

LABORATORY SAFETY



Prof. Sunil Kumar Jha
DEAN, SPAHS
CUTM

- All students must read and understand the information regard to laboratory safety and emergency procedures prior to the first laboratory session. **Your personal laboratory safety depends mostly on YOU.** Effort has been made to address situations that may pose a hazard in the lab but the information and instructions provided cannot be considered all-inclusive.
- With good judgment, the chance of an accident is very small. Nevertheless, research and teaching workplaces (labs, shops, etc.) are full of potential hazards that can cause serious injury and or damage to the equipment. Working alone and unsupervised in laboratories is forbidden if you are working with hazardous substances or equipment. With prior approval, at least two people should be present so that one can shut down equipment and call for help in the event of an emergency.
- Safety training and/or information should be provided by a teaching assistant, technician, or staff member at the beginning of a new assignment or when a new hazard is introduced into the workplace.

Emergency Response

- It is your responsibility to read safety and fire alarm posters and follow the instructions during an emergency
- Know the location of the fire extinguisher, eye wash, and safety shower in your lab and know how to use them.
- Notify your instructor immediately after any injury, fire or explosion, or spill.
- Know the building evacuation procedures.



Common Sense:

Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgement and common sense. If at any time you are not sure how to handle a particular situation, ask your Teaching Assistant or Instructor for advice. **DO NOT TOUCH ANYTHING WITH WHICH YOU ARE NOT COMPLETELY FAMILIAR!!!** It is always better to ask questions than to risk harm to yourself or damage to the equipment.



Personal and General laboratory safety

- Never eat or drink while working in the laboratory.
- Read labels carefully.
- Do not use any equipment unless you are trained and approved as a user by your supervisor.
- Wear safety glasses or face shields when working with hazardous materials and/or equipment.
- Wear gloves when using any hazardous or toxic agent.
- Clothing: When handling dangerous substances, wear gloves, laboratory coats, and safety shield or glasses. Shorts and sandals should not be worn in the lab at any time. Shoes are required when working in the machine shops.
- If you have long hair or loose clothes, make sure it is tied back or confined.
- Keep the work area clear of all materials except those needed for your work. Coats should be hung in your room or placed in a locker. Extra books, purses, etc. should be kept away from equipment that requires air flow or ventilation to prevent overheating.



We want to avoid this.



Care in handling glassware and electricity



Report all incidents/injuries immediately



goggles

gloves

lab coat

shoes



- Disposal - Students are responsible for the proper disposal of used material if any in appropriate containers.
- Equipment Failure - If a piece of equipment fails while being used, report it immediately a technician. Never try to fix the problem yourself because you could harm yourself and others.
- If leaving a lab unattended, turn off all ignition sources and lock the doors.
- Clean up your work area before leaving.
- Wash hands before leaving the lab and before eating.



Electrical safety:

- Obtain permission by the safety coordinator before operating any high voltage equipment (voltages above 50Vrms ac and 50V dc are always dangerous, extra precautions should be considered as voltage levels are increased)
- Maintain an unobstructed access to all electrical panels.
- Avoid using extension cords whenever possible. Extension cords should not go under doors, across aisles, be hung from the ceiling, or plugged into other extension cords.
- Never, ever modify or otherwise change any high voltage equipment.
- before attaching the power supply to your setup make sure there are no “live” wires which can be touched when possibly.
- when attaching a high voltage power supply ALWAYS switch off the supply
- When you are adjusting any high voltage equipment or a laser which is powered with a high voltage supply, **USE ONLY ONE HAND**. Your other hand is best placed in a pocket or behind your back. This procedure eliminates the possibility of an accident where high voltage current flows up one arm, through your chest, and down the other arm.

Chemical safety

- Fill in an “experiment information chart” before conducting an experiment in the chemical lab and let it check and sign by the safety coordinator (Remco Sanders).
- Treat every chemical as if it were hazardous.
- Make sure all chemicals are clearly and currently labeled with the substance name, concentration, date, and name of the individual responsible.
- Never return chemicals to reagent bottles. (Try for the correct amount and share any excess.)
- Comply with fire regulations concerning storage quantities, types of approved containers and cabinets, proper labeling, etc. If uncertain about regulations, contact the safety coordinator.
- Use volatile and flammable compounds only in a fume hood. Procedures that produce aerosols should be performed in a hood to prevent inhalation of hazardous material.
- Never allow a solvent to come in contact with your skin. Always use gloves.
- Never "smell" a solvent!! Read the label on the solvent bottle to identify its contents.

- ***Nanoparticles safety***

Always talk to the safety coordinator When you plan to conduct new or chanced experiments with nanoparticles

- ***Cryogenics safety***

Always talk to the safety coordinator When you plan to conduct new or chanced experiments with liquid nitrogen or liquid helium.

- ***Magnetic safety***

Always talk to the safety coordinator When you plan to conduct new or chanced experiments with strong magnetic fields.



Lasers safety

- Before building up a new setup with a laser, check your plans with the laser safety coordinator.
- NEVER, EVER LOOK INTO ANY LASER BEAM, no matter how low power or "eye safe" you may think it is.
- Always wear safety goggles if instructed by your Instructor or Teaching Assistant.
- The most common injury using lasers is an eye injury resulting from scattered laser light reflected off of mountings, sides of mirrors or from the "shiny" surface of an optical table. The best way to avoid these injuries is to always wear your goggles and NEVER LOWER YOUR HEAD TO THE LEVEL OF THE LASER BEAM! The laser beam should always be at or below chest level.
- Always use "beam stops" to intercept laser beams. Never allow them to propagate into the laboratory. Never walk through a laser beam. Some laser beams of only a few watts can burn a hole through a shirt in only a few seconds.
- If you suspect that you have suffered an eye injury, notify your instructor or teaching assistant IMMEDIATELY! Your ability to recover from an eye injury decreases the longer you wait for treatment.



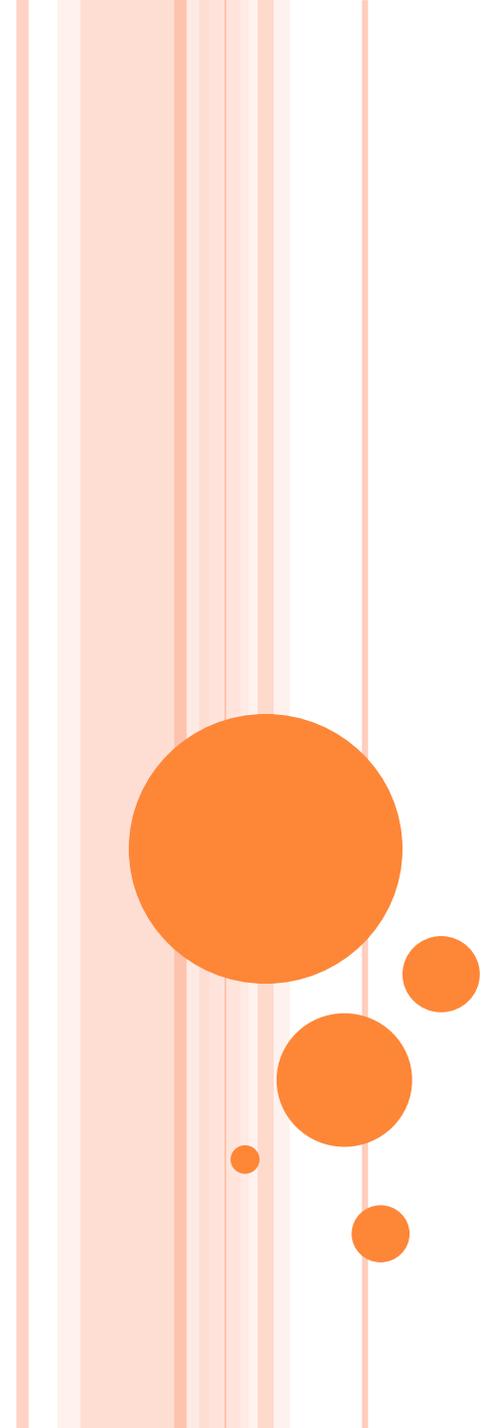
Additional Safety Guidelines

- Never do unauthorized experiments.
- Never work alone in laboratory.
- Keep your lab space clean and organized.
- Do not leave an on-going experiment unattended.
- Never taste anything. Never pipette by mouth; use a bulb.
- Never use open flames in laboratory unless instructed.
- Check your glassware for cracks and chips each time you use it. Cracks could cause the glassware to fail during use and cause serious injury to you or lab mates.
- Maintain unobstructed access to all exits, fire extinguishers, electrical panels, emergency showers, and eye washes.



- Do not use corridors for storage or work areas.
- Do not store heavy items above table height. Any overhead storage of supplies on top of cabinets should be limited to lightweight items only.
- Areas containing lasers, biohazards, radioisotopes, and carcinogens should be posted accordingly. However, do not post areas unnecessarily and be sure that the labels are removed when the hazards are no longer present.
- Be careful when lifting heavy objects.
- Clean your lab bench and equipment, and lock the door before you leave the laboratory.





COMMON LABORATORY HAZARDS

Laboratories involve numerous chemicals, procedures, and operations, they require extensive safety precautions. The common cause of laboratory hazards are the following:

- Chemical hazards:
Toxins, corrosives, flammables, and reactives
- Biological hazards:
Microbes, animals, plants, and genetically modified agents
- Radiation hazards:
Ionizing and nonionizing radiation
- Physical hazards:
Heating devices, noise, projectiles, fire, cold, etc.
- Electrical hazards:
Fire and shock
- Mechanical hazards:
Moving machinery
- Airborne hazardous materials:
Vapors, dust, etc. (Fumigation)
- Ergonomic factors: (it the study of ppl's efficiency in their working environment)
Standing, repetitive motion (monotonous)



FUMIGANTS:

- Methyl bromide was among the most widely used fumigants until its production and use was restricted by the Montreal Protocol due to its role in ozone depletion.
- 1,3-dichloropropene.
- Dazomet
- Chloropicrin.
- DBCP - Dibromochloropropene (banned worldwide)
- Formaldehyde gas.
- Hydrogen cyanide.
- Iodoform.





FIRST AID IN LAB ACCIDENTS

ACCIDENTS IN THE LABORATORY MAY HAVE VARIOUS CAUSES:

- Acids and alkalis: splashes on the skin or in the eyes, swallowing.
- Toxic substances.
- Heat: naked flames, hot liquids, flammable liquids, explosions.
- Injuries involving infectious material, electric shocks, etc.



FIRST-AID BOX:

The first aid box should contain the following;

- An instruction sheet giving general guidance.
- Individually wrapped sterile adhesive dressings in a variety of sizes.
- Sterile eye-pads with bandages for attachment.
- Triangular bandages.
- Sterile dressings for serious wounds.
- Safety pins.
- A bottle containing eye drops.
- A first – aid manual.
- Antiseptic solution like dettol.
- Scissors.
- Grip bandage.



- Safety pins
- Disposable sterile gloves
- Tweezers – plucking of hairs and picking of small objects.
- Alcohol-free cleansing wipes
- Thermometer (preferably digital)
- Skin rash cream, such as hydrocortisone or calendula
- Cream or spray to relieve insect bites and stings
- Antiseptic cream
- Painkillers such as paracetamol (or infant paracetamol for children), aspirin (not to be given to children under 16)
- Cough medicine
- Antihistamine tablets





CHEMICAL EXPOSURE

- Most standard sources recommend that water rinsing/flushing following skin or eye contact with a chemical should continue for 15 or 20 minutes. However, all chemicals do not cause the same degree of effects (some are non-irritants while others can cause severe corrosive injury).
- 5-minutes for non-irritants or mild irritants,
- 15-20 minutes for moderate to severe irritants and chemicals that cause acute toxicity if absorbed through the skin,
- 30 minutes for most corrosives, and
- 60 minutes for strong alkalis (e.g., sodium, potassium or calcium hydroxide).
- It is very important that water flushing start immediately following skin or eye contact with a chemical. It is better if complete water flushing occurs on-site. However, moving the exposed person to an emergency care facility earlier may be necessary depending on their condition (e.g., compromised airways, breathing, or circulation) and/or the availability of a suitable water supply.





NOTICE
CHEMICAL SPILLS
MUST BE REPORTED
IMMEDIATELY



CHEMICAL SPILL ON BODY

- Flood exposed area with running water from faucet or safety shower for at least 5 minutes.
- Remove contaminated clothing.
- Make sure chemical has not accumulated in shoes.
- Obtain medical attention, if necessary.
- Report incident to supervisor.





He who helps in the saving of others, saves himself as well.

-HARTMAN VON AUE



BIOLOGICAL SPILL EMERGENCY

- Attend to injured or contaminated persons and remove them from exposure.
- Alert people in immediate area of spill.
- Close doors to affected area.
- Put on protective equipment.
- Cover spill with paper towels or other absorbent materials.
- Carefully pour a freshly prepared 1 in 10 dilution of household bleach around the edges of the spill and then into the spill. Avoid splashing.
- Allow a 20-minute contact period for the bleach solution to be effective.
- Use paper towels to wipe up the spill, working from the edges into the centre.
- Clean spill area with fresh towels soaked in disinfectant.
- Place towels in a plastic bag and decontaminate in an autoclave.
- Have person knowledgeable of the incident and laboratory assist emergency personnel.



WARNING!



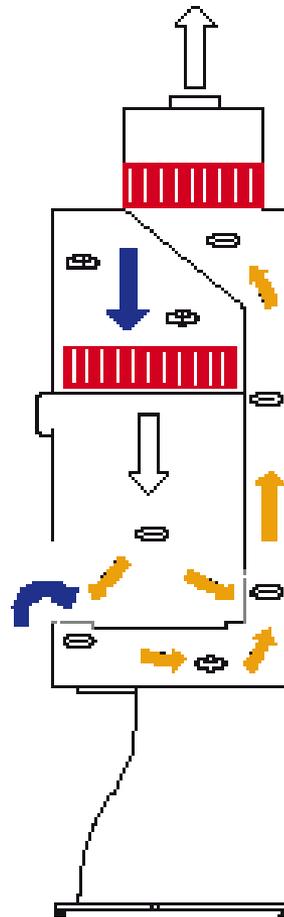
- Make sure that you wear disposable gloves.
- Place towels in plastic bag for disposal.
- Clean spill area with fresh towels soaked in disinfectant.
- Biological spills outside biological safety cabinets will generate aerosols that can be dispersed in the air throughout the laboratory. These spills are very serious as most of these agents have the potential for transmitting disease by infectious aerosols.
- To reduce the risk of inhalation exposure in such an incident, occupants should **Hold Their Breath** and leave the laboratory immediately.
- The laboratory should not be re-entered to decontaminate and cleanup the spill for at least 30 minutes. During this time the aerosol will be removed from the laboratory by the exhaust air ventilation system.



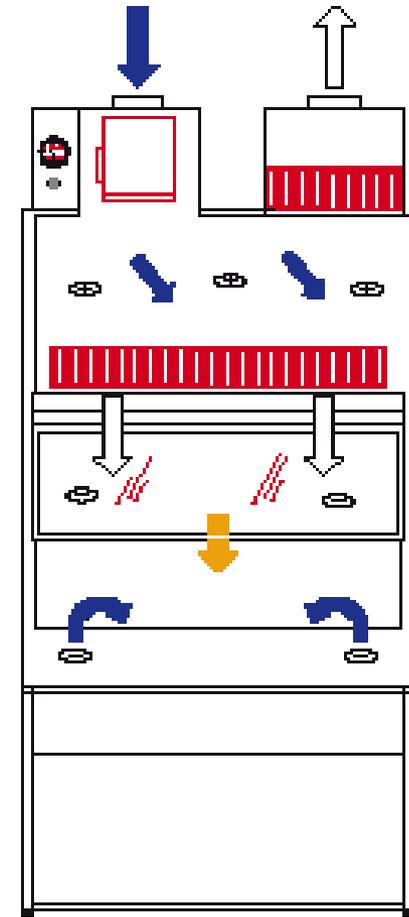


BIOSAFETY CABINET DESIGNED STRUCTURE

-  HEPA filter
-  Room Air
-  Potentially contaminated air
-  HEPA Filtered air
-  Positive pressure
-  Negative pressure



Section View



Front View

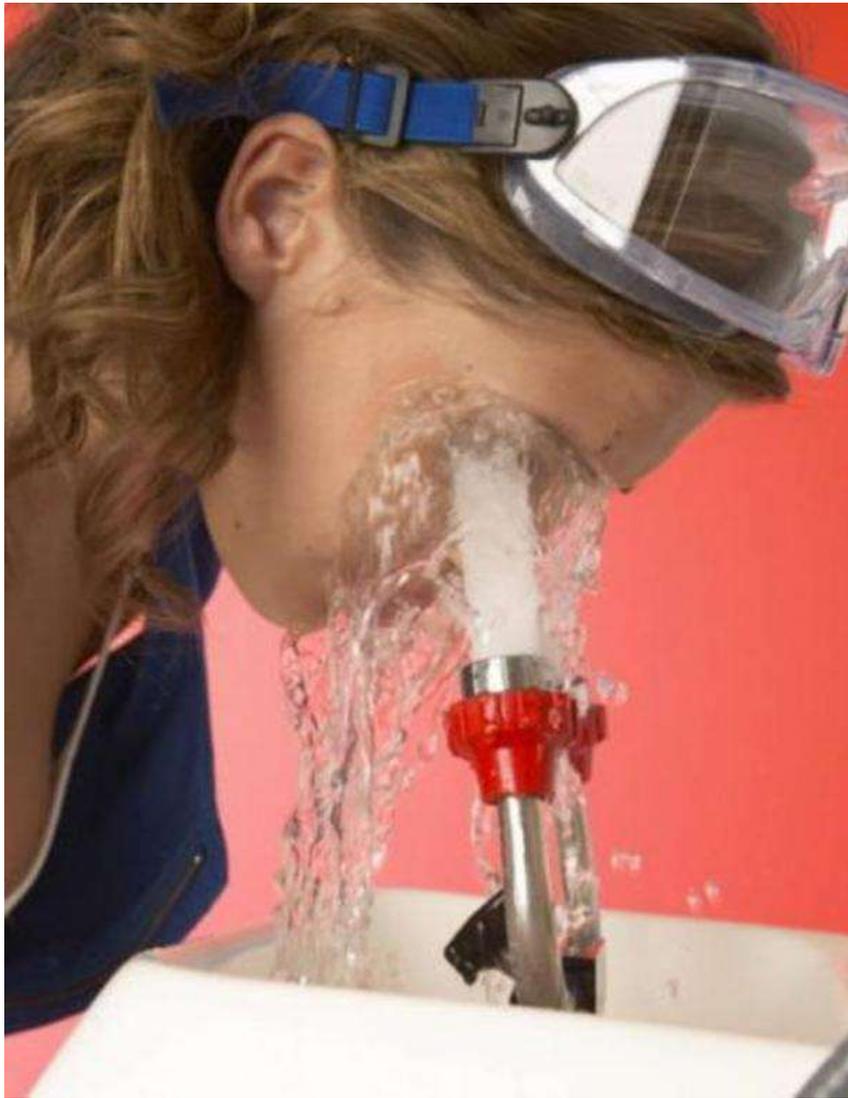


BIOLOGICAL SPILL ON BODY

- Remove contaminated clothing.
- Vigorously wash exposed area with soap and water for one minute.
- Obtain medical attention, if necessary.
- Report incident to supervisor.



EYE WASH



SAFETY SHOWER





HELP YOUR CO-WORKING STAFFS IN CASE OF EMERGENCIES



RADIATION EXPOSURE:

- People threatened with radiation exposure should evacuate the area in a quick, orderly manner.
- Local authorities will give specific instructions on how best to do it.
- People already exposed should remove and discard all clothing that was worn at the time of the exposure and should wash their bodies thoroughly for a prolonged period of time in a shower.
- Medical advice should be sought promptly.
- Evacuation and admission to a hospital out of the area of radiation may be advised.



CAUTION



RADIOACTIVE

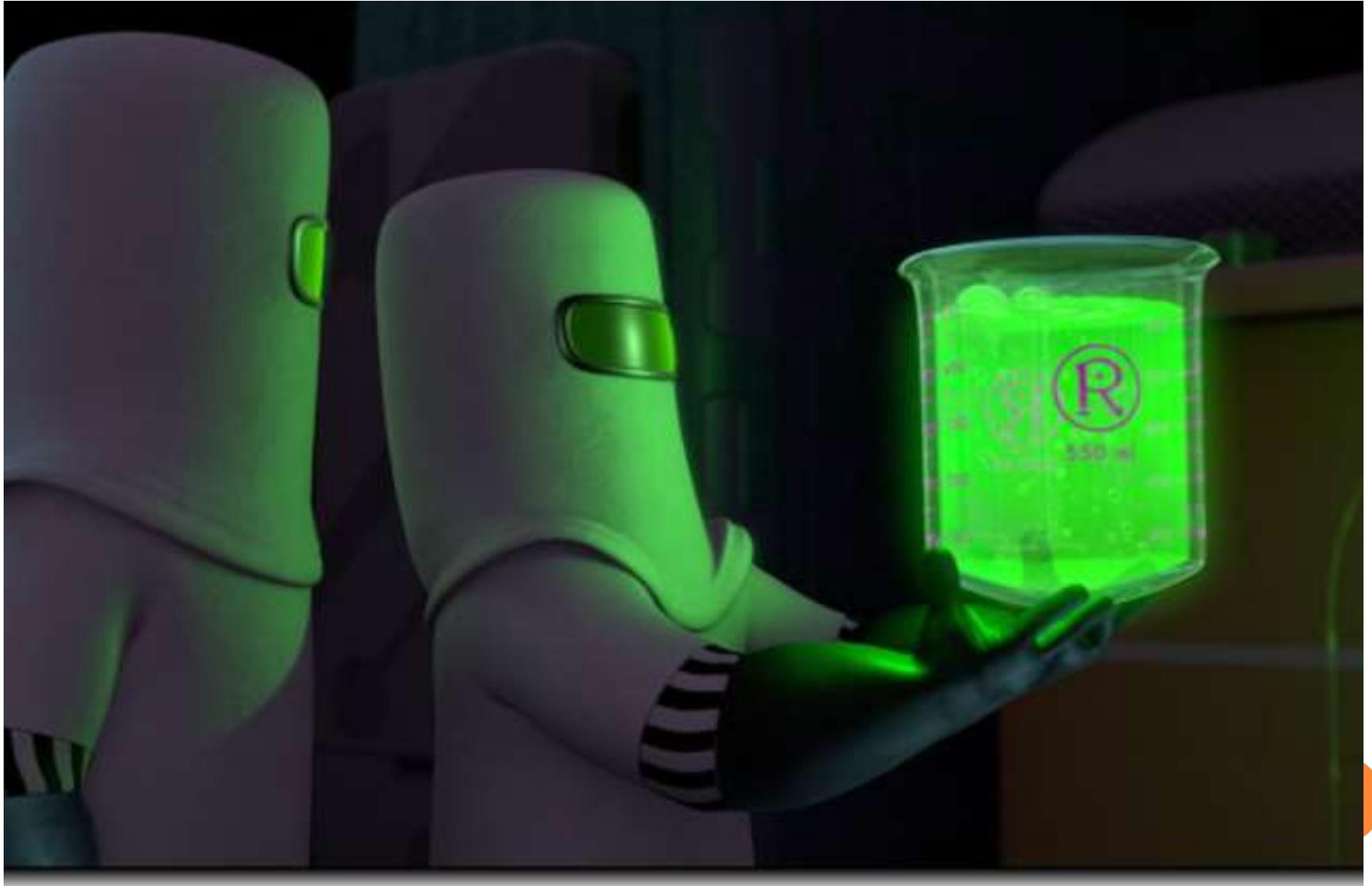


RADIOACTIVE SPILL ON BODY

- Remove contaminated clothing.
- Rinse exposed area thoroughly with water.
- Obtain medical attention, if necessary.
- Report incident to supervisor and school radiation safety officer.



SAFETY !



DRESS CODE FOR PEOPLE DEALING WITH RADIOACTIVE ELEMENTS



FIRE EXPOSURE



DIFFERENT TYPES OF EXTINGUISHERS



To operate an extinguisher:

Pull

Aim

Squeeze

Sweep



Know your extinguisher

Use the correct extinguisher

(Check your own extinguisher's label for detailed instructions.)





KNOW YOUR FIRE EXTINGUISHER CODE



CO₂

B FOR USE ON:
Flammable Liquids

FOR USE ON:
Live Electrical Equipment

DO NOT USE ON:
Wood, Paper and Textiles

DO NOT
Use in a confined space

DRY POWDER

A FOR USE ON:
Wood, Paper and Textiles

B FOR USE ON:
Flammable Liquids

C FOR USE ON:
Gaseous Fires

FOR USE ON:
Live Electrical Equipment

AFFF FOAM

A FOR USE ON:
Wood, Paper and Textiles

B FOR USE ON:
Flammable Liquids

DO NOT USE ON:
Live Electrical Equipment

DO NOT USE ON:
Flammable Metal Fires

WATER

A FOR USE ON:
Wood, Paper and Textiles

DO NOT USE ON:
Live Electrical Equipment

DO NOT USE ON:
Flammable Liquids

DO NOT USE ON:
Flammable Metal Fires

VAPOURISING LIQUIDS

A FOR USE ON:
Wood, Paper and Textiles

B FOR USE ON:
Flammable Liquids

C FOR USE ON:
Gaseous Fires

FOR USE ON:
Live Electrical Equipment



CATEGORIES OF BURNS

- First, second and third degree
- Categorization depends on severity of tissue damage
- Check extent of burn before deciding self treatment
- Seek help if burn is over a couple of inches in diameter.
- If it involves large sections of the hands, feet, face, groin or buttocks, or a major joint



FIRST-DEGREE BURNS

- Injuries are superficial / mild
- Swelling & redness of the injured area
- Pain develops
- No blisters seen
- Burned area becomes white on touch
- Takes 3-6 days to heal



TREATMENT

- Remove patient from heat source.
- Remove the burnt clothing.
- Run cool water over burnt area.
- Gently clean the injured area.
- Gently dry.
- Apply anti biotic such as Silver Sulphadiazine.
- Use a sterile bandage to cover burns.
- Take tetanus vaccination, if required.



SECOND-DEGREE BURNS

- Burns extends to middle skin layer, dermis.
- Swelling, redness and pain observed.
- Burnt area may turn white on touch.
- Blisters develop, that ooze a clear fluid.
- Scars may develop.
- Restricts movement, if injury occurs at joint.
- Dehydration may occur.
- Healing time varies, depends on extent of injury.



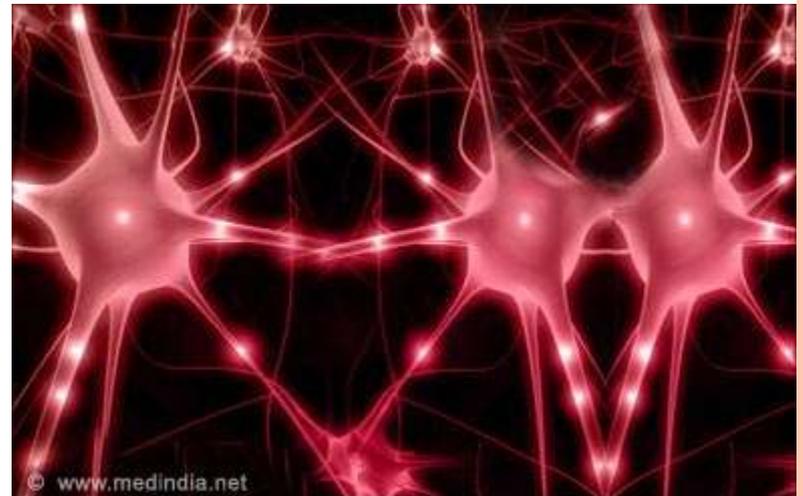
TREATMENT

- Clean the affected area thoroughly.
- Gently dry.
- Apply antibiotic cream over affected area.
- Make the patient lie down.
- Keep burnt body part at a raised level.
- Skin graft may be required.
- Physical therapy may be essential to aid mobility.
- Splints may be used to rest affected joints.
- Hospitalization is essential.



THIRD-DEGREE BURNS

- Damage occurs to all 3 skin layers
- Destroys adjacent hair follicles, sweat glands, nerve endings
- Lack of pain due to destroyed nerves
- Injured area does not turn white on touch
- Swelling occurs.
- Discoloration of skin observed
- Scars develop .
- Dehydration occurs.
- Symptoms may worsen with time
- Disfigurement may result
- Healing depends on extent of injury
- 90% body surface injury results in death
- 60% injury in elderly, fatal



TREATMENT

- Requires immediate hospital care.
- Dehydration treated through intravenous fluid supply.
- Oxygen is administered.
- Eschars(Dry Dark Scab) are surgically opened.
- Periodically run clean cool water over burns.
- Nutritious diet helps to heal quickly.
- Regular monitoring essential.
- Mental Depression treated by anti-depressants.



THANK YOU!

