Safety Manual

Graduate School of Environmental Science
Faculty of Environmental Earth Science

Contents

1. Introduction

In the graduate school and research faculty, research can be classified in terms of chemical, physical, and field research. Chemical research ranges from analyses carried out in general laboratories to specific chemical synthetic experiments, chemical reactions with conditions such as high and low temperature, high air-pressure, and vacuum etc. Physical research includes physiological and breeding studies of guinea pigs like mice, rats, and drosophilae and plantation. Field surveys and research take place in areas including high mountains or collapsing cliffs. Sampling, boating in rivers, lakes, and oceans, and diving also belong to this group. Furthermore, because research objects vary from micro scale to macro scale and particular methods are used in different fields, the most important means of preventing research accidents is to keep in mind that "safety is the top priority." People should keep in mind that they have the tendency to be careless, so it is necessary to be particularly careful. It is quite possible that small accidents undisclosed to the public, will result in future terrible or fatal incidents if they are not reflected upon and if solutions are not found. Even in Hokkaido University, fatal accidents involving oxygen insufficiency, organic solvent fires caused by dusty plugs, and diving exercises have been announced since 1992.

1-1. Definition of Safety

Although Japan is known as one of the safest countries in the world, it is possible to be injured anywhere in the graduate school, such as by slipping on wet corridors and falling down, fracturing bones, tripping over difference in floor level in corridors, or bumping into unexpected protruding objects. Hence, danger is all around. Vigilance after an accident is too late. Secondly, it is necessary to check in detail what kinds of dangerous factors exist in your surroundings prior to conducting research. Thirdly, it is essential to regularly examine research risk degrees. Please check the factors which can contribute to accidents listed in the next page.

In order to enhance education and research functions to their full capabilities, it is crucial to prepare suitable surroundings in which the top priority is the establishment of a safe environment. Such an environment is formed by safety-consciousness and efforts by people on site.

1-2. General Regulations Inside the Graduate School

1) When entering or leaving the laboratory, check the nameplate and confirm one's location.

2) Check the electricity supply, the gas supply, the water supply, and the heating system. When leaving or being absent for a long time, turn off the electricity supply and cut off the gas and water supply. Make sure locks are secured and fire precautions are taken.

3)Confirm locations of fire extinguishers, hydrants, smoke detectors, emergency phones, life-saving equipment, emergency doors, emergency windows, and emergency routes. Also, be familiar with the operation of the abovementioned facilities.

4) Smoke in indicated places only and completely extinguish cigarettes and matches. Smoking is strictly prohibited in laboratories containing organic solvents due to flammability.

5) Secure items in laboratories against earthquakes. Be specifically careful about shelves.

6) In principal, it is necessary to obtain supervisors' permission to use laboratories after 10:00 PM on schooldays and at any time during the weekend and holidays.

7) In principal, avoid conducting experiments alone.

8) When entering or leaving the buildings of the graduate school other than during working hours, use entrance cards and student ID cards. When being absent inform laboratories, ensure the doors are locked and be careful about theft. Inform the guards or faculties of any strangers at the facilities.

9) Always remember to clean laboratories. Also, clear public facilities, such as seminar rooms,

lecture rooms, and discussion rooms after use.

10) Whether at the school or outside, be careful about traffic safety, obey traffic rules, and pay attention not to cause traffic accidents. In order to ensure peaceful research surroundings and pedestrian routes, follow traffic signs when driving and cycling and keep to a speed at which immediate breaking is possible should such an action be necessary. Secondly, do not park cars and bicycles in prohibited areas, especially near hydrants. You may cause an obstruction in emergencies such as fires.

11) When someone is unconscious of his/her health disorder or mental suffering, people noticing such problems should inform supervisors of these problems.

Over-efficiency requirement: It is necessary to allot spare time for either research practice or movement to the field.

Overconfidence of capabilities: Frequent practice does not ensure security. It may be that you just haven't been involved in accidents.

Admiration

Bad habits

Overwork: Do not concentrate for long periods of time and be sure to take enough rest.

Disorder of laboratories: Clean and rearrange laboratories after use.

Hallucination: Presume certain probabilities at which happenings will take place. Make use of fail-safe solutions for high-risk operations.

Absent-Mindedness: Follow instructions for high-risk operations.

Insufficient information: In wilderness surveys domestically or overseas, as much field information as possible on such factors as harmful animals, cliff collapse, river swelling, and political status should be collected. Security should be confirmed prior to the commencement of field surveys.

The toxicity, nature and characteristics of poisonous or harmful substances and flammable solvents should be thoroughly investigated before use. It is necessary to extinguish fires caused by organic solvents, using methods appropriate for that type of substance. Specialist work such as that carried out underwater or at heights should be entrusted to specialists.

Overwork

Health disorder: It is encouraged to discontinue research should you feel the onset of a cold, fever, heaviness, headache, or nauseous. Secondly, a health check of potential heart diseases, balance disorder, trance should be made for the wilderness survey in advance.

Distraction: Do not concentrate for a long time and be sure to take proper rest.

Sleepiness

Night work: Remember that help is unavailable when working alone.

2. Safety Guidelines for Domestic and Overseas Field Survey and Research

In our graduate school and research faculty, research objects include various environments. No matter whether they take place domestically or overseas, survey and research activities are carried out in diverse geographic environments, such as oceans, coastal areas, plains, rivers, lakes, and mountains. Under such circumstances, accidents may occur simply because of ignorance. The risk increases in places with severe climates and geographic features. In plains supposed to be safer, however, troubles such as endemics and poisonous creatures can be unexpectedly harmful.

Furthermore, in overseas activities, there is the potential of danger from natural disasters and poor personal security. Therefore, it is necessary to carefully collect relevant information while preparing for such activities. Graduate students and research students unaccustomed to these kinds of research activities are constantly susceptible to the danger of accidents or ill health caused by the inability to deal with unfamiliar food and drinking water, and sudden consumption of energy brought about by their lack of experience.

Therefore, it is necessary to be careful about health management during field research.

Supervisors in the research faculty have numerous achievements in field research and vast experience. Nonetheless, research contents and objects usually vary. Also, objects and environments are continually changing. Hence, even if research is carried out in familiar places, attention should be paid to avoid accidents.

This manual should be referred to only for basic safety guidelines, preparation, and solutions for accidents, in order to prevent unfortunate happenings in field research from occurring. Because it is impossible to make perfect guidelines covering all field areas for all researchers, students and the research faculty and graduate school, it is necessary to check other publicized manuals for detailed local information for field and research activities in high-risk areas. These kinds of manuals contain listings of home pages with immigration information, information resources, and health management. Information related to current epidemics such as malaria is also available. Moreover, the home page of the Ministry of Foreign Affairs publicly announces immigration-related information including overseas medical organizations and risk information. Foreign embassies provide local information on security issues and risky areas, some of which is available on the Internet. Researchers and graduate students conducting overseas research should take responsibility in obtaining the latest information and be careful to avoid accidents. In addition, references of safety manuals and books are available at the “safety guidelines” corner of the graduate school library. Please make use of them.

2-1. For Your Safety in Domestic Research and Observation in the Wilderness

In the field, the probability of meeting with dangers is higher than on campus. When you go to the field, no matter whether the field is domestic or overseas, you should obtain information on local conditions and wear suitable clothes. Moreover, information such as weather conditions, snow depth, daylight hours, and tidal ebb and flow should be obtained and taken into consideration when planning your research trip.

1) General Attention

(1) Make detailed plans in advance.
(2) Since the complete prevention of traffic accidents is impossible, it is recommended to have travel insurance.
(3) Most accidents in the field are traffic accidents. Do not overwork and then drive while tired. Moreover, be especially careful when driving on unfamiliar roads. In the countryside of Hokkaido, oncoming cars are few, so it is easy to drive over the speed limit unconsciously and then cause traffic accidents. Hence, be sure to drive within the speed

limit. If accidents occur, immediately report them to the police.

(4) When clean drinking water is unavailable In the research field, prepare sufficient drinking water.

(5) When you work in the field, obtain the latest weather information by regularly checking the radio and be careful of sudden changes. Furthermore, it may be possible to be stranded on a sandbank in the middle of a river because of freshwater streams in the upper stream area. It is very important to know the latest information.

(6) Obtain permission prior to entering privately owned lands.

(7) In the field, wear suitable clothing so as not to leave skin exposed, and to prevent skin contact with thorny plants and stings. For footwear, you should prepare shoes with solid bottoms to avoid injury from stepping on glass and other sharp objects. Prepare rucksack that is easy to remove in the event of falling into a river.

(8) Pay specific attention when entering marshes deeper than knees height. Be careful about mossy or furry stones to prevent slipping. Furthermore, be aware that clear streams might be deeper than they look and that the depth could change sharply. When the weather turns bad, avoid research and survey along rivers. Even if the weather is fine in the field, the sudden change of clear to muddy water implies flooding (heavy rain) upstream. Discontinue research at once should this occur.

(9) It is recommended that field work be carried out in the presence of others (not alone), because it is difficult to get help in case of emergency if you are alone. If it is necessary to conduct field work alone, submit a detailed plan in advance to your supervisor. Take mobile phones and transceivers to be able to communicate with others.

(10) When it is necessary to enter dangerous areas or conduct dangerous research in the field, be especially careful and be sure to wear security gear such as helmets according to the occasion.

(11) Obtain information on harmful animals, insects and plants, including bears, snakes, bees, moths, and lacquer etc. Prepare for accidents in advance. Furthermore, if an ambulance is unavailable and it is difficult to contact others for help in the area, learn first-aid skills and carry first aid equipments to the field.

(12) If accidents occur, do not panic. Calmly judge the situation and act accordingly. In most cases, it is possible to reach human habituation within three days on the premise that no fractures have be sustained and that the weather is fine. However, when it is rainy and at night, the air temperature drops even in summer, which can cause a fatal decrease in body temperature. Prepare warm clothes and necessary equipment.

2-2. Items Regarding Overseas Research and Surveys in the Wilderness

In the case of field work in foreign countries, it is necessary to be careful about peculiar overseas security solutions and health management.

(1) In politically unstable countries, be careful to avoid such troubles as coups and revolts. Check overseas risk information publicized by the Ministry of Foreign Affairs prior to departure.

(2) Because immediate response and rescue is often unavailable overseas, it is suggested that you carry more first aid equipment and basic medical items than usual.

(3) In the field overseas, health management is especially important. It is easy to get sick through water, foods, and stings etc. The contraction of illness such as the following epidemics is terribly dangerous, and prevention methods, such as vaccination, are suggested prior to departure.

i) micro-infection (Loa loa, Orchocerca volvulus, Filarioidea)

ii) viral infection (hepatitis, Japanese encephalitis, AIDS, Ebola hemorrhagic fever, dengue fever, Marburg disease, EB virus infection, popularly known as “kiss disease”)
iii) Malaria (tropical Malaria, three-day Malaria fever, four-day Malaria fever)
iv) Schistosoma mansoni blood parasite disease
v) Trypanosoma infection (African Sleepiness Disease)
vi) Bacterial infection (cholera, bacteria dysentery, typhus fever)
Secondly, in terms of latent periods, if fever or diarrhea occurs within one month after return, immediately seek medical consultation. The latent periods of some diseases can span years.

(4) Certain countries operate a “flying doctor” system, which is a type of insurance system in which an annual premium of less than 100 dollars entitles those insured who are seriously injured, to be examined by a doctor dispatched from the nearest city, and if necessary, to be transported to an appropriate hospital.

(5) Occurrences of pick pocketing, theft, and robbery are often more frequent overseas than in Japan, and special attention should be paid when venturing out at night, or with regards tempting invitations. In addition, be alert to the theft of passport, credit and/or ID cards as embassies will not issue new passports unless personal identification is completely confirmed. Check accommodation for emergency exits.

(6) It is important to be familiar with culture in foreign countries. For instance, in some countries, taking photos of people even if they do not obviously refuse can lead to problems. It is also prohibited in some countries to take pictures of railway stations, bridges, airports, and port facilities due to military concerns. Carrying large-scale maps or GPS could be also interpreted as spying in certain countries.

(7) Although mobile phones and transceiver services are popular around the world, Japanese equipment doesn’t work in all countries. Secondly, carrying transceivers is illegal in some countries. Obtain relevant information in advance.

(8) Be aware that it is easy to become stressed and fatigued because of differences in natural environments (air temperature, humidity, the amount of ultra-violet rays) and social environments (foods and habits.)

(9) Regarding the aforementioned items, it is crucial to collect sufficient information from local governments and local branches of domestic companies. The brainstorming of proper solutions for risks is also important. Secondly, if accidents do happen, contact the section of affairs of the Graduate School of Environment Sciences and ask for help from local embassies or consulates at the same time.

2-3. Attentions in Preparation for Sampling

1) Submission of your plan

In case you carry out any field work in Japan or abroad that involves risks, you must submit the following documentation in addition to the usual application forms.

(1) A document of the sampling plan that includes the name of the members and your schedule. Especially for field work in a mountainous region, a climbing schedule is required.

(2) A copy of your travel insurance. Especially for sampling in mountainous regions, a copy of accident insurance is required.

2) Content of the field work plan

You must include the following information in your plan in case of emergency.

(1) The purpose of your field work (2) The names of those who will accompany you (3) Planned schedule and contact details

3) Insurance

If any accident happens, the expense for treatment or rescue will be substantial. In carrying out sampling or research abroad or in dangerous places such as mountainous regions, you should take along an insurance policy in case of any accident or disaster. In case some graduate school students accompany you, you should make sure that they also carry along their accident insurances. There are three types of accident insurance. **(1) Insurance for travel abroad**: The full period of your journey should be covered. The insurance is divided to cover disability, illness, personal possessions, the cost of compensation, and the costs incurred in rescue activities. (2) **Mountaineering accident insurance**: standard accident insurance with the specially added aspects of mountaineering. In the case of a policy being taken out with a non life-insurance company, the activities covered are divided into those carried out domestically and those overseas, with the cost of premiums differing according to the activities covered. Payments are made in the case of death, lump-sum payments for disability, costs incurred in search and rescue activities, hospital fees and compensation liability.

In addition, there is a mountain disaster relief system offered by Japan Mountaineering Association. **(3) Student disaster and accident** insurance in education and research: Students of this graduate school may have already joined this insurance. Verify and make sure of this in advance.

<Information about accident insurance>

Japan Mountaineering Association: (http://www.jma-sangaku.or.jp/)
Hokkaido University Coop insurance section

4) Information about security and infectious diseases in foreign countries

Be sure to procure up-to-date security information in foreign countries from the home page of the Ministry of Foreign Affairs (http://www.anzen.mofa.go.jp/index.html). This home page includes information on security, infectious diseases, and diplomatic establishments abroad in detail.

2-4. Health Care and Vaccination

When field work is conducted in a remote area where there is no suitable medical treatment facility, some physical problems such as colds, diarrhea, or light bruises, have the possibility of becoming serious. Therefore, health care is very important and you should carry proper medications for primary care. In addition, when your physical condition is poor, you should not be involved in excessive action. When you get into areas prone to yellow fever, cholera, malaria, and hepatitis infections, be sure to get vaccinated in advance or carry proper preventive medicine and take them as required. In some foreign countries such as African countries, visas cannot be received if there is no certificate of vaccination for yellow fever. Thus, be sure to procure necessary information beforehand.

Even in Japan, there is a possibility of contracting tetanus; therefore it is desirable to get vaccinated against it.

1) Information about infectious diseases

The home page of the Ministry of Foreign Affairs provides information on security, infectious diseases such as cholera, yellow fever, the plague, and SARS. In addition, the home page FORTH (For Traveler's Health) offered by the quarantine section of the Ministry of Health, Labor and Welfare at Narita Airport provides detailed information in detail on the symptoms, prevention, and treatment of diseases in addition to up-to-date case reports.

2) Vaccination

Each health center in Sapporo or quarantine office in Otaru and Hakodate (Otaru: 0134-22-5234; Hakodate: 0138-41-5108) provides information about vaccination and hospitals where vaccinations can be received. As for information about vaccination, details are also published on the FORTH home page, which was introduced above.

3) Medications

The necessity of medications differs depending on the area. Generally, it is necessary to carry the following types of medications.

Medications: Antiseptic for external use, cold remedy, digestive medicine, salve containing antibiotic, antibiotic medicine, anti- malarial medicine, repellent, snake poison antitoxin, poultice, portable medical apparatus, etc. Furthermore, it is important to select appropriate medications while taking allergies into account

4) Attention in areas where infections diseases are prevalent

There is a fear of infectious diseases all over the world, but in particular, infectious diseases caused by living things and harmful animals are found in Southeast Asia, South Asia, West Asia, Africa, and Middle and South America.

It is important to collect information about the issues above in advance. In addition, the following should be noted during your activities.

(1) Avoid accumulation of fatigue: Plan activities with sufficient time to spare.

(2) Avoid drinking unpurified water: In most countries, tap water is not good for drinking or even for washing teeth. For drinking, bottled mineral water or boiled tap water should be used. Most bottled mineral water might be good for drinking, but there have been cases of inadequately sterilized water. Hard water sometimes causes diarrhea. Be sure not to share bottles with others. Water that has remained in the bottle for some time should be considered the same as unpurified water.

(3) Avoid heavy drinking and overeating: Once you develop stomach troubles, you get tired easily and your resistance to disease decreases. It is essential to avoid heavy drinking and overeating.

(4) Avoid eating fresh vegetables and raw fish: It is important to take care in eating fresh vegetables and raw fish, because infectious oral diseases and parasitic diseases are all caused by the consumption of raw foods.

(5) Avoid having careless sex: AIDS, syphilis, gonorrhea, and type B hepatitis are caused through blood contact, saliva, semen, and vagina secretion

(6) Attention when receiving treatment at a local hospital: In case you receive an injection, you should ensure that the needle is only used on one patient.

(7) Avoid careless contact with animals such as dogs: Rabies has not yet been eradicated, and there are some dogs that carry the virus.

(8) Pay attention to insect bites: Some infectious diseases are carried by bloodsucking insects and organisms. The use of repellents and mosquito nets is effective when sleeping.

2-5. Information on Safety and Security in the Research Regions

There is a possibility of becoming the victim of terrorist activity, kidnapping, plunder, and burglary in politically and socially unstable regions. Besides the theft of items and money, there is also the threat of injury or death. It is necessary to confirm safety in the research region in advance so as not to encounter such situations.

1) Access to information about dangerous regions in the world

The political situation around the world changes daily. Be sure to confirm information about overseas security in detail from the homepage of the Ministry of Foreign Affairs (http://www.anzen.mofa.go.jp/index.html). Should the security level of the country, released by the Ministry of Foreign Affairs, be orange “Postpone making a passage for the country” or red "Get evacuated”, you should postpone your journey. You can contact with the Overseas Safety Consultation Center of the Ministry of Foreign Affairs by telephone (TEL: 03-5501-8162).

2) Securing contacts in regions you intend to visit

Acquire information about diplomatic establishments abroad from the homepage of the Ministry of Foreign Affairs about overseas safety, and secure a contact in case of emergency. The main diplomatic establishments abroad offer information about each country. In addition, the JICA (Japan International Cooperation Agency, http:// www.jica.go.jp/worldmap/oversea.html) has offices all over the world and can be a contact point in times of emergency.

3) Method of contact in emergency.

When public security deteriorates considerably, it may be impossible to make contact by telephone. However, it is possible to secure a contact line by using satellite a communication system such as INMARSAT (http://www.jdc.ne.jp/index.html).

4) Attentions in socially insecure regions?

The probability of becoming a target of burglary and mugging is high in such regions. Moreover, not being able to speak the local language may result in miscommunication that leads to injury. Attention to the following is required.

(1) Secure a reliable person as a guide and interpreter and be sure not to walk alone.
(2) Do not carry a large sum of cash.
(3) Always carry your passport
(4) Do not go out in case of civil unrest.
(5) Secure contact details for diplomatic establishments abroad.

2-6. Safety Guidelines for Field Research

1) Cautions in mountainous regions

To ensure safety, 3 things are essential.

(1) Experience (You must be experienced. If you are not so, you must go with experienced people).
(2) Nature information (especially weather information).
(3) Health care (Fatigue helps accidents occur).

There are 4 types of possible natural accidents/disasters

(1) Treacherous weather conditions: rain/wind/cold/thunder etc. Snowstorm / heavy snow/snow avalanche (winter time)
(2) Accidents occurring at slopes: falling rocks/ snow avalanche/slip drop etc.
(3) Accidents occurring at mountain streams: flash flood/falling down steep valleys/ waterfall basins
(4) Disasters caused by animals: wasps/ vipers/ bears etc.

Reading guide books referring to mountain climbing to get enough information on safety measures against these disasters is strongly recommended. Careful and well-advised behavior is the most important thing to prevent these disasters. Outdoor activities in severe natural conditions will exhaust your mind and body, and can cause these 7 kinds of phenomena.

(1) Fatigue: cold weather, long lasting activities and lack of sleep accelerate fatigue

(2) Stomach and intestinal troubles: Having indigestible food causes physical problems and accelerates exhaustion

(3) Mental stress: A variety of stresses and strains may cause stress-related difficulties that may impair your judging making abilities.

(4) Injury: bruising/ fractures/ sprains/ Achilles' tendon damage/ cuts/burns/ sunburn/ snow blindness etc. You should give correct first aid to these according to the fist-aid emergency guidelines.

(5) Heat stroke: Heat stroke is divided into heat cramps, sunstroke and heat exhaustion. These are caused by too much perspiration, by being exposed to hot conditions beyond physical temperature-control capacities. You should be careful to ensure water supply, ventilation and shade.

(6) Mountain sickness: Mountain sickness is caused when you are unable to adapt to the thin air in Mountain areas. Generally this sickness occurs at altitudes over 2500 meters. General symptoms of mountain sickness are headaches, vertigo, nausea, sleep interruption etc. When the condition is better, you can recover from this disease by avoiding hard exercise and getting adequate fluids. But when the condition is worse, moving to lower altitudes or taking oxygen is essential.

(7) Cold injury: Cold injury is caused by exposing your body to low temperatures. At first, the complexion of the skin would become dark blue. When the condition gets worse, blisters develop, and skin turns black, becoming in necrotic. Wearing thermal clothing is essential to protect the body. If some symptoms are observed, you should quickly soak the affected part of the body in warm water. Hypothermia is progressive when the amount of heat radiated from your body exceeds the amount of heat produced by your body. During the first stage of hypothermia, you experience violent tremors, while the next stage you experience being in a haze. As symptoms progress, you gradually become half-conscious. The condition is quite dangerous when the body temperature becomes lower than 32ºC. Accurate information and careful action are needed in order to overcome this kind of situation.

2) Cautions near water

Research around water areas tends to require less care than research in mountainous areas because laboratories are commonly situated onboard ships or in places near water. But special attention that is different from those for experiments in the laboratory is essential. If you undervalue them, fatal accidents may occur.

There are 5 types of fields near water.

(1) Research or experiments on a research vessel
(2) Research or experiments at rivers or lakes
(3) Research or experiments beside the sea, rivers and lakes
(4) Research or experiments under water
(5) Research or experiments on frozen sea and frozen lakes

Follows are safety guidelines for each type. You have to read the land-research section too because common things for land and aquatic field research are not described here.

Points of cautions at a port of call are similar to those for outdoor research in a foreign country.

2-1) General cautions

(1) Consider the purposes and procedures adequately and make plans.
(2) You should learn about equipment which you will use for your research, and conduct preliminary surveys or examinations.

(3) Avoid conducting field work alone. You should cooperate with and be in contact with others at all times.
(4) Pay attention to changes in weather. Stop research when you feel or find any perils or dangers. Delayed decision making could make situations worse.
(5) Pay attention to your health, and be careful not to get sick. If your health condition is not good, you can not make correct judgments. This attention is also quite important not only for your own safety but also for people accompanying him.
(6) Life jackets are essential for work on a vessel. But you should know wearing a life jacket alone is not sufficient. When you fall into the water and drift, buoyancy of the life jacket gradually weakens. If your body temperature is lower than 35ºC, you are at risk of cold temperature-related illnesses. When your body temperature is lower than 32ºC, the situation is quite dangerous.

2-2) Research or experiments on a research vessel

Ocean observation is generally done on a research vessel. Although you can conduct experiments on large vessels like you do at laboratories, it is important to know there are great perils present all the time when you are on a vessel. At most research vessels, crews already have their own rules or guidelines for each vessel and will make you aware of such guidelines. Reading the guidelines intensely is essential. Small vessels are used for research or experiments at seacoasts or lakes. Small vessels are mainly used for taking samples and using observation equipment, and because analysis does not usually take place, work can be carried out in a short period of time. But you should pay attention to circumstances and organize your whole plan in detail because small vessels are easily influenced by weather changes such as waves or wind. The following are common differences between land-based and water-based research.

(1) Large vessels

(a)Differences of circumstances between land-based and water-based research

Instruction system on a vessel:

The vessel operates on a chain of command that starts from the captain. Staff meetings should be conducted before observations. You should ask your senior researcher to attend the meeting.

Structural features of vessels:

Vessels are designed for work to be carried out efficiently in confined spaces, and in preparation for the unexpected, such as the intrusion of seawater, etc. Characteristics are as follows

The doorways are narrow and there are steps

The slopes of stairs are steep.

There is an inclination on decks, and decks are surrounded by fences.

A variety of equipment is crammed onboard vessels. You should be aware of the presence of such equipment.

High-voltage equipment such as radiotelegraphy is on deck.

Wires fill the deck during operation.

Living circumstances:

There are pitches and rolls caused by waves.

Many persons live on a vessel and someone is always sleeping because a vessel is sailed 24 hours, utilizing three rotating shifts.

Vessels operate on set schedules.

Carried water is limited. Although all-purpose water is made onboard, drinking water is limited.

Works on a vessel: What you do depends on the purpose of your research. You generally fix observation equipment to wires and lift them up and down with a winch.

(b) Cautions

Circumstances on a vessel are quite different from those of daily life on land. Furthermore, you may feel nauseas and your judgment skills may become poor compared with those on land. For such reasons, some cautions are essential and you need to obey the instructions of crew members in order to ensure your safety.

Life in a vessel:

You should be careful not to fall overboard. It is better not to be on deck when it is not essential. Don't put your hands in your pockets so you can grab support should you need to. You shouldn't lean over the edge of the vessel.

Spaces in the vessel are confined, but finding someone is not easy. Make sure others are aware of where you are at all times.

The structure of vessels is very unique; you should pay attention to areas above your head and where you walk.

Be careful not to fall down stairs. You should support yourself using handrails or such supports

Do not run in the vessel and on the deck.

You should cooperate at all times and be careful not to trouble others.

You should not drink alcohol aboard the vessel (the number of dry ships has increased recently). Drinking worsens your condition and makes it impossible to react to emergencies etc.

Health:

You may feel stress living with many people in confined spaces. It is necessary to understand this and make appropriate judgments.

Infections are easily transmitted aboard a vessel. You have to be careful to look after your health and seek medical consultation when you feel sick.

Clothing:

You should wear something you can work easily in.

You shouldn't expose your skin.

You should button your sleeves and tuck your shirt into your pants to ensure they don't get caught in equipment.

You are strongly recommended to wear gloves, working shoes and a helmet.

You must wear a life jacket.

Works:

You should obey crew members and not make decisions personally.

You must not touch working equipment when it is not necessary to do so. You must be very careful when using a winch.

Don't stand close to winches as cables may break.

You should keep out the way of crew members and must not disturb them when the ship arrives and leaves port.

Refer to cautions in a laboratory when you analyze something onboard a vessel, and be careful of pitching and rolling.

When the vessel is calling at a port:

You should prepare and leave contact information. Vessels sometimes have to change drifting point and leave suddenly. In that case, you are needed to be contactable at all times.

Be punctual all the time. Take care of your health and avoid substantial changes in

lifestyle brought about by the freedom of being on land.

Other cautions:

Be careful of fires. Once a fire breaks out, extinguishing it is impossible.

You must classify dangerous items, off-scouring, waste and bring them back to a port to dispose of them.

(c) Cautions in emergencies

There are two kinds of accident: one is the kind of situation that requires you to evacuate a vessel, and the other is falling overboard.

In emergencies:

You should obey crew members. You should undergo inductions and trainings when the vessel leaves port.

Falling overboard:

You must avoid this situation, but should such an incident occur, you should remain calm so as not to waste your stamina and wait for help. In the case someone else falls overboard, you must speedily contact nearby crew members and ask for help.

(2) Small vessels

When you are aboard small vessels, you tend to feel safe because you can call at a port easily. But you should understand the possibility of capsizing is greater in small vessels than in large vessels because small vessels are easily influenced by winds. You should prepare meticulously, and follow the cautions listed in the section concerning large vessels

2-3) Research or experiments at rivers and lakes

When you do field-research at rivers or lakes, you need to be more cautious than when conducting ocean research because work is often done in small groups and decisions are made arbitrarily. In particular, the danger of capsize, falling, faulty diving equipment, drowning related to rope troubles, and heart attack caused by temperature fluctuation is great. You should take note of the following cautions.

Utilization of small boats or vessels: You need to utilize vessels that suit the scale and situations of rivers or lakes. Licensed persons should operate the boats. (License information: http://www.j-b-s.co.jp/index.html)

Life jackets: You must wear a life jacket when you use boats or vessels.

Life savers: You must prepare floaters, ropes etc.

2-4) Research and experiments at seaside and lakeside

You tend to regard seaside observations like those on land, but you must take into account that there is the possibility of becoming tangled in sea weed and falling into deep waters. There are some places where sea urchin shells, disposed cans and bottles are scattered. It is essential to wear suitable clothing to protect yourself from such dangers. Wearing a life jacket is also essential.

2-5) Works under water

Under water work is permitted to those who have a diving license. So you must conduct research that requires under water work in collaboration with a license holder. As far as diving is concerned, you must take trainings related to troubles caused by water pressure and have a deep knowledge such dangers. You should avoid activity alone because there is always the possibility of unexpected accidents occurring. You should pay adequate attention to health management. Especially, researchers planning to engage in dangerous activities such as diving, must take a medical examination and confirm ‘they are not at risk of sudden attacks. You sometimes need to decide not to participate in work in places that are far away and require long-term stays. When

you conduct diving work, you must be careful of the following 3 things. First, be sure to check diving instruments. Second, prepare a supplemental air pump. Third, obey regulations and the law of sanitation safety regulations regarding high pressure work (Jinnjiinn-kisoku10-4 Oyobi Koukiatsusagyou-Anzeneiseikisokutou-Kanrenhourei). For instance, you should heed the guidance of instructors when you deal with valves to adjust ventilation.

2-6) Research on frozen seas or frozen lakes

You must understand that activities on frozen seas or lakes are more dangerous than other regions. It is recommended that you perform work after attaining information regarding the situation, from predecessors or those around you. It is important that you make plans in which you can finish work efficiently, taking into consideration of the thickness and cracks of the frozen surfaces.

2-7. Coping with Accidents Occurring during Field Research

1) About emergencies and first aid

Swift and appropriate first-aid measures are required in situations where breathing or heartbeats are recognized as having stopped as a result of drowning or heart attacks. You need first aid knowledge about treating wounds and bruises when accidents occur. Guidelines referring to such first aid are published from disaster prevention organizations or medical organizations. You need to peruse such guidelines and be able to take proper measures in a variety of situations.
Emergency measures are explained at the home page of the Japan Red Cross:
<http://www.jrc.or.jp/safety/index02.html>

2) Contact information when accidents occur

When accidents occur in the field, you need to contact a medical organization in the area and also the Graduate school to inform them of the situation and any measurements you have taken. You must also contact an insurance company and ask for guidance.

Contact information: General Affairs Department of the Graduate school of Environmental Science (direct line): +81-(0)11-706-2202 (day time)
+81-(0)11-728-4715 (night time)
Office fax: +81-(0)11-706-4867
E-mail: somu@ees.hokudai.ac.jp

3) Relief operations

In case of a large-scale accident in which there is a possibility of secondary disasters occurring, pay attention to experienced people and set about conducting relief operations.

4) Reporting of the accident

When you come back to the Research institute, you must report situations, measures, progress, to the presidents of the school and research institute.

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3. Sexual Harassment

Sexual harassment is unwelcome and displeasing physical and/or verbal conduct of a sexual nature by staff members or students, which make other staff members or students feel uncomfortable. Such behavior adversely affects a staff member's ability to work or a student's ability to learn and participate in school activities (hostile environment harassment); or threatens the employment and educational opportunities of staff members and students respectively should they refuse to accept such unwelcome conduct (quid pro quo harassment). Unwelcome physical and/or verbal conduct of a sexual nature, both on and off campus (work place harassment), is basically related to sexual interest and desire but also includes cases related to gender discrimination such as the assignment of work based on gender.

Sexual harassment may be perpetrated by faculty members on students or general staff, by general staff on students and by senior students to junior students, depending on the power relationship that may vary from time to time between them.

1) What is verbal conduct of a sexual nature? Obscene jokes, questions about sexual experiences, sexual rumors, and so on. Verbal conduct based on gender discrimination such as "You're a man with no guts," "Women are not eligible to do this work," and referring to an adult as a boy or a girl.

2) What is physical conduct of a sexual nature? Displaying nude posters, displaying or viewing obscene photographs, comics and pornography in public places; persistent and unwelcome requests for dates or dinner; unwelcome telephone calls, letters or e-mails of a sexual nature; unnecessary physical contact; and so on. Behavior based on gender discrimination such as unwelcome requests to perform domestic duties, unwelcome requests to sing Karaoke together, the unwanted allocation of a seat next to a teacher or superior student at a party, and so on.

3-1. How can you Prevent Sexual Harassment?

Harassment is deemed to occur when a person feels uneasy about the unwelcome physical or verbal conduct of a sexual nature. If your behavior seems to make the others slightly uneasy, stop the conduct immediately and never repeat it. You should not interpret silence or the lack of an explicit rejection as acceptance of such behavior (of a sexual nature). This can sometimes increase the victim's suffering. The best precaution against sexual harassment is to consult student advisors at the university as soon as possible when trouble arises.

Working in the daytime, which is the common practice in the workplace, should be conducted at a school. Working late does not necessarily mean diligence. Since a university campus by nature is not a place where evening or night shifts regularly take place, working late is not recommended in order to avoid potential misunderstandings and possible sexual harassment that may occur.

3-2. Precautions for Research Activities outside the School

You should take into consideration the time of day when conducting surveys or research outside the school, especially in foreign countries. It is not recommended to study late at night or after regular laboratory working hours since there is a possibility that this may bring about sexual harassment or even a criminal case. Extra attention should be paid during field surveys since students and staff members are isolated in a closed environment. Harassers may, being unaware of causing harassment, make victims feel depressed under such intimate circumstances. One should behave very carefully taking into consideration the feeling of persons in inferior positions so as to avoid inadvertent harassment. Once you have fallen victim to sexual harassment, you should consult a

student advisor even when far from campus. As such, you should have a mobile phone and/or device that allows e-mail communication with you at all times. If you can not communicate directly, your friends or those around you may contact the university's student adviser on your behalf.

3-3. What to do once Sexual Harassment Occurs?

Once sexual harassment occurs, corresponding countermeasures should be taken to help the victim. The later an appropriate response to a sexual harassment case is, the more excruciating the pain inflicted upon the victim. Since a prompt response to a harassment case makes an early resolution possible, the victim should not suffer in silence but should contact a student advisor at the university as soon as possible. If you are asked for advice by a victim of sexual harassment, you may encourage her/him to report the case to a student advisor and to follow suggestions from the advisor. The victim may consult an advisor either by telephone, e-mail or ordinary mail. Consultation through a proxy is also possible. The university's student advisor will make an appropriate response taking the victim's situation into consideration. The advisors should handle the matter discreetly so as not to interfere with the dignity and privacy of those involved. The university does not allow any retaliation as a result of the victim's reporting an act of harassment or consultation with the university's student advisor.

The University's Student Adviser

Hokkaido University Student Adviser Office: Phone, 011-706-7463 (10:00 to 12:00 and 13:00 to 17:00 Monday through Friday).

Consultation and/or counseling is available from 10:00 to 14:30 on Monday, and from 13:00 to 17:00 on Tuesday through Friday for students of Hokkaido University or their parents if the students are not able to come.

Sexual Harassment Counselor: Phone/FAX, 011-706-2097 (8:30 to 12:30, and 13:00 to 17:00 Monday through Friday). E-mail soudan@general.hokudai.ac.jp. Available to students, faculty/staff members and temporary employees of Hokkaido University.

The Hokkaido University Student Advisor Office provides advice not only on sexual harassment cases but also on various problems related to campus life such as relationship problems, hopelessness, academic difficulties, depression, and stalking and harassment. Students are encouraged to contact the Student Advisor Office for any problems they face, regardless of the severity of the problem.. Sexual harassment counselors can be consulted for the various problems mentioned above and will respond promptly.

Foreign students may also contact: Advisers for International Students at the International Student Center (phone 011-706-2650 or 2178) or at the Student Exchange Office (phone 011-706-2182).

URL

Hokkaido University Student Adviser Office (*Gakusei Soudan Shitsu*)

http://www.hokudai.ac.jp/bureau/gakumu/gakusei/soudan.htm

Sexual Harassment Countermeasures Office (*Sexual Harassment Boushi Taisaku Shitsu*)

http://www.hokudai.ac.jp/jimuk/soumubu/jinjika/sekuhara/index/index.html

Hokkaido University Guidelines for the Prevention of Sexual Harassment (2003)

http://www.hokudai.ac.jp/jimuk/soumubu/jinjika/sekuhara/guide/guideline.html

http://www.hokudai.ac.jp/bureau/gakumu/gakusei/soudan.htm

References

Sexual harassment is not a matter between individuals but a matter which their institution(s) should prevent. Most books on sexual harassment are, therefore, written for managers of companies or organizations. Maintaining a comfortable environment is a common issue for academic members and the general public.

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4. Safe Handling of Chemicals

4-1. General Attentions

We should be fully aware of the danger inherent in handling chemicals even in small experiments. Accidents that happen while experiments are being carried out, such as explosion do not only cause substantial physical damage, but also such problems as mental shock. In order to avoid such accidents that may harm the experimenter and those in the vicinity, experiments should be conducted in a proper manner with full attention. As a consequence of the development and interdisciplinary expansion of research and technology, chemicals are generally used irrespective of the specialty. Since most chemicals are potentially dangerous, it is important to know the nature and hazards of chemicals in order to utilize them safely, appropriately and effectively.

Chemicals are categorized according to their hazardous properties, and the handling of chemicals is under the control of the Fire Service Law, Poisonous and Deleterious Substances Control Law, Industrial Safety and Health Law and National Personnel Authority (Table1). The storage and management of poisonous and deleterious substances is regulated by the bylaws of the Graduate School of Environmental Science. We must follow these laws, regulations and bylaws.

Table 1. Classification of hazardous substances

Ignitable substances	Alkyl aluminum, yellow phosphorus, reducing catalyst, etc.	Fire Law, No. II, III
Water reactive substance	Sodium metal, calcium hydride,	Fire Service Law, category III
Flammable gas	Hydrogen, oxygen, methane, liquefied petroleum gas, etc.	High Pressure Gas Safety Law
Flammable substances	Special inflammable substances (ether, dimethylsilane, carbon disulfide)	Fire Service Law, category IV
	Petrochemical Class 1, (acetaldehyde, acetone, petrol, acetic ester)	Fire Service Law, category IV
Combustible substances	Acetic anhydride, acetone, acetonitrile, acetyl chloride, acrylic acid, acrylonitrile, anisole, chollidine, collodion, benzaldehyde, benzene, benzyl chloride, benzylamine, bromobenzene, ethanol, ethyl acetate, etc.	Fire Service Law, category IV
Explosive substances	Explosive compounds (ammonium perchlorate, picric acid, TNT	Explosives Control Law
	Self-reacting substances	Fire Service Law, category V
Oxidizing substances	Oxidizing solids(ammonium perchlorate, inorganic peroxide, permanganate, etc.)	Fire Service Law, category I
	Oxidizing liquids (perchloric acid, hydrogen peroxide, fuming nitric acid, etc.)	Fire Service Law, category VI
	Oxidizing gases (oxygen, ozone, fluorine, chlorine, etc.)	High Pressure Gas Safety Law
Strong acids	Chlorine, nitric acid, chlorosulfuric acid, hydrogen fluoride, trichloroacetic acid, formic acid, etc.)	Fire Service Law, etc.
Poisonous gas	Chlorine, fluorine, hydrogen sulfide, hydrogen cyanide, etc.	High Pressure Gas Safety Law

Toxic substances	Arsenic, sodium azide, anhydrate arsenious acid, white phosphor, hydrogen cyanide, sodium cyanide, nicotine, mercury, selenium, hydrofluoric acid, endrin, phosphorus sulfide, methyl parathion, etc.	Poisonous and Deleterious Substances Control Law

(1) Be aware that all chemicals are hazardous. We can avoid risks by properly dealing with chemicals. To safely handle chemicals, it is necessary to know the nature, the characteristics and the degree of the hazard inherent in each chemical before conducting experiments.
(2) Flammable substances including organic solvents and poisonous and deleterious substances exceeding prescribed amounts should be used under the control of the person in charge, and they should be stored at designated storage facilities. Only the required amount should be taken out for use. Follow the guidelines of the facilities. Use designated shelving and be sure to note the amount of chemicals carried in and out. Do not forget to lock the door of the facility to avoid robbery.
(3) When you use or keep hazardous materials (e.g. flammable substances exceeding the prescribed quantity, poisonous and deleterious substances) in the laboratory, instead of the designated storage facility, label the substances as “poisonous and deleterious” or “dangerous” accordingly Lock the reagent cabinet in case of robbery. As mentioned above, keep an inventory record of chemicals. Stored chemicals should be checked periodically by the safety committee.
(4) Poisonous, deleterious and explosive substances should be obtained from the person in charge and be used after confirming necessary handling instructions.
(5) The laboratory table and areas around it should be kept in order to minimize accidental risks.
(6) As a mitigation measure for unexpected situations such as earthquakes, chemicals for experiments should be placed in sturdy reagent cabinets reinforced with safety frames and sliding doors.
(7) The risk of flammability, explosiveness, combustibility, and toxicity of chemicals should be investigated beforehand using MSDS etc. Use dangerous and deleterious substances after considering countermeasures for expected accidents.
(8) Be aware of your responsibility in the handling of chemicals which encompasses the acquiring, storing, using and disposing of chemicals.

4-2. Attentions on the Purchase of the Chemicals

(1) Do not purchase excessive amounts of chemicals that are under the control of the Fire Service Law, since the total allowable storage of such chemicals in the reagent storage facility and laboratories in the Graduate School of Environmental Science is regulated.
(2) Do not purchase excessive amounts of chemicals that are prone to degradation. In order to increase the credibility of experimental results, do not purchase more than required, even if the chemicals are relatively less hazardous.
(3) You should make appropriate plans to purchase chemicals. Some chemicals require considerable time for delivery. Additionally, large amounts of delivered chemicals require substantial storage capacity.
(4) Although chemicals are generally sold in 500g (500mL) bottles, they are also available in various other units, such as minimum units of 1g, 25g and 250g bottles or 3L and 15L units. Purchase accordingly, i.e. several times that of the expected amount.

4-3. Storage and Transportation of Chemicals

(1) Store chemicals in a safe container that is accurately labeled. The labels may easily come off or discolor, depending on the types of chemicals they are in contact with. In such cases, the labels should be replaced or protected by tape that prevents their detachment and discoloration.
(2) Chemicals, even those used frequently, should be kept in minimal amounts. In particular, laboratory storage of chemicals under the control of the Fire Service Law is limited to below one-fifth (Fire Service Regulation, Sapporo City) of the designated amount (e.g. ether: 50L, alcohol: 400L, Safety Guideline Heisei 17, p102).

(3) The reagent cabinet and the storage cabinet must be kept in order to prevent the mixing of chemicals of different inherent properties. For example, inorganic substances should be arranged according to anions, and organic compounds could be categorized by functional groups.
(4) Chemicals classified as poisonous (e.g. potassium cyanide, sodium azide etc) or deleterious (e.g. sulfuric acid, hydrochloric acid, sodium hydroxide), and dangerous chemicals (e.g. potassium chlorate) should be kept in a steel cabinet that is lockable.
(5) Refrigerators and freezers are often used to store chemicals that are unstable at room temperature. Keep the highly flammable vapor of chemicals from coming into contact with fire. Use the explosion-protective refrigerators to store flammable chemicals. These refrigerators or freezers should be lockable in order to prevent the robbery of poisonous, corrosive and dangerous chemicals.
(6) To protect against earthquakes, the cabinets should be appropriately partitioned, and a safety frame should be installed.
(7) Proper containers should be used to carry chemicals.

4-4. Precautions in the Handling of Chemicals

(1) Investigate the nature, toxicity and hazardous level of chemicals before use, and make sure of the safety measures.
(2) The scale of experiment should be in proportion with the purpose. Over-scale experiments might cause disastrous consequences should accidents occur. The chemicals should be kept in proportionate amount that matches the usage.
(3) Ensure that chemicals do not come into direct contact with skin, eyes etc. Wear protective goggles to protect eyes from chemical splashes and splintering glass.
(4) In addition to protective glasses, protective gloves (leather, cloth), protective masks, gas masks, protective face masks and safety screens must be available in laboratories where dangerous experiments are frequently conducted. A fire extinguisher and a first-aid kit should be available.
(5) Accident-prone experiments should not be conducted alone. Experiments late at night or on holidays should especially be restrained, because no help is available at such times in the event of accidents occurring.
(6) To inhibit the propagation of fire in case of accidents, laboratory tables should be kept in order. Chemicals not in use must be kept in the designated storage facility. After experiments, chemicals should be returned to the designated cabinet, and do not forget to note their entry.
(7) Oxalic acid peroxide, perchlorate salts etc. are highly explosive and dangerous. Work with small quantities and make sure the chemicals are not subjected to forces such as vibration, agitation or heat. Beware of the contamination of organic substances. The handling of these chemicals should not be conducted alone, but under the supervision of professionals.

4-5. Understanding and Handling of Hazardous Substances

1) The Hazards

(1) It is better to consider all chemicals to be toxic. The ingestion of sugar or glucose kept in laboratories could be fatal, because the likelihood of contamination is extremely high in such environments. Never add laboratory sugar or glucose to your drink (e.g. coffee), even if you run out of the edible sugar in kitchen.
(2) Contact with highly toxic chemicals can be fatal. Toxicity and its chemical properties should be investigated beforehand and the chemicals should be handled with extra care.
(3) We should always consider the risk of toxicity in the handling of chemicals in spite of

ambiguous hazards classification for such chemicals.
(4) Beware of chemicals of chronic toxicity that are harmful only after a prolonged period of exposure.
(5) Benzene, chloroform, aniline or formalin etc. are frequently used in laboratories and known to be carcinogenic. Adequate ventilation in the laboratory is required while using these chemicals.
(6) We tend to reckless after getting used to chemicals that are used daily, however, we should consider all chemicals of unknown toxicity to be highly poisonous and carcinogenic.

2) The risk of poisonous and deleterious substances and their handling

(1) Note that the handling, storage, control and disposal of t poisonous and deleterious substances are under the bylaw of the Graduate School of Environmental Science.
(2) Chemicals can gain entry into human body via various routes depending on their chemical properties, such as inhalation (in vapor), ingestion (in solution) and absorption via the respiratory system, digestive system and skin, respectively. Appropriate protective measures are necessary.
(3) Bottles containing poisonous and deleterious substances must be tightly closed so that the chemicals do not come into contact with the air. Bottles should be clearly labeled in case the person in charge of the bottle forgets what the content is. The identification and the disposal of unlabeled chemicals is extraordinarily troublesome and costly.
(4) If you are using a chemical for the first time, investigate its risks thoroughly or ask an expert before conducting experiments.
(5) If the chemicals come into contact with skin or other body parts, you should immediately wash the area. Contaminated lab coats or laboratory clothes must be washed. Chemicals might be splattered or come into contact with skin during the drying procedure.
(6) Tables 2-4 show the corresponding gastrolavage fluid for inorganic toxins, organic toxins and chemical poisonings respectively. After administering first aid for poisoning, you should immediately seek medical assistance.

3) Carcinogenic (cancer-causing) substances

The tests on animals revealed that the substances listed below have carcinogenic effects on certain organs.

Arsenic compounds: skin, liver, lungs
Asbestos: lung, intestines
Benzene: haematogenesic tissues
Benzidine: bladder
Vinyl chloride: liver, lungs

Therefore, these chemicals should be dealt with in a chemical fume hood with adequate ventilation. Production of some of these chemicals has been banned. .

Table2. Toxicity of and methods of dealing with organic and inorganic substances

Arsenic	**Toxicity**: Arsenous acid is especially toxic. Fatal dose: 0.1-0.2 g. Following diarrhea and stomachache, difficulty breathing, a coma and heart attack results from arsenic poisoning. **Attention**: Limit laboratory use to a minimum amount. Use with caution. **Measures**: Make the patient vomit the chemical, and then feed 500mL of milk. Gastrolavage the stomach with 2-4 L of warm water.
Mercury and its compounds	**Toxicity**: Mercury vapor is harmful to respiratory organs. Mercury chloride (II) that harms intestines and so on is fatal. **Attention**: Mercury should be kept in tightly sealed containers. **Measures**: Feed skimmed milk, egg white dissolved in water etc.
Phosphorus and its compounds	**Toxicity**: White phosphorus in particular can scald, so can phosphorus trichloride. The vapor is stimulating and corrosive to the mucous membranes of nose and throat. The intake causes digestive violations and finally causes death.
Strong Acids (Especially Sulfuric acid) and Strong Alkalis	**Toxicity**: Harmful to skin when contacted. They cause severe chemical scalds and corrosion. Clothes etc. might be also corroded. **Attention**: Do not place them on the edge of laboratory tables or places which are unstable. **Measures**: **Strong acids**: In case of swallowing, feed magnesium oxide in water emulsion, aluminum hydroxide gel, milk or water to dilute. In case of their attachment to the skin, rinse with running water for an appropriate period and neutralize with diluted alkalis, soap etc. If the chemical enters the eyes, rinse it away with running water for more than 15 minutes and then seek immediate medical assistance. **Strong alkalis**: In case of swallowing, neutralize the chemicals by feeding diluted vinegar (approximately, one-fifth dilution). If attached to the skin, flush it away with running water until the skin is no longer slimy. If the chemical enters the eyes, rinse it away with running water for more than 15 minutes and then seek immediate medical assistance.
Aniline, Nitrobenzene	**Toxicity**: By physical contact and respiration of the vapor, causing headaches, nausea and sometimes unconsciousness. **Attention**: Some aromatic amines are highly carcinogenic. Use them in drafts. **Measures**: In case of swallowing, gastrolavage the stomach after vomiting the chemicals. Use a laxative to discharge. In case of chemical skin trouble, rinse with soap, water etc.
Phenols and Nitriles	**Toxicity**: Highly corrosive and harmful to nervous system by absorption through the skin. They cause trouble in digestive organs and the nervous system. **Attention**: Liquid and gas nitriles are especially harmful. **Measures**: In case of swallowing, feed water, milk or emulsion of active carbon in water and vomit the chemical. Gastrolavage. Use a laxative (castor oil, sodium sulfate) to discharge. In case of chemical skin trouble, rub off the chemicals with alcohol and wash carefully with water.

Methanol	**Toxicity**: Swallowing 30-50mL of methanol causes vomiting, convulsions, difficulty breathing and visual trouble. Respiratory paralysis may cause death. Sometimes methanol causes the loss of sight. **Measures**: Gastrolavage well with 1-2% sodium hydrogen carbonate.
Benzene	**Toxicity**: Vapor is poisonous. It causes anemia as a chronic toxic symptoms, and nervous distraction as an acute poisoning. **Attention**: Extremely deleterious. Carcinogenic. **Measures**: Make the patient breathe clean air. Except when one a large amount of benzene has been swallowed, refrain from gastrolavage and emetic medicine because they may cause additional damage.
Carbon disulfide	**Toxicity**: The vapor causes problems with the nervous system. **Measures**: In case of swallowing, gastrolavage or use emetic medicine to promote vomiting. Then keep the patient warm while exposing the patient to fresh air.
Dimethyl sulfate	**Toxicity**: Inflammation and necrosis of skin and mucous membranes. Lung troubles leading to fatality. **Attention**: It is difficult to recognize the gas, because it has no color or smell. Absorption through skin is very rapid. Pay close attention.

Table 3 General measures for chemical poisonings

	Measure
In case of swallowing chemicals	(1) Contact a medical specialist (2) Make the patient vomit the chemical. Corrosive chemicals such as acids and alkalis or liquid hydrocarbons should not be vomited. (3) Feed milk, egg, water, tea or a water emulsion of flour or starch. Depending on the chemical, the measures listed below should be conducted. **Strong acids**: Feed an emulsion of magnesium oxide, aluminum hydroxide, or milk. **Strong alkalis**: Feed 1-2% acetic acid or lemon juice. **Mercury**: Feed egg white dissolved in water or skimmed milk. **Silver nitrat**e: Feed salt water. **Methanol**: Gastrolavage with ammonium hydrogencarbonate.
Gas poisoning	Breathe fresh air. The patient should be laid quietly in bed and kept warm. Depending on the patient's condition, practice artificial respiration. Those measures listed below should be conducted according to the gas. **Cyanogens gas**: Inhale amyl nitrate. **Bromide gas**: Inhale alcohol. **Phosgene gas**: Inhale diluted ammonia. **Ammonia gas**: Inhale oxygen.
In case of chemicals coming into eyes.	Flush the chemicals away with running water for more than 15 minutes.
In case of chemicals sticking to skin.	Wash the skin with water, except in the case of phenol or phosphorus poisoning. Depending on the chemicals, follow the listed measures below. **Strong acids**: Wash the affected part with water, then with ammonium hydrogen carbonate. **Strong alkalis**: Wash carefully with water, then wash the affected part with 2% acetic acid. **Phenol**: Rub off the chemicals with alcohol and wash carefully with water and soap. **Phosphorus**: Do not wash with water first. Wash the affected part with 1% copper sulfate, and then rinse.

Table 4 Gastrolavage solutions

Toxins	Solution
Alkaloid	0.02% potassium permanganate
Hypochlorous acid	5% sodium thiosulfate
Copper	1% Potassium ferrocyanide
Iron	Physiological salt solution including 10% sodium hydrogen carbonate with 5-10g of deferoxamine
Fluorides	5% lactic acid or calcium carbonate solution, milk
Bromides	Starch solution
Phenol, Cresol	Plant oil (not mineral oil)
Phosphorus	1% copper sulfate (approximately 100mL). Never forget to discharge.
Salicylic acid	10% sodium hydrogen carbonate.
Others	The emulsion of active carbon or warm water is applicable in all cases.

4-6. Handling Methods of Combustible Materials

1) Spontaneous combustion-related materials

(*e.g.* alkylaluminum/ white phosphorus/ reducing metal catalyst)

(1) Properties: The ignition temperatures are low. These materials ignite in air at room temperature. Most of them ignite through contact with H_2O.

(2) Caution in usage: These materials must not come into contact with the air. For example, white phosphorus must be stored in water, and alkylaluminum must be stored in inert gas. They also must be stored isolated from other materials.

(3) Extinction: Generally, dry sand or a powder fire extinguisher is used. When the amount of material is small, large quantities of water may be used.

2) Water-reactive materials: (*e.g.* sodium, calcium, calcium carbide, calcium phosphide, quick lime, lithium aluminum hydride, lithium hydride, phosphorus pentoxide, fuming sulfuric acid, chlorosulfuric acid, acetic anhydride etc.)

(1) Properties: These materials will react as shown below when they come into contact with water.

(sodium) Combustible gas is produced and ignites.

(calcium carbide) Combustible gas is produced, however, generally ignition won't occur.

(calcium phosphide) Poisonous gas is produced. If the gas is mixed with air, it ignites.

(quick lime) Exothermic reaction occurs. When combustible materials are near, they might ignite.

(sulfuric acid/ chlorosulfuric acid) Extreme exothermic reaction occurs, causing danger from the materials splashing from their containers.

(2) Caution in usage: Contact with water must be avoided. Decomposition can occur even through air moisture. Sodium and potassium must be stored in petroleum, and isolated from other materials.

(3) Extinction: Powder fire extinguisher, dry sand, or sodium chloride is generally used. Water and carbon dioxide fire extinguishers must not be used.

3) Inflammable materials (e.g. Special combustibles: ether, carbon disulfide, pentane etc. Petrol I: Gasoline, hexane, benzene, toluene, alcohol, acetone, ether acetate etc. Others: kerosene, heavy oil, animal oil and plant oil)

(1) Properties: Substances will not ignite just by coming into contact with air but are easily ignited by a spark or flame. Dangerous temperatures can be detected by the flash point. The flash point of special inflammable liquids is below -20ºC, and that of Petrol I oil is below 20°C. Ether and carbon disulfide is extremely inflammable. They can be ignited by flames several meters away.

(2) Caution in usage: Excessive amounts of inflammable materials must not be stored in a laboratory. When using these materials, any flames must be extinguished, and mantle heaters only should be used for heating. A burner must not be used. In case vapor production expected, sufficient ventilation must be provided.

(3) Extinction: powder fire extinguishers or carbon dioxide fire extinguishers must be used.

4) Solid inflammable materials (*e.g.* sulfur, red phosphorus, powder metal)

(1) Properties: At room temperature, ignition won't take place even after contact with a spark. If materials are heated, ignition will occur easily. When the temperature exceeds the flash point, such material poses a similar danger to inflammable liquids.

(2) Caution in usage: There is a danger of ignition when inflammable materials with low flash

points come into contact with the surface of metals. The vapor produced by heating is heavier than air and easily accumulates near the floor, and can be ignited by a source of heat.

(3) Extinction: Apply large quantities of water or use a powder fire extinguisher or a carbon dioxide fire extinguisher.

5) Self-reactive materials (e.g. ammonium perchlorate, sodium perchlorate, ammonium nitrate, benzoyl peroxide, picric acid, trinitrotoluene, etc.)

(1) Properties: Since these compounds are unstable, there is a danger of explosion from heating or shock .

(2) Caution in usage: There is a risk of explosion by fire or shock. These explosive materials must be used after risk has been researched. Since these compounds may be produced as the byproducts of various reactions, and also by the oxidation of stored solvents, adequate attention must be paid. This is especially true when a kind of ether (ether, tetrahydrofuran) is oxidized by oxygen in the air, and organic peroxides are easily produced. In the case of the distillation of ether, substantial amounts of ether should be left after distillation. Since there is a risk of explosion when acid or alkaline materials come into contact with metals or reducing materials, these materials must not be mixed together without attention being paid.

(3) Extinction: Apply large quantities of water. However, people should be evacuated from the vicinity in case an explosion occurs during the extinguishing process.

6) Explosive compounds (*e.g.* Refer table 5)

(1) Properties: There is a risk of rapid increase in liquid temperature, boiling, scattering, and explosion by the heat reaction produced by a mixture of more than two materials.

(2) Caution in usage: There is a possibility that these compounds are produced at an unexpected point of an experiment. Sufficient care must be taken.

(3) Extinction: Apply large quantities of water.

7) Oxidation-related materials (*e.g.* an oxidation-related solid: chlorate, perchlorate, inorganic peroxide, permanganate etc. an oxidation-related liquid: perchloric acid, hydrogen peroxide, fuming nitric acid etc. an oxidation-related gas: oxygen, ozone, fluorine, chlorine etc.)

(1) **Properties:** Extremely chemically reactive**.** Reacts easily with other substances, causing the risk of fire or explosion. When exposed to heat, friction or shock, solid oxidizing agents decompose while emitting oxygen, and at the same time a large amount of heat is also generated.

(2) **Caution in usage:** These materials must not encounter heating, friction and shock. Contact with inflammable materials and strong acids must be avoided. Sunlight must be avoided and chemicals must be kept away from heaters.

(3) **Extinction:** Generally, water is used. If an alkaline metal peroxide is present, it is treated as a water-reactive material.

8) Strong acid materials (ex. sulfuric acid, nitric acid, chlorosulfuric acid, hydrofluoric acid, trichloroacetic acid, formic acid etc.)

(1) **Properties:** Most of these materials cause an explosion when mixed with an oxidation-related material. Severe chemical burn is caused when these materials come into contact with skin or mucosal membranes. Pulmonary edema is caused when the vapor is inhaled in high concentrations. Metals and other materials are corroded by contact

Table 5. Explosive compounds (Chemical A + Chemical B)

Chemical A	Chemical B
nitrate, concentrated nitric acid, chromic anhydride, permanganate, acidic halide (chlorate, chlorite, hypochlorite)	inflammable materials (organic materials etc.)
aluminum, magnesium	oxygenated compounds (**Fe_2O_3, Na_2SO_4, Na_2CO_3, ZnO**)
carbon tetrachloride, chloroform	sodium
permanganate, acidic halide (chlorate, perchlorate, chlorite, hypochlorite)	strong acids
labile ammonium salt (nitrite, chlorate, permanganate)	stable ammonium salt
concentrated sulfuric acid, fuming sulfuric acid, chlorosulfuric acid)	water, alkali

4-7. Managements and Disposal of Harmful Waste Fluids

1) General cautions

Heavy metals and organic solvents are contained in waste fluids produced in the laboratory. Waste fluid is regulated by law. Since the composition of waste fluid is complex, diverse and also made up of dangerous materials, adequate attention must be paid. In our university, the disposal of waste fluids is performed by the Environmental Preservation Center. There is a rule that waste fluids are sorted and stored in a waste fluid container, which are carried out to a specified places on days specified by the center. The character and content must be known by the person who disposes of waste fluids. There is a duty to carry out proper disposal and inform the center of any cautions required during disposal.

2) Classifications and storage of waste fluids

Classification of waste fluids must be carried out as shown in Table 6, and fluids must be stored in 10L plastic waste fluid containers with a label attached which describes its contents and properties. There are three types of plastic waste fluid container: inorganic waste fluids (white), organic waste fluids (red), and fixers (blue). There are two types of label: inorganic waste fluids (blue), and organic waste fluids (pink). The labels are kept by the harmful waste fluid storage assistant (accountant). When waste fluid containers are used by several persons, attention must be paid to ensure that waste fluids with different properties aren't mixed together. If they are mixed together, not only will disposal be difficult, but several reactions may occur and heat and poisonous gases may be produced.

3) Collection of Waste Fluids

Stored waste fluids are collected on the second Tuesday of every month. Waste fluids must be carried out before 9:30 AM of the collection day to the designated location. Empty waste fluid containers will usually be returned to the designated location on the collection day of the following month. Returned waste fluid containers should be taken back to the laboratory. (Organic waste fluid containers are returned en masse in June, September, and November)

Instructions for the disposal of waste fluids are shown below.

(1) The date of disposal, name of the person disposing, pH etc. must be entered on the label.

(2) The departments, types of waste fluids etc. should not be written on the containers since the

containers are used in all departments.
(3) The containers should not be carried out more than two days before the day of collection.
(4) The volume of waste fluid should be less than about 80% of the container's capacity and the top should be packed to prevent spillage.
(5) To don't leave glass tubes, glass fragments, and stirring bars or other solid bodies in waste fluid.

4) Predisposal of Waste Fluids

The final disposal of waste fluids is performed at the Environmental Preservation Center, however, predisposal shown in Table 6 must be done to the fluids. Waste fluids not containing toxic substances or abolished alkali are not objects of collection. Naturalization of these solvents is conducted by each experimenter and then disposed via laboratory sinks.

In disposal, inorganic waste fluids containing heavy metals are naturalized, cohered, and deposited, and organic waste fluids are burned after emulsifying. Attention must be paid not to mix organic solvents or oil in water solutions. If organic solvents or oil are mixed with a water solution, disposal will be very difficult.

Table 6. Classification and instructions of harmful waste fluids

Types		Instructions
Inorganic waste fluid	chromic acid mixture	Store all mixtures (include the first lavation)
	mercury compound solution	Store when the solution's concentration is more than 0.005mg/L; Don't dispose of metal mercury.
	general metal compound solution	Cadmium, lead, selenium (more than 0.1mg/L); Chrome (more than 0.5mg/L); copper (more than 3mg/L); zinc (more than 10mg/L); iron, manganese, and other heavy metals (more than 10mg/L)
	fixing solution for photographs	Store all solutions (Silver will be collected. Don't mix with developing solution or other waste fluids)
	cyan compound solution	Store when cyan concentration is more than 1mg/L; Make the solution alkaline and store.
	arsenic compound solution	Store when arsenic concentration is more than 0.1mg/L; Indicate the solution's pH
	fluorine compound solution	Store when fluorine concentration is more than 15mg/L; If the solution is acid, store after neutralization.
Organic waste fluid	inflammable organic solvent	Since benzene is an object of regulation, collection must be done thoroughly. PCB, explosive nitrate compounds, and peroxide won't be collected; inflammable solvents must be weakened by other solvents.
	developing solution for photographs	Store all solutions.
	waste oil	Don't mix PCB together. PCB won't be colleted.
	hydrous organic solvent	Store solvents which contain water (more than 10% v/v). Enter the percentage of water contained on the label.
	halide organic solvent	Store the solvent in containers marked with the appropriate label. PCB is not collectable so should not be mixed within containers.

4-8. Access to Chemicals Information

Information on the physical properties, effects on human, spillage disposal and storage of chemicals can be obtained through the substance name and the CAS number. Some web sites on chemicals are shown below.

(1) International Chemical Safety Cards (ICSC) Japanese version (NIHS)
http://www.nihs.go.jp/ICSC

(2) Environmental Health Criteria (EHC) Japanese excerpt (NIHS)
http://www.nihs.go.jp/DCBI/PUBLIST/ehchsg/

(3) Chemical Toxicity Database –Toxicity Test Reports
http://wwwdb.mhlw.go.jp/ginc/html/dbl-j.html

(4) Total Search System for Chemical Substances (Chemical Management Centre, National Institute of Technology and Evaluation (Incorporated Administrative Agency))
http://www.safe.nite.go.jp/ english/index.html

(5) National Institute for Environmental Sciences: Chemical Database
http://w-chemdb.nies.go.jp/

(6) Kanagawa Environmental Research Center: System for Chemical Safety (kis-net)
http://www.k-erc.pref.kanagawa.jp/

(7) Chemical Evaluation Organization (former Chemicals Inspection & Testing Institute): Existing Chemical Substances Safety (Hazard) Evaluation
http://www.ceri.or.jp/ceri-jp/koukai/sheet/sheet_index4.htm

(8) Information Center of Safety and Health: Chemicals Information
http://www.jaish.gr.jp/user/anzen/kag/kag_main01.html

(9) Chemical Products Database (Japan Chemical Industry Association)
http://61.204.48.89/jciadb/

(10) Tokyo Metropolitan Institute of Public Health: Data on Biological Effects of Suspected Endocrine Disrupting Chemicals
http://www.tokyo-eiken.go.jp/edcs/edcs_index.html

(11) CAS Number/ Chemical Search for MSDS Sheets
http://www.camd.lsu.edu/msds/msds_search.html

(12) Material Safety Data Sheets (MSDS)
http://msds.ehs.cornell.edu/msdssrch.asp

4-9. Search Examples of Chemicals According to International Chemical Safety Cards (ICSC)

Although the cards are currently (as of 5th December, 2005) relevant only for 1456 substances, they include diverse information by specialists, regarding physical properties, important data, fires, explosions, exposure to the body, inhalation, skin damage, eye damage, oral intake, spillage disposal, storage, packaging, labeling, etc. The ICSC have been translated into Japanese by the National Institute for Health Sciences, Division of Chemical Information. Information is displayed either in textual-form or tabular form. The textual form of “Sodium perchlorate” is shown below as an example. (http://www.nihs.go.jp/ICSC/)

Sodium perchlorate

PERCHLORIC ACID, SODIUM SALT

Tertiary Structure

· Sodium perchlorate
· Inert
· $NaCLO_4$
· Molecular weight 122.4

· CAS no. 7601-89-0
· RTECS no. SC9800000
· ICSC no. 0715
· U.N. no. 1502[4]
· EC no. 017-010-00-6[5]

Physical Properties

· Melting point (decomposes): 482 °C [7, 8]
· Specific gravity: 2.02 [8, 9]
· Water solubility: easily soluble (209g/100ml, in 15 °C water)

Important Data

Physical state; Appearance

· White hygroscopic crystals or powder [6, 9, 10]

Chemical Dangers

· Decomposes when heated and releases toxic fumes (chlorine, chloroxides). [11,12]
· Extremely reactive with organic materials, sulphuric acid, ammonium nitrate, and metal powders. Danger of causing fire and an explosion hazard. [6, 10, 11]

Acceptable Concentration

· TLV not established.

Exposure Path

· Routes of entry: inhalation of aerosol, ingestion.

Danger of Inhalation

· Evaporation at 20 °C is negligible, but airborne particles may rapidly reach toxic concentration when dispersed.

Short Term Exposure Effects

· Eye, skin irritation, and respiratory tract irritation. [7, 8]

Long Term or Repeated Exposure Effects

· May affect blood (methaemoglobinemia) (ref. “Notes”). [7, 8, 10]

Fire

Primary Disaster

· Incombustible, but promotes ignition of other substances.
· Can cause fire or explosion by multiple reactions.
· Releases irritating or toxic fumes (or gas) during fire.

Prevention

· No open flames, sparks, smoking
· No contact with combustible material or metallic powder

Fire Fighting

· Apply large quantities of water, water spraying [9, 10]

Explosion

Primary Disaster

Prevention

· Avoid friction and shock

Fire Fighting

· During fire: Cool by spraying water on drums
· Extinguish fire from sheltered position

Exposure

Acute Symptoms

Prevention

· Prevent dust dispersion

· Avoid contact especially with juveniles and infants

First Aid Measures

Inhalation

Acute Symptoms

· Cough, sore throat

Prevention

· Local exhaust ventilation or usage of respirator.

First Aid

· Fresh air and rest.

· Refer to medical attention

Skin

Acute Symptoms

· Reddening

Prevention

· Protective gloves

First Aid

· Remove contaminated clothes

· Rinse and wash skin with water and soap

Eyes

Acute Symptoms

· Reddening, pain

Prevention

· Safety goggles or respirator in combination with eye protector.

First Aid

· Rinse with plenty of water for several minutes (remove contact lenses if possible), seek medical assistance.

Ingestion

Acute Symptoms

Prevention

· No drinking, eating, or smoking during work

First Aid

· Rinse mouth

· Contact medical institution

Spillage Disposal

· Wash down spilled liquid with plenty of water

· Sweep spilled substance into sealable container

· Do not use combustible absorbents such as sawdust.

· (Personal Protection Equipment: P2. filter respirator for harmful particles)

Storage

· Keep in fire-resistant facility (required)

· Keep away from combustible material and reducing agents (ref. “Chemical Dangers”).

· Store in cool area.

· Dry.

· Tightly sealed.

Packaging & Labeling

· UN Hazard Class: 5.1

· UN Pack Group: II

Notes

· Melting point of other substances: sodium perchlorate monohydrate: 130 °C
· Susceptible to shock when mixed with organic materials
· Specific treatment necessary in case of poisoning with this substance; taking appropriate means under instruction must be available.
· Rinse contaminated clothes with plenty of water (fire hazard)
· Recommended guidelines written on this Card are uniformly applied to sodium perchlorate monohydrate.
· Transport Emergency Card: TEC(R)-840
· NFPA(National Fire Protection Association) code: H (Health) 2; F (Flammability) 0; R (Reactivity) 2

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5. Safety Guidelines for the Handling of Gas

Most people who engage themselves in laboratory experiments pay the closest possible attention while handling flammable gas, such as hydrogen, or toxic gas, such as carbon monoxide. However, fatal oxygen deficiency accidents have occurred even with nitrogen gas, which lacks explosiveness and toxicity and is thus considered safe. In general, investigation into the causes of accidents reveals an unexpectedly large number of cases lacking safety awareness, i.e. trying too hard, paying insufficient attention and lack of knowledge or training.

1) Gas classification

(a) Flammable gas: Hydrogen, carbon monoxide, ammonia, hydrogen sulfide, methane, propane etc.

(b) Susceptible gas: Air, oxygen, ozone, chlorine, nitrogen monoxide, nitrogen dioxide, etc.

(c) Explosive gas: A mixture of flammable gas and susceptible gas. In addition, silane, alkyl aluminum, metal hydride, organometals erupt even with only contact with air.

(d) Inert gas: Nitrogen, carbon dioxide, helium, argon etc. These gases are harmless, but pose a risk of causing oxygen deficiency.

(e) Liquefied gas and solidified gas: Nitrogen, helium, LPG, dry ice, etc. These can cause frostbite, explosion and oxygen deficiency.

(f) Poisonous gas: Chlorine, fluorine, hydrogen halide, hydrogen sulfide, hydrogen cyanide etc. Fatalities can occur even after inhaling only small amounts of these gases.

(g) Corrosive gas: Chlorine, hydrogen chloride, ozone, etc. They can corrode metals, plastic rubber etc and cause unexpected disasters. In addition, they can cause injuries to skin and mucous membranes.

2) Safety measures to prevent accidents such as burning, fire, and explosion

(1) About the handling of explosive gas

Explosive gas is a mixture of flammable gas and susceptible gas. When mixing them in a certain ratio, the mixture has explosiveness. The explosion limit (table 7) of the gases with air and the permission limit (table 8) of poisonous gases are shown. In addition, with oxygen, the range of the explosion limit is increased. It is important that there is no leak of flammable gas, and that adequate indoor ventilation is provided. In addition, when leakage occurs, it is essential to ensure the explosion limit is not exceeded

Table7. Explosion limit in air of main gases (%, 1 atm, room temperature)

Gas	Lower limit	Upper limit	Gas	Lower limit	Upper limit
Acetylene	2.5	81.0	Hydrogen sulfide	4.3	45.0
Benzene	1.4	7.1	Hydrogen	4.0	75.0
Toluene	1.4	6.7	Carbon monoxide (humid)	12.5	74.0
Cyclopropane	2.4	10.4			
Cyclohexane	1.3	8.0	Methane	5.0	15.0
Methanol	7.3	36.0	Ethane	3.0	12.4
Ethanol	4.3	19.0	Propane	2.1	9.5
Isopropyl alcohol	2.0	12.0	Butane	1.8	8.4
Acetaldehyde	4.1	57.0	Pentane	1.4	4.8
Diethyl ether	1.9	48.0	Xylene	1.2	7.4
Acetone	3.0	13.0	Ethylene	2.7	36.0
Ethylene oxide	3.0	80.0	Propylene	2.4	11.0
Propylene oxide	2.0	22.0	Butane-1	1.7	9.7
Vinyl chloride (monomer)	4.0	22.0	Isobutylene	1.8	9.6
ammonia	15.0	28.0	1,3-butadiene	2.0	12.0
Carbon disulfide	1.2	44.0	trifluoroethylene	10.0	42.0

Table 8. The permission limit of poisonous gases (ppm)

Gas	Permission limit	Gas	Permission limit
Ammonia	25	Ozone	0.1
Carbon monoxide	50	Phosgene	0.1
Chlorine	1	Phosphine	0.3
Fluorine	1	Sulfur dioxide	5
Bromine	0.1	Acetaldehyde	100
Ethylene oxide	50	Formaldehyde	5
Hydrogen chloride	5	Nickel carbonyl	0.001
Hydrogen fluoride	3	nitromethane	100
Hydrogen sulfide	10	Acrolein	0.1
Hydrogen cyanide	10	Methylamine	10
Bromomethane	15	Diethyl amine	25
Nitrogen monoxide	5		

(2) Ignition source

A fire or an explosion occurs due to the presence of flammable gas, susceptible gas and the ignition source. Ignition sources include not only a naked light but also just heating (or contact with a high-temperature object), a silent spark, a shock, a very small amount of catalyst and a large quantity of metal powder. Therefore, the sign “no source of ignition permitted” should be displayed when handling flammable gas. In addition, silane, organometal and metal hydride gas might explode when mixed with air even without an ignition source.

(3) Response to a gas leak accident

Accident countermeasures should be thoroughly studied on a routine basis to ensure that appropriate arrangements can be made according to the severity of accidents. It is particularly necessary to examine measures to prevent the expansion of an accident, such as the ensuring of escape routes, the preparation of safety tools and the removal of ignition sources.

(4) Oxygen deficiency accident by inert gas

Inert gas itself is harmless, but may cause an oxygen deficiency accident. The oxygen density of the atmosphere is about 21%, but, with a decrease of oxygen density, the following symptoms appear: 1. You will suffer from a headache and/or dizziness when the density falls to 18% or below; 2. You will suffer from hypoxia, lose consciousness and become unable to respond on your own when it reaches 15% or below; 3. When oxygen density decreases close to 7%, you will loose consciousness and suffer from respiratory arrest in a short time. Hence, appropriate judgment and responses are required to prevent secondary disasters by taking into account the possibility that in the case of an oxygen deficiency accident, rescue members may also suffer from hypoxia. When you discover a person suffering from hypoxia, you should first notify those around you out loud of the situation. You should then stop breathing and promptly carry the person outside the room. If the rescue operation requires several minutes, you should not act on your own because the risk of a secondary disaster is high.

(5) Explosion accident by liquefied gas, gas poisoning, frostbite

Liquefied gas experiences significant volume expansion and vaporization heat absorption at the time of vaporization. Therefore, even a slight leakage may cause the gas to reach its explosion limit, resulting in an explosion. In addition, the density of liquefied gas may easily influence our body. Therefore, we should perform the routine inspection and maintenance of plumbing, containers and appliances, and pay due attention to the handling of liquefied gas.

Exposure to low-temperature liquefied gas will cause you to suffer from heavy frostbite. If liquefied gas infiltrates thick cotton gloves or clothes, affected clothing will stick to your skin, making it hard for you to take it off and causing a severe frostbite. If you have liquefied gas on your clothes, take off as much clothing as you can and rinse off the gas with large amounts of tap water. When handling liquefied gas, put on leather gloves, not cotton gloves. Furthermore, special attention is required when you pour liquefied gas into a container of normal temperature, carry a container with liquefied gas or place an object of normal temperature into liquefied gas solution because liquefied gas can suddenly boil and gets scatter. Close attention is also needed when you pour liquefied gas from a large-sized storage container to a small container. These operations should be conducted in the presence of an expert until you get used to it.

(6) Handing of poisonous gas

Since poisonous gas even in a very small quantity could lead to a great accident, it should be handled with the greatest possible care. When you use poisonous gas during experiments, leakage

must be avoided. In the event of an accident, however, you should study the toxicity of gas, emergency measures for accidental inhalation and antidote before use, and examine proper ways and procedures to cope with a leakage accident if any exist. In addition, all possible measures should be taken by examining containers, plumbing and processing method to be used during experiments. Furthermore, you should prepare gas masks and a gas neutralizer suitable for the types of antidote and gas. When you conduct a poisonous gas experiment, you should make it known to people in your surroundings by putting up signs that read that poisonous gas is being used. This is important measure to prevent secondary disasters.

The permission density of poisonous gas is shown in Table 8. When you handle a poisonous gas, you must wear an effective gas mask, fully concentrate on your experiment and always pay careful attention so that you can sense even the slightest abnormality. If an accident occurs, the safety of life should come as the top priority. If the situation does not allow you to confirm safety, prompt judgment and courage to take refuge are required.

Since the risk of a secondary disaster is higher than in a hypoxia accident, when you discover an unconscious person considered to be suffering from gas poisoning, more careful judgment and responses are required. In an accident like this, motor functions may be impaired as soon as you breathe a poisonous gas. Therefore, in order to take appropriate actions, it is important that you all understand who is conducting what experiment and where.

(7) Precautions for handling high-pressure cylinders

A wide variety of high-pressure gas cylinders are in use. This section includes precautions concerning the handling of high-pressure gas cylinders and pressure regulators.

Since the weak point of a cylinder is its mouthpiece, the cylinder should be fixed in order to prevent falling in the event of an earthquake, for example. In addition, if a cylinder equipped with a pressure regulator falls, damage to its mouthpiece may cause an accident. Therefore, whenever the cylinder is transported or whenever it is not in use, it should be protected with a cap. There are two types of main cock for cylinders: needle bubble type and auto-closed type. Cylinders for flammable gas and toxic gas are of needle valve type. The needle part is susceptible to damage and we must not close it too hard. To confirm that the main cock is closed, reduce pressure on the primary side of the pressure regulator and then close the valve on the secondary side to see that pressure on the primary side does not increase. However, when a pressure regulator is to be removed, you should close the needle valve slightly too hard just in case. Cylinders for oxygen gas and nitrogen gas are of auto-closed type. Although a small amount of gas leaks momentarily during opening and closing, the leakage is not abnormal. In case leakage lasts one second or more, the cylinder is considered faulty. In this case, the leakage may stop if you fully turn the valve to the “open” direction, which should be judged based on the gas type and surrounding circumstances.

You should confirm the rotating direction of a pressure regulator handle before operation. A pressure handle is usually in the reversed direction. That is, a second pressure increases when you turn it to the right. Beginners easily make mistakes in this regard. When you open the main cock with the handle fully turned to the right in an attempt to close it, you will go beyond the pressure gauge on the secondary side. If you take time to respond, the bourdon tube gear of the second side pressure gauge will not be returned to its original position or it may burst, leading to an accident. When you install a pressure regulator, you should open the main cock with the handle fully turned to the left and you should execute this operation from the side of the regulator. In addition, to prevent the incorrect plumbing of oxygen gas and hydrogen gas, a reverse screw is used for the installation nut (the left screw) of the hydrogen gas pressure regulator. There are also cases in which screws of different diameters are used depending on the types of gas.

6. Safety Guidelines for Biological Experiment

All experimental machines and devices are potentially dangerous. The potential for danger is not affected by the size of the machine or device. Following standard procedures reduces the level of risk. Please produce a usage manual for each device and hang the manual on the nearest wall to assure easy access to the appropriate reference material.

1) General attention

(1) Before using machines or devices for the first time, read the manufacturer's manual, and receive instruction from a representative of the manufacturer.

(2) After appropriate skill acquisition, careful attention is needed while operating the machine or device. A mistake when using a high-risk device (high temperature, high voltage, high speed, and/or heavy device) may cause a serious accident. If an accident occurs, stop the machinery promptly and contact a representative of the manufacturer

(3) After using devices and machines, you must clean them.

2) High voltage devices (electrophoresis and mass spectroscopy devices etc)

Contact with machinery after turning on the electricity may be dangerous. Therefore, avoid contact with machines during operation. If an accident occurs due to electric shock, turn off the device immediately and separate the person who sustained electric shock from the device. To avoid direct contact with the shocked person, wear rubber gloves. After separating the victim from the source of electricity, contact a doctor. If necessary, provide cardiopulmonary resuscitation and artificial respiration.

3) High-speed rotation devices (centrifuge etc)

(1) It is necessary to attach a rotor or bucket to a centrifuge. Before using these accessories, you must ascertain the maximum rotation speed (maximum centrifugation force) specific to the accessory. When using the centrifuge, the accessories ought to be driven below their maximum speed. In particular, the maximum speed appropriate for an old rotor may be lower than specified (due to wear). Please confirm the appropriate speed with a representative of the manufacturer.

(2) Please ensure the correct installation of the bucket or rotor in the apparatus when exchanging accessories.

(3) To avoid rotor imbalance, be sure that the tube or bucket is positioned symmetrically. Particular care should be taken when positioning a rotor with many holes for multiple tubes.

(4) During operation, you must not open the cover or cause shock to the machinery. In addition, do not touch the rotor or shaft until rotation has completely stopped. Touching a rotating rotor or shaft may result in an accident or problem with the machine.

4) High-pressure devices (autoclave etc)

(1) When using the autoclave, always do so at the designated place under the instruction of the person responsible.

(2) Always keep the inside packing of a container clean.

(3) Confirm the quantity of water in the container and avoid heating without water.

(4) An accident can easily be caused by a mistake during the exhaust procedure (opening and shutting of the valve or button); sufficient attention is needed to prevent accidents during this procedure.

(5) There may be danger due to high temperature steam generated during the exhaust procedure. Open the door only after pressure and temperature have decreased sufficiently. To avoid

burns, wear heat-resistant gloves, and then remove the sterilized objects.

5) Utilization of low temperature devices (deep freezer etc) **and liquid nitrogen**

(1) Wear leather gloves or low temperature resistant gloves to remove samples from the deep freezer. The refrigerator and deep freezer always requires cleaning and rearrangement; samples should be removed and stored quickly in order to prevent ice adhesion. This will maintain the performance of the device over the long-term.

(2) To prevent frostbite, please wear gloves when directly touching either dry ice or cooled containers. To prevent an ignition accident, chilling compounds containing dry ice, acetone, and alcohol must not be used near fires or open flames of any type.

(3) To avoid accidents, experiment using liquid nitrogen should not be performed alone. In particular, observation by an experienced researcher is needed when a beginner is performing an experiment.

(4) If the oxygen density becomes less than 16%, a person loses consciousness due to hypoxia. At that time, attention to prevent secondary disasters is necessary, and affected person(s) should be carried to another location. Artificial respiration should be performed, and medical assistance should be sought immediately.

(5) When using liquid nitrogen for the rapid freezing of a sample, wear a HAZMAT suit, glasses, and gloves. In addition, attention to ventilation is necessary. At the time of rapid freezing, a glass thermos can be easily broken by an impact. Attention is necessary to prevent such an impact from occurring. If nitrogen contacts your clothing, change clothes promptly to avoid frostbite. Then seek medical examination and treatment.

6) Ultraviolet (UV) and sonicator etc.

(1) The sterilization of microorganisms is performed using UV irradiation in the biological laboratory. UV irradiation to the eyes over the long-term raises the risk of burnt eyes ("*setsugan*"). Therefore, protective goggles should be worn when performing UV procedures.

(2) Sonication for cell destruction and particulate suspension produces high frequencies and raises the risk of deafness. Take countermeasure to protect against high frequencies.

7. Guidelines for Prevention of Biological Hazards

Microorganisms used in this graduate school at present are designated as Biohazard Levels 1 and 2 according to “Manuals for safety managements of microorganisms in universities and institutions” provided by Japan’s Ministry of Education, Culture, Sports, Science and Technology (MEXT)in January, 1998. Thus, the establishment of designated laboratories and/or appointment of accident prevention managers is not required. However, experiments must be done in laboratories equipped for the appropriate management of microorganisms. In particular, experiments with a risk of aerosol release should be done in safety cabinets (biohazard cabinets). Microorganisms and equipment contaminated by microorganisms must be sterilized properly. In experiments using microorganisms designated as Biohazard Level 2 and organisms containing recombinant DNA molecules, mouth pipetting is prohibited. Further, in any experiment using microorganisms, mouth pipetting should not be performed. Eating, drinking, smoking, storing food or utensils, or applying cosmetics is prohibited in any laboratory using microorganisms designated as Biohazard Level 2 and organisms containing recombinant DNA molecules. Persons under 15 years of age are prohibited from entering the laboratory.

With the progress of genetics, experiments using organisms containing recombinant DNA molecules are becoming popular. MEXT provided “Guidelines for research using recombinant DNA molecules in universities and institutions” in April, 1998, and Hokkaido University provided “Guidelines for the safe managements of research using recombinant DNA molecules”. All research using recombinant DNA molecules must follow these guidelines. In addition, research must be registered prior to the initiation of work. Experiments in our university at present are assigned to the B_1P_1, B_1P_2, B_2P_1 or B_2P_2 levels; i.e., microorganisms used in our laboratories are not infectious or toxic and have low viability in nature and high host specificity. Thus, these organisms are rather safe. However, they must be managed properly, since there is still a risk that mutants with infectious ability and toxicity may arise. Microorganisms with recombinant DNA molecules and related wastes must be stored and transported in hard-shell containers, and experiments must be done in laboratories with doors and windows closed. **If contamination occurs, decontaminate immediately.** Persons who have no experience of experimentation using recombinant DNA molecules must be taught the safe management of microorganisms, techniques for physical and biological containment, the hazardous risks of experiments, and appropriate measures in case of accidents.

1) Notices to experiments using microorganisms

Infection by and the release of experimental microorganisms must be prevented to ensure the safety of yourself and nearby persons. Infections could occur directly by contact with microorganisms escaped from laboratories or be transmitted indirectly via flies or mosquitoes. Researchers must know appropriate methods for microorganism management and disinfection to avoid contamination in laboratories and outside. If there is a risk of infection, researchers must wear laboratory coats, gloves or masks. Experimental materials must be labeled with the name of the users or persons who have responsibility for them. After experimentation, researchers must disinfect all equipment used, clean desks, and sterilize their hands.

2) Notices to experiments using laboratory animals

For the appropriate handling of laboratory animals, the Council for Science and Technology provided a report “On the necessity of guidelines and committees for the handling of laboratory animals” in 1987. In Hokkaido University, any research using laboratory animals must follow “The guidelines for the handling of laboratory animals in Hokkaido” established in 1988.

Experimental animals are sometimes infected by pathogens, and they could cause infections in

humans. Therefore, animals with a low possibility of pathogen infection should be obtained from well-managed institutions or providers, and they must be raised in clean containment areas. To protect animal welfare, researchers must not submit animals to unnecessary pain or kill them without explicit purposes. Animals must be raised in enriched environments and sacrificed humanely with minimal pain and distress under anesthesia.

Animals should be raised in exclusive containment areas where the intrusion of flies, cockroaches, mosquitoes or ticks is prevented. Animals must be prevented from escaping from cages, and their urine, feces and bedding wastes must be discarded properly following the law for the disposal of industrial wastes. If animal hairs cause an allergic reaction, masks should be used. Researchers must pay attention not to be bitten or injured. If injured or bitten, take medicine, and go to hospital for medical assistance if necessary.

3) Attention regarding experiments using human and animal blood

Researchers who handle human or animal blood have a high risk of infection by viral or bacterial microorganisms among others. They must wear disposable plastic gloves. In particular, special attention must be paid when researchers have scratches or injuries on their hands or arms. When giving injections to animals, they must be held securely and treated carefully so as not to be injured or bitten. Containers contaminated with blood must be washed after disinfection by 5 % sodium hypochlorite solution.

4) Guidelines for the prevention of accidents by biological agents in fields

Substantial research in our graduate school manifests itself as field work in domestic and oversea areas. Our activity extends from cities to mountain areas, from tropics to polar areas, and from fresh waters to deep seas. Thus, we face various risks. General guidelines for prevention of risks in field work are provided in Section 2. In this section, guidelines for the prevention of risks due to biological agents are provided. To avoid accidental encounters with dangerous animals, field researchers should obtain information on animals in the vicinity of their research from local peoples prior to the initiation of work. In some areas, rivers and lakes are contaminated with pathogenic parasites or fungi. Careful use of water is needed. Ticks in grasslands and forests mediate diseases such as encephalitis, tularemia, tsutsugamushi-disease, spotted fever or Lyme disease, and tsetse flies mediate trypanosomes. In particular, the Hokkaido and Tohoku districts are contaminated by Echinococcus, tsutsugamushi-Rickettsia and the Lyme-disease pathogen. Special attention on vector insects and animals is needed when conducting field work. In addition, the careful intake of foods and drinks is needed during overseas field work even if local people have no problems with these foods and drinks, since local people often have immunity or tolerance to native pathogens or local pollution.

8. Attention in the Safety Management and Use of Computers

1) General attention

Those using computers should always be aware that computer disorder (accidents) can be potentially damaging to other users, and care should be taken so as not to create causes of such disorder. In order to do so, users should obey regulations regarding the use of the computer system, and in particular, follow the correct procedures for starting up and closing down the system. When abnormalities occur they should be dealt with swiftly, based on instructions in the manual, and the like. In addition, conditions at the time abnormalities occur, and the measures used to deal with the problems should always be recorded. When problems cannot be dealt with immediately, the device should be switched off. Effort should be made to take appropriate back-up measures to minimize the amount of damaged caused when disorders occur.

2) Items of Attention During Use

Work that involves staring at a display (VDT) for long periods of time may be harmful to the eyes, and therefore periodic rests should be taken. Bad posture during the use of computers could cause inflammation of tendons and backache; be sure to maintain a correct posture. Always use e-mail and the Internet within the bounds of common social etiquette and never post information that is slanderous or likely to breach public order or decency standards. In addition, attention must always be paid to copyright.

3) Security

Password control is a basic security measure of a computer system, and due care and attention should be paid to that control. Attention should be paid to intrusions from external sources that occur in the network when computers are connected to it. Always establish a system administrator, carry out regular checks for intrusion, and perform administrator password management and modifications, strictly. Stop all unnecessary external services, and continually gather security information and measures. When necessary, restrict access that utilizes the IP address, and wherever possible use an SSH coded manual method when connecting via the network. Never install or use software that carries a risk if virus infection; never download viruses carelessly via untrustworthy sites; never open mail that has a risk of being infected by a virus. Always install anti-virus software and carry out regular checks for infection, and always use the latest version of software. Furthermore, never attempt to infiltrate a computer system for which use has not been approved.

9. Daily Precautions to Prevent Fire

1) Do not place any obstacles on emergency stairs, in hallways, in front of firewalls, near fire hydrants and on balconies, etc., as they hinder fire fighting and escape routes, and may lead to casualties.

2) Make note of the position of fire extinguishers and emergency ropes and **learn how to use them**. Especially **make note of the position of fire extinguishers in each laboratory.** It is important to practice to prepare for accidents to ensure appropriate response should accidents occur

3) Laboratory equipment such as instruments, shelves for chemicals and books, etc. should be laid out properly to secure human movement in case of an emergency. Proper anti-**earthquake procedures** should be taken for such equipment.

4) Do not use defective **burners and gas heaters.** Never leave a room with a burner or heater on, and never place combustible materials near heaters. Burners should be used on fire-resistant boards and enough distance should be kept between burners and walls. It is advised to use pressure tight gas hoses. Replace old hoses often because they may develop cracks (they should routinely be replaced every few years). Be sure to turn off the main valve after use.

5) When using **a combustible solvent, only take the least amount required.** Pay attention to the existence of fire when you use solvent that has a low boiling point, high volatility and inflammability. **If you need to stock large amounts of combustible solvent, you must keep it in a separate facility for organic solvent storage.** The existence of solvent in a laboratory and the amount can be a critical factor in the spread of fires and may cause difficulties with evacuation.

6) Electric cords should be in good condition and do not use one with scratches or cracks. Do not cross or touch electric cords with gas hoses. **Use appropriate fuses for the switchboard and apparatus in each room**.

7) Periodically check on cell culture apparatus, air ovens, isothermal incubators, dry blocks and mantel heaters, etc. to prevent electric leakage or electrical shock. Cords of these apparatus with large electric capacities can burnout or degrade due to heat caused by prolonged use. Even electrical appliances that don't generate much heat should be used properly to avoid short circuiting.

8) Do not plug too many leads into a single socket. In particular, such overloading on the floor causes dust aggregation which can result in a fire hazard (In fact fire caused by such a reason happened in our university a few years ago.) For the apparatus that should be supplied with power for long periods of time, such as cell culture apparatus and isothermal incubators, etc., it is also advisable to connect directly to a switchboard. Periodically clean up the dust around plugs if the apparatus is connected to an electric outlet.

9) You should ask the manager immediately to repair damaged or malfunctioning equipment and apparatus if you find any.

10) When you leave a laboratory, you should lock the room after checking that all power sources and gas valves have been turned off.

11) Although not directly connected with fire prevention, leaving research rooms and laboratories unlocked for long periods of time may lead to the theft of laboratory equipment, chemicals and personal belongings (cash, credit cards, documents, etc), or could possibly lead to intruders knocking over heating equipment that may result in fires breaking out. Therefore it is necessary to lock rooms and laboratories that are expected to be left unmanned for hours on end.

9-1. Response to Fire

1) Shout "Fire" loudly to turn people's attention to the fire, call for help, and set off a fire alarm if necessary.

2) In the case of a small fire, you may extinguish it, but you must remain calm. It is also important that you judge the cause, gauge the current situation and take appropriate measures. When fire is caused by organic solvents, in many cases fire makes attendants panic and may result in the spreading of the fire; even to your clothes. Do not try to extinguish such fires alone. It is preferable to let someone else with experience handle further extinguishing than you act in a state of panic.

Evacuate immediately when you judge that it is impossible to extinguish the fire. Delaying evacuation is directly linked to critical accidents such as burns, oxygen deficiency, anthracemia and respiratory problems caused by smoke.

3) When fire doesn't spread, remove any combustibles from the vicinity, turn off the main gas valve and turn off the electricity if it is possible.

4) When your clothes catch fire, use an **emergency shower or ask others to put the fire out** . Although difficult at first, it is effective to go out into the corridor and extinguish fire by rolling on the floor. It is recommended that experimenters who use organic solvent frequently avoid wearing clothes comprised of synthetic fibers or blended fabrics

5) When a large amount of combustible or flammable solvent has spilled on to the floor or a large amount of combustible gas has spewed out from cylinders, turn off the power immediately, extinguish any naked flames, such as burners, and open the window to ventilate the room as certain concentrations may lead to fires or explosions. In the case of poisonous gas or large amounts of smoke being emitted, take refuge upwind immediately and put on a gas mask. Do not place too much trust in gas masks because their capacity declines if the concentration of poison exceeds the mask's limit level.

9-2. Correspondence for Evacuation

1) Evacuate the building immediately when you feel that it is impossible to suppress the fire or gas leak by yourself. An on-site director should conduct an evacuation, and others should follow his/her instructions.

2) Do not use elevators to evacuate.

3) The on-site director should check for anyone who is late evacuating, and wherever possible, deal with the main gas valve, fire source and any hazardous materials. If necessary, the director operates fire shutters to minimize damage. **Fire shutter control is conducted only by the on-site director.**

9-3. Notification Procedure of Fire

1) Office hours (Weekdays 8:30-17:15)

(1) The person who triggers or discovers a fire should alert others of the fire breaking out and attempt to extinguish it.

(2) In case of a small-scale fire, persons in the vicinity should call the faculty office (ext. 2206) or the head official (ext. 2201). Report the condition of the fire swiftly and concisely, confirming details regarding **[scale of fire, when, where, what, who, what has happened or is happening and what action should be taken]**.

(3) In case of a large-scale fire, which is impossible for you to put out, you should a call fire station (ext. 0-119) before calling the faculty office. After calling the fire station, you should call the faculty office.

(4) An on-site director of fire should provide directions after recognizing the situation regarding hazardous materials.

2) Out of office hours (Weekdays after 17:15, Saturdays, Sundays and Holidays)

(1) The person who triggers or discovers a fire should alert others of the fire breaking out and attempt to extinguish it.
(2) In case of a small-scale fire, persons in the vicinity should call the janitor's room (ext. 0-728-4715) and call the director of the facility at home.
(3) In case of a large-scale fire, which is impossible for you to put out, call a fire station (ext. 0-119) before calling the janitor's room. After calling the fire station, you should call the janitor's room.

3) Others

In case an emergency arises, it is necessary to know the location of fire extinguishing equipment / extinguishers and escape routes. It is especially important during evacuation and taking measures for electric outage.

10. Others

1) Preparation for earthquake

It is impossible to forecast the time and magnitude of earthquakes. Nobody has forecasted an earthquake just below our campus, but earthquakes with a seismic intensity of 4-5 do occur once every few centuries because of an active fault near Sapporo. It is necessary to take measures to protect against earthquakes such as anchoring shelves to prevent falling. It is possible to reduce degrees of damage by such countermeasures, and it is irresponsible not to take such measures.

2) Evacuation in the case of earthquake

You should turn off electricity, gas, and running water as soon as possible in case of an earthquake, no matter how small or great, and evacuate your facility. Be careful about falling objects such as walls and glass windows during evacuation. Do not use elevators to evacuate. If you an earthquake hits while you are in an elevator, you should press all buttons and get out of elevator at the first available opportunity.

3) Student comprehensive insurance

It is possible for students to suffer accidents and encounter injury, illness and death during practice, research experiments and field work. As contingency, “comprehensive student insurance” is offered. We recommend enrollment for all students. Gakujutsu-josei-kakari can be consulted about the insurance.

11. Postscript

This manual was made by members of the safety committee. All members take charge of the part/parts of this manual related to their major field/fields of studies. This manual aims to establish a safety guideline for research work. We sometimes forget old accidents. In the past ten years alone, there some large-scale accidents such as a case of oxygen deficiency at the Faculty of Engineering, a fire resulting from dust near a plug at the Center for Research and Development in Higher Education, a fire caused by the flames of organic solvent at the Faculty of Pharmaceutical Sciences and a fatal accident during an underwater operation. Campus rumor also suggested that small-scale accidents also occur frequently.

The risk of accidents is inherent in laboratory and field work. It is highly likely that accidents may also occur due to careless mistakes as a result of psychological conditions, or a combination of illusion and coincidence. Daily consideration of safety is important in preventing accidents because most accidents arise from a lack of preparation and caution. These safety guidelines have been created with that in mind, and we recommend that all students inexperienced in research or experiment read this manual and carefully digest relevant points before conducting research work. We hope that you will succeed through study with the thought that “accidents cannot be eliminated unless each and every individual is aware of safety.”

Reflecting on near misses leads to safer working practices. Such first-hand information is an extremely important source in the prevention of accidents, and conveying those measures either verbally or in writing, through reports to the safety committees for each specialty or department, or to the Environmental Science clerical department will lead to the further development of this manual.