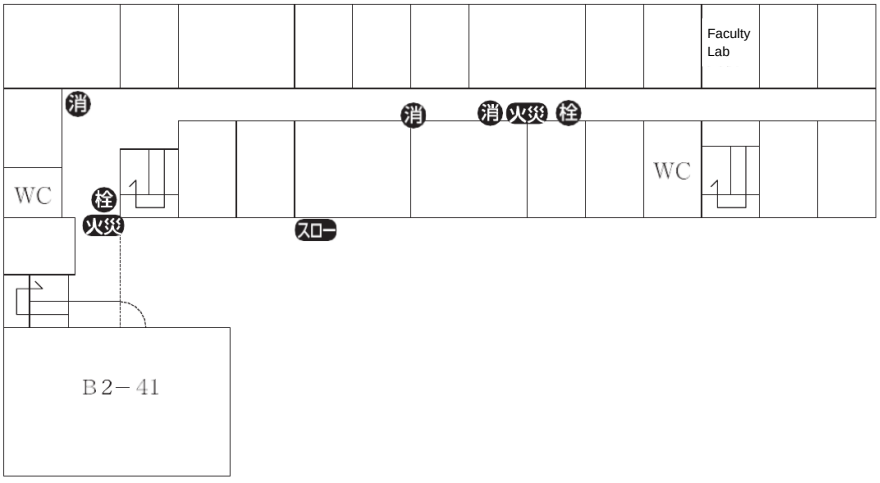


Building B2

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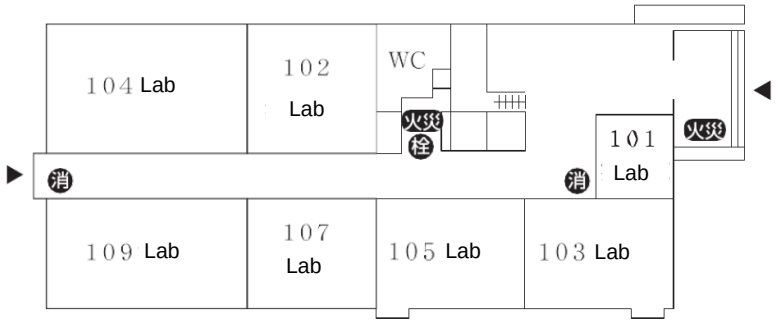


4th Floor

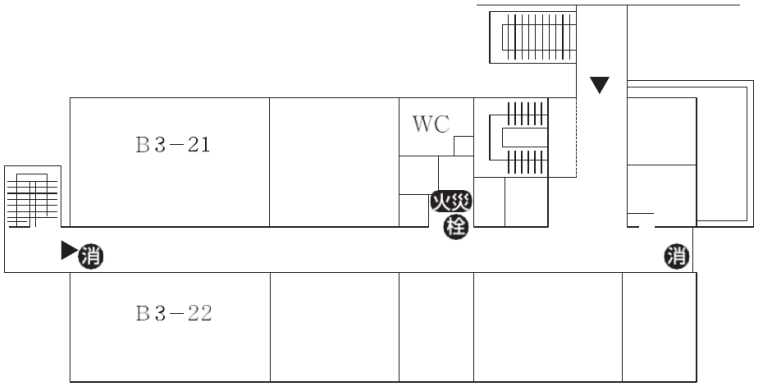


Building B3

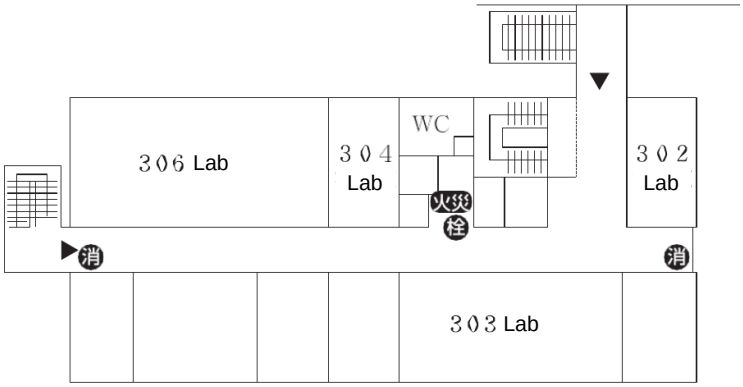
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2nd Floor

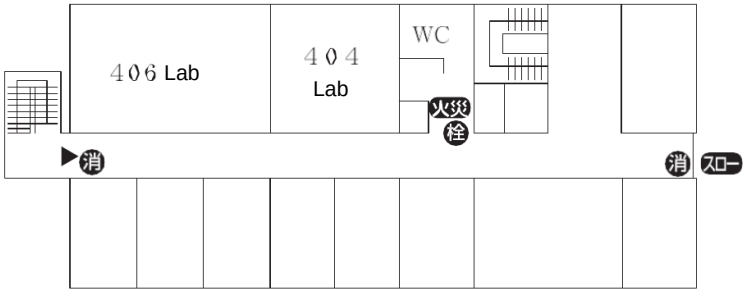


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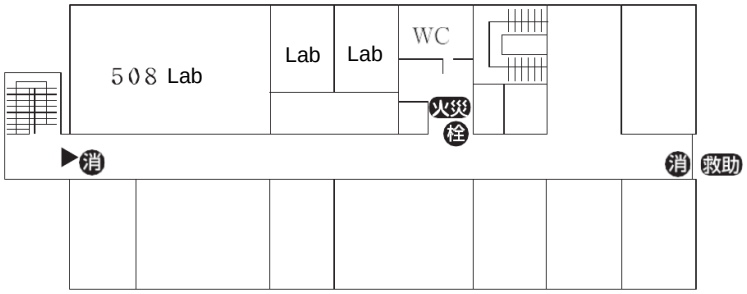


Building B3

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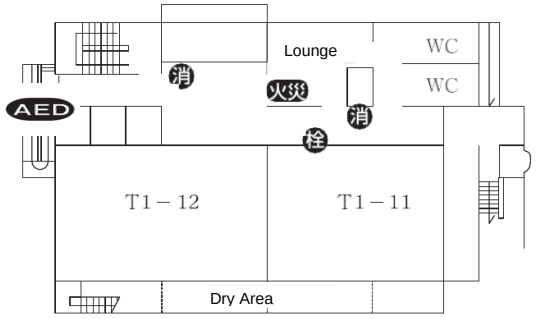


5th Floor

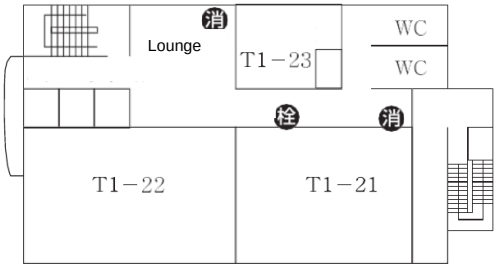


Building T1

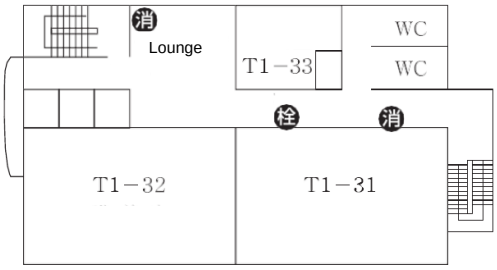
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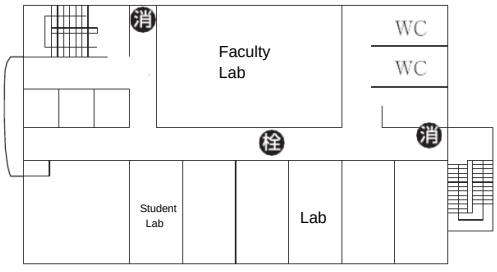
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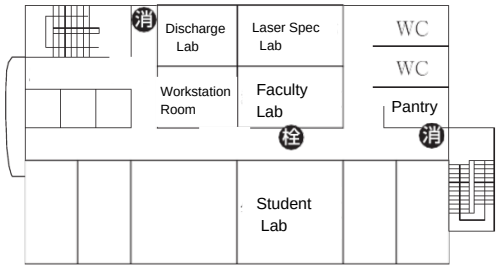
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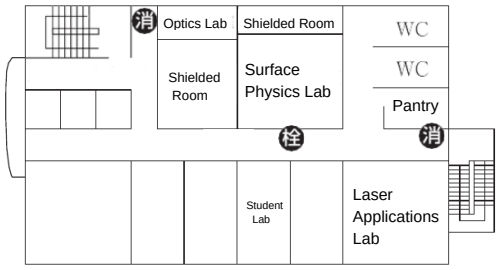
4th Floor



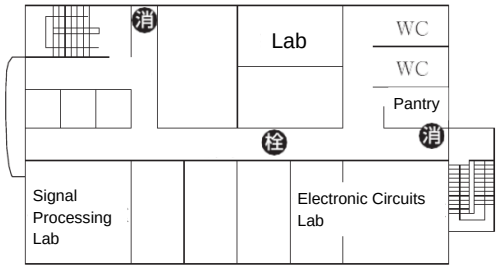
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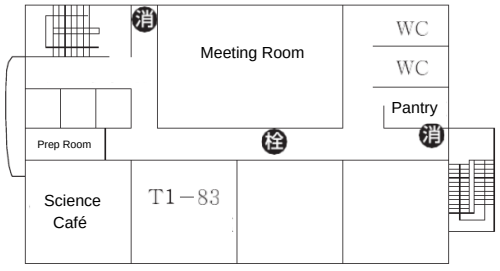
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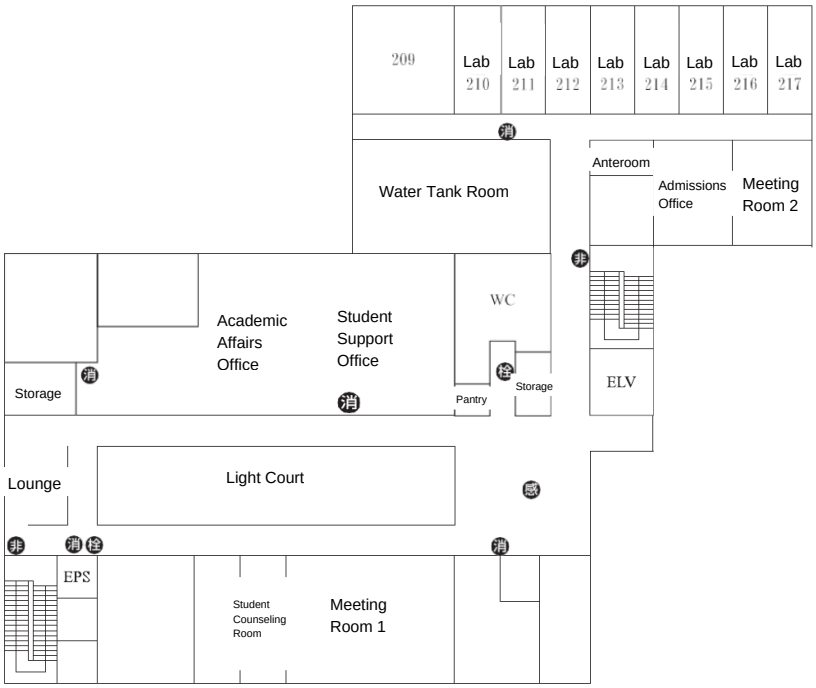
7th Floor



8th Floor

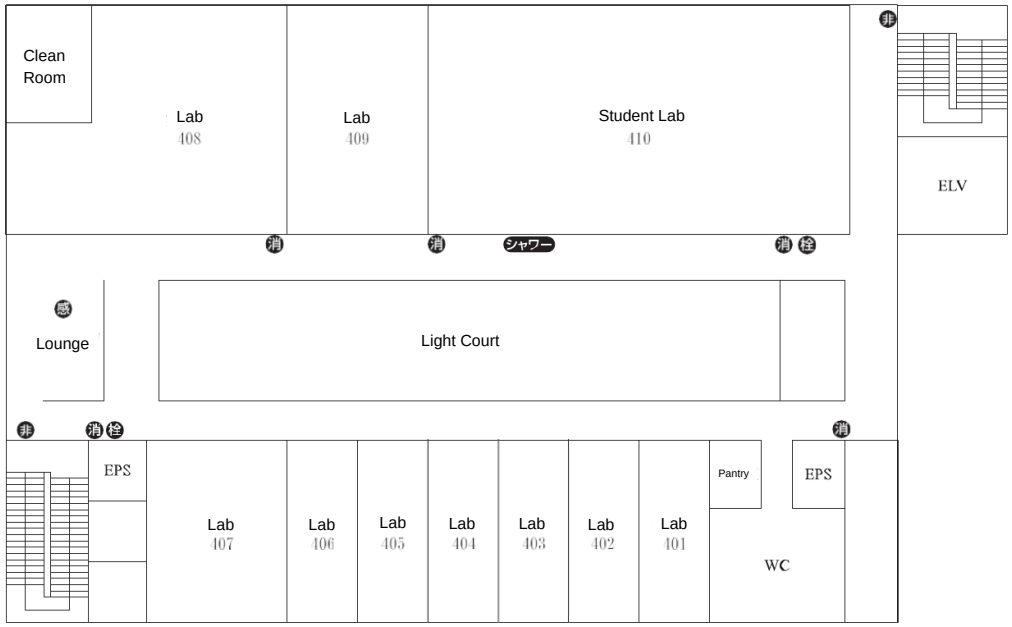


Research Center Building



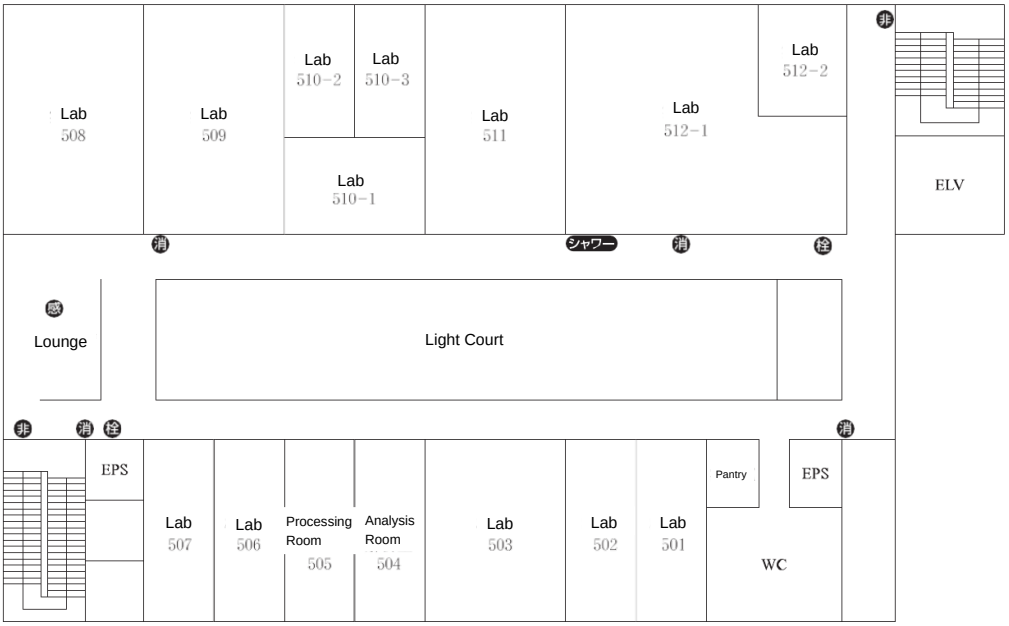
2nd Floor

Research Center Building



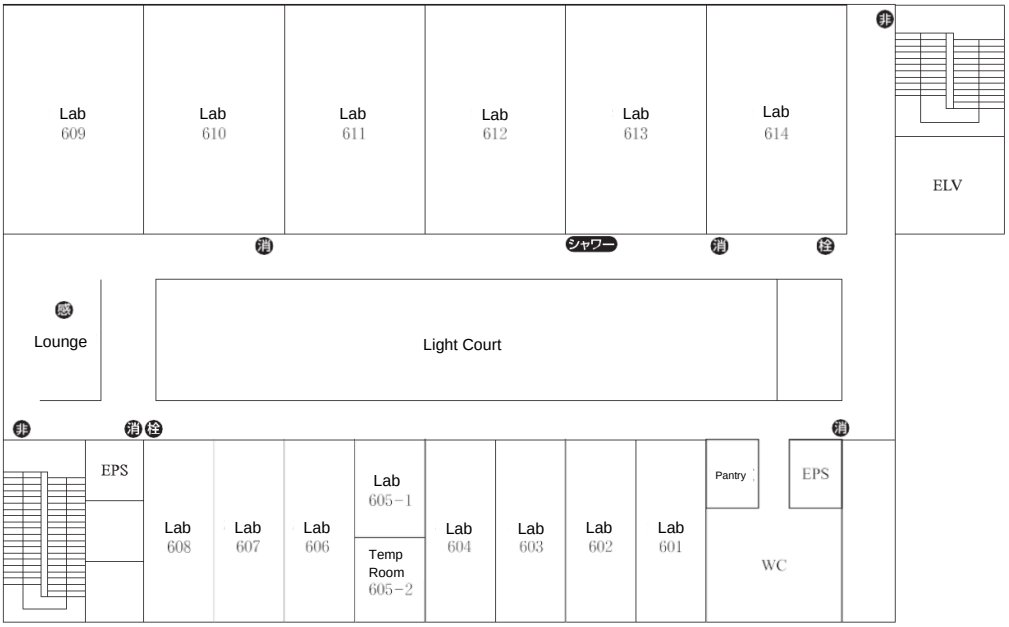
4th Floor

Research Center Building



5th Floor

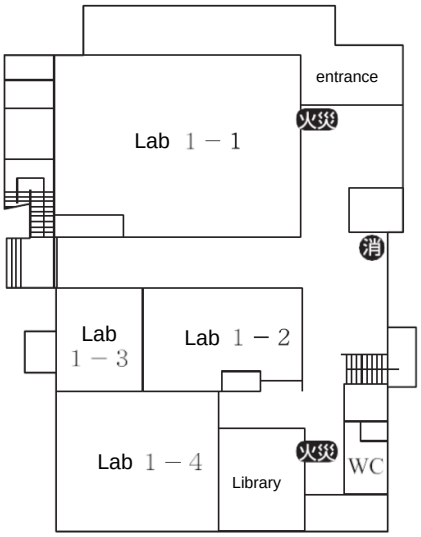
Research Center Building



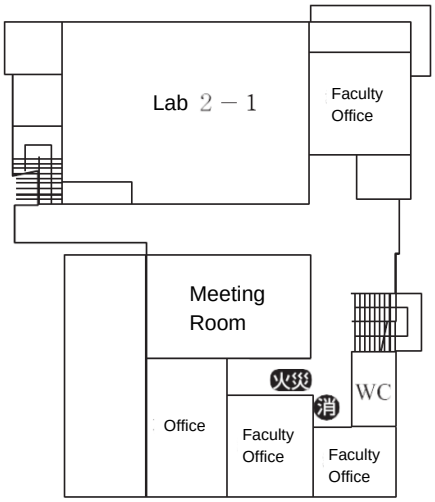
6th Floor

Clean Energy Research Center

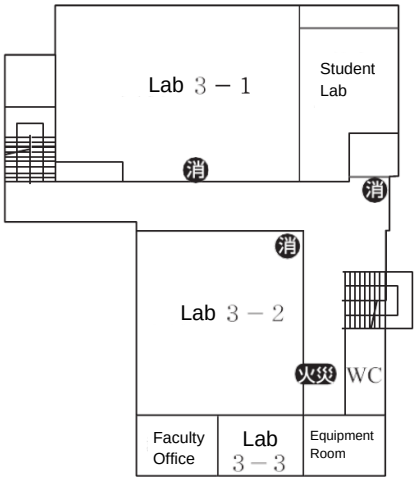
1st Floor



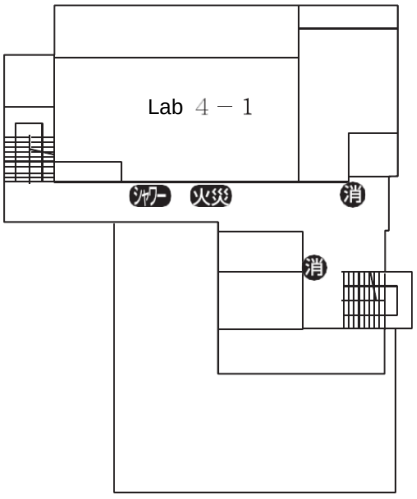
2nd Floor



3rd Floor

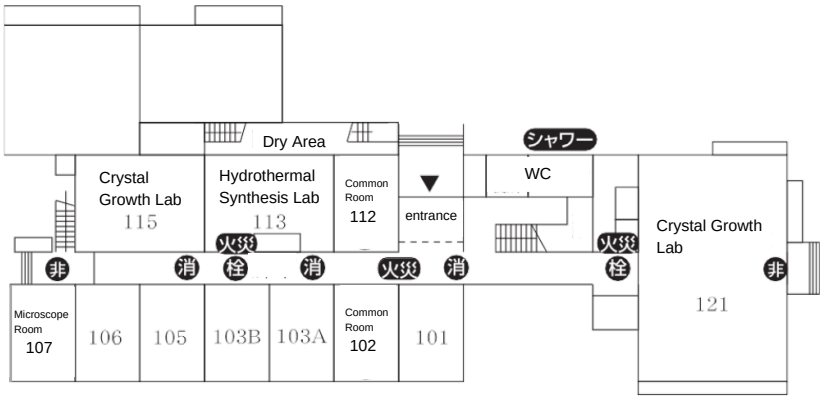


4th Floor

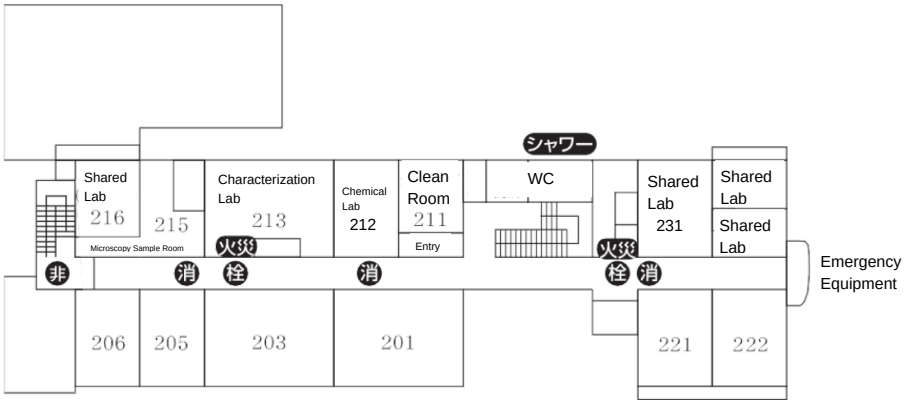


Center for Crystal Science and Technology

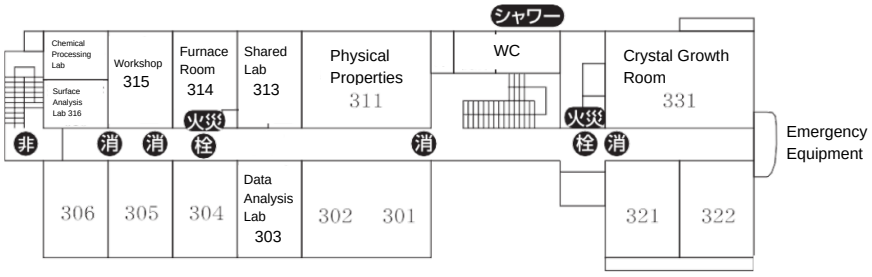
1st Floor



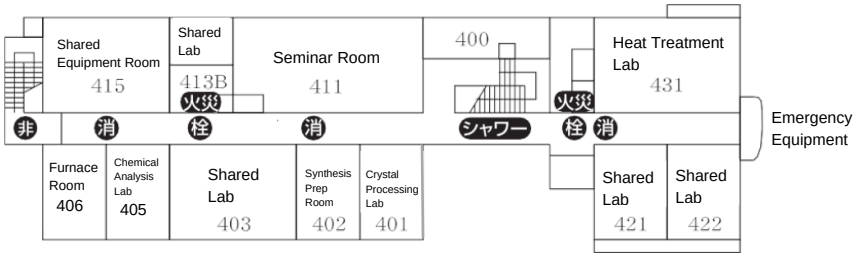
2nd Floor



3rd Floor

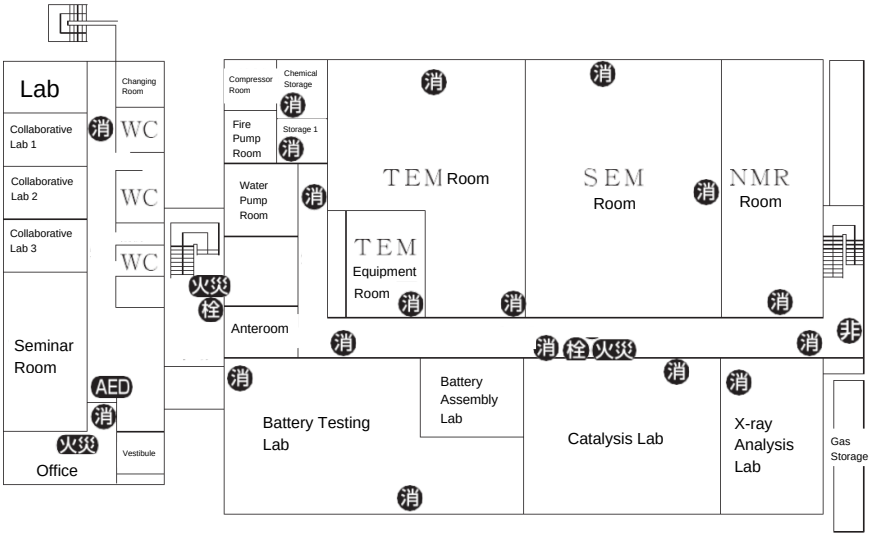


4th Floor



Hydrogen and Fuel Cell Nanomaterials Center

1st Floor



2nd Floor

