Electronics Lab Safety

PROFESSOR: JACKY LAU, **jacky.lau@senecapolytechnic.ca**

School of Software Design and Data Science

Seneca

Content

1. Laboratory First Aid
2. Electrical Safety
3. Emergency Procedure
4. Personal Protective Equipment

Emergency Contact

In case of a life threatening emergency:

Call 911

For fire, medical, or police

Then call:

Campus security: **416-764-0911**

For assistance

Image Source: shutterstock

Emergency Contact

If it is NOT a life threatening situation and you just need assistance:

Then call:

Campus security:

416-764-0911

For assistance

Image Source: veryicon

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Someone with Difficulty Breathing

1) Determine if the victim is conscious. Tap her/him on shoulder and yell: **"ARE YOU OKAY?"** If there's no response, start first aid at once.
2) The first step is to **open up her/his airway**. Put one hand under their neck and gently lift up, while with the other hand you gently push down on their forehead. This "head tilt" will move tongue away from the back of the throat.
3) Now **check for air**. Place your ear and cheek close to the mouth and nose. Listen and feel for return of air. At the same time, look for the chest to rise and fall.
4) Check for about 5 seconds. If there's still no breathing, start mouth-to-mouth resuscitation.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Someone with Difficulty Breathing

Mouth-to-mouth Resuscitation (if necessary)

1) Maintaining a head-tilt, pinch the nose shut with the hand you had on the forehead; this will prevent leakage.
2) Now open your mouth wide, take a big breath, seal your mouth around her/his mouth, and blow 4 full breaths as fast as you can. You should take only enough time between breaths to lift your head slightly for better inhaling.
3) If this still doesn't start an air exchange, re-position the head and try again. After 4 more quick breaths, again monitor whether there is air exchange If there is still nothing happening, change your rate to one breath every 5 seconds, and continue patiently until the person starts to breathe on their own.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Do NOT start CPR unless you are qualified or received instruction from medical service to do so over the phone.

You may be liable for injury to the victim if you did something wrong!

If you cannot find the victim's pulse, **Call 911** then **call security** and ask for an **AED**.

Automated External Defibrillator (AED)

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Poisoning Aid

1) If the victim is **unconscious, Call 911** then campus security. Only perform AR / CPR if you think the poison will not harm you. Do NOT give fluid to an unconscious victim.
2) If the victim is **conscious, dilute poison by giving the person a glass of water or milk** – if he/she is not convulsing.
    a) If victim is convulsing, just maintain an open airway.
3) Save the label or container of the suspected poison for identification. (If the victim vomits, save sample for analysis.)
4) Phone **Poison Control Centre 416-813-5900** and seek assistance.
5) If the victim is **vomiting, turn the head** so that material drains.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Poisoning Aid (Victim is convulsing or confused)

1) Do NOT attempt to restrain the victim: just position her/him in such a way that they will not injure themselves by knocking against objects.
2) Loosen clothing at neck and waist.
3) Watch for obstruction of airway and correct it by head positioning.
4) Do NOT force a finger between her/his teeth. Do NOT give fluids. Do NOT induce vomiting. (If the victim is vomiting, position the head so that the material drains.)
5) After the convulsion, place in prone position with head turned to allow fluids to drain.
6) If the victim become **unconscious, Call 911** then campus security. Only perform AR / CPR if you think the poison will not harm you. Do NOT give fluid to an unconscious victim.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Eye Aid (If something got into your eye)

1) USE the eyewash fluid, don't be afraid to use it. Flush out your eye with water at once. Pour lukewarm water gently into the inside corner of the victim's eye and tilt head so that water flows across eyeball and off the face. Use a container of water or a tap that's 2 or 3 inches above eye. Do this for 15 minutes. (Victim can also use shower to wash eyes.)
2) Call Poison Control Centre at 416-813-5900 or physician for additional advice.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Skin Aid (If something got onto your skin)

1) Remove contaminated clothing and wash skin with large amounts of water.
2) Call Poison Control Centre at 416-813-5900 or physician for additional advice.

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

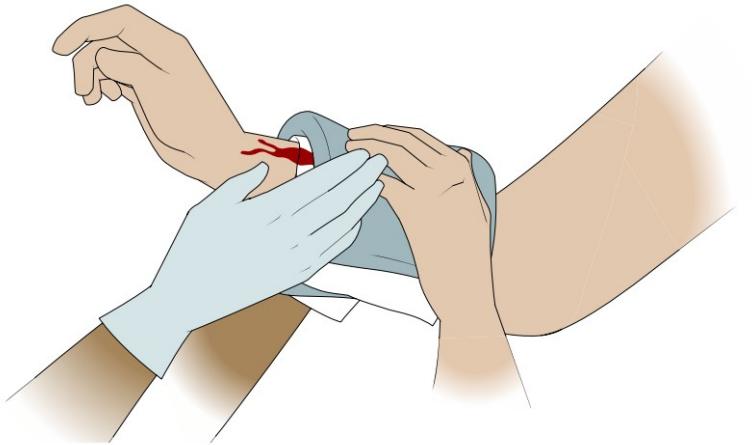
Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Bleeding (Cut) Aid

1) For large cut with major lose of blood, **Call 911** then campus security for assistance.
2) For minor cut, use **Band-Aid** at the safety station or **apply pressure** by placing your palm on a dressing directly over the open wound. In an emergency, you can use your bare hand – but only until compress can be obtained.
3) The **compress, a thick pad of cloth,** will absorb blood and allow it to clot. Never disturb clots formed within the pad. If blood soaks through pad without clotting, don't remove it. Just add additional pads and continue pressing more firmly.
4) On most parts of the body a **pressure bandage** can be used to hold a pad on a severe wound and free your hands. Place centre of bandage directly over pad on wound. Keep steady pull on bandage to hold pad in place as you wrap both ends around body part. Then, tie knotting directly over pad.



St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

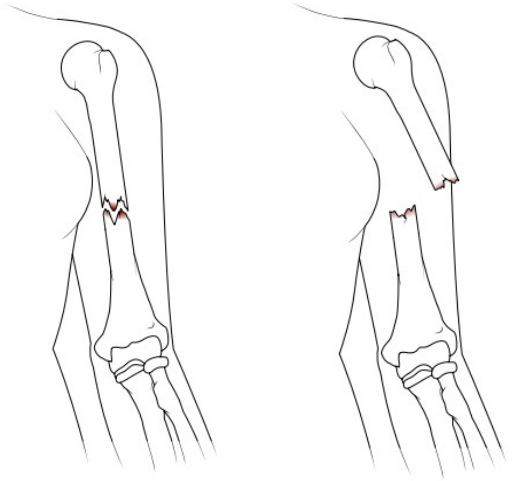
Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

What is a Fracture?

A fracture is a **crack or break in a bone**. If the victim is conscious, they can provide clues. (They may have heard bone snap or feel a grating sensation.) You may note deformities, swelling, and discoloration.

CLOSED fractures are more common. Since they're "inside," accurate diagnosis requires x-ray. But if you even suspect a fracture, carry out aid to prevent further injury.

OPEN fractures are the result of a broken bone end that has torn through the skin and slipped back again. Open fractures are more serious because of tissue damage, bleeding and danger of infection. They get priority.



CLOSED OPEN

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Fracture Aid

1) **Prevent motion** of injured parts.
2) Maintain **open airway** (artificial respiration, if needed).
3) **Elevate** involved extremities, **if possible**.
4) Apply **splints** if there will be a delay in ambulance service or medical assistance. But never attempt to set a fracture or push a protruding bone back!
5) If you lift or move an unconscious victim, act as though there is an injury to their neck or spine. If ambulance will arrive shortly, do not attempt to move.

If fracture is an open one, cut away clothing. Control bleeding by applying pressure through a large sterile or clean dressing. Never wash, probe or insert fingers. If bone fragment is protruding, cover entire wound with a large sterile bandage, compress or pad.

R – Rest
I – Immobilize
C – Cold
E – Elevate

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

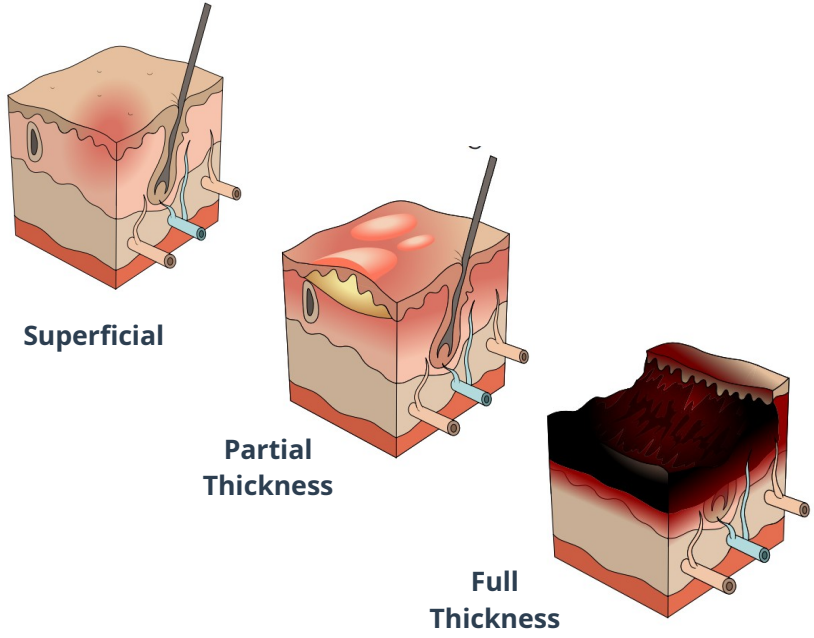
Recognizing Burns

Burns are classified by depth ("degree") of skin damage.

First-degree burns (Superficial burn) result from hot objects or scalding. Signs: redness or discoloration, mild swelling, pain.

Second-degree burns (Partial Thickness burn) result from heavier contact with hot objects or flash burns from gasoline and kerosene. Signs: greater depth than first-degree burns; red or mottled appearance; blisters; a "wet" look. Usually hurts more than deeper burns because nerve endings aren't destroyed.

Third-degree burns (Full Thickness burn) show deep tissue destruction: white or charred look: complete loss of all layers of skin.



St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

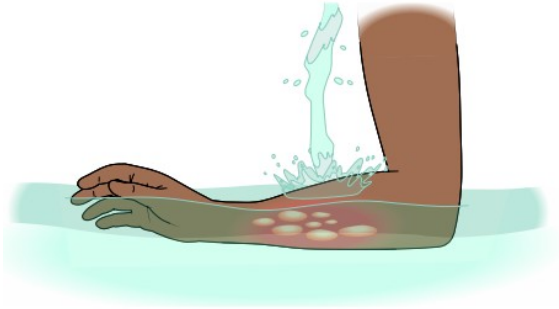
In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Burn Treatment (First and Second Degree)

1) Use cold water applications or submerge burned part in cold water.
2) Apply a dry dressing if necessary.
3) Apply freshly laundered clothes wrung out in ice water if necessary.
4) Apply dry sterile gauze or clean cloth as bandage.
5) If arms or legs are affected, raise them.

NEVER break blisters or remove tissue. NEVER use an antiseptic preparation, ointment, or spray.



St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Burn Treatment (Third-degree Burn)

1) Call 911 as you do not have the resource to treat this injury.
2) Do not remove adhered particles of charred clothing from burned area.
3) Cover burns with thick sterile dressings or freshly laundered sheets.
4) Keep burned hands elevated above level of heart. Keep burned feet or legs elevated (don't let victim walk).
5) Have victim with face burns sit up or prop them up. Keep her/him under constant observation for breathing issues. If problem develops, maintain open airway.
6) **Do not submerge a large burned area or use ice-water.** This may increase the risk of shock. But, you can apply a COLD PACK to face, hands or feet.
7) Quickly arrange transportation to hospital. If an ambulance can't come within one hour and the victim is conscious, give them a weak "salt-soda" solution to sip (it's 1 teaspoon salt, ½ teaspoon baking soda in quart lukewarm water).
8) Do not apply ointment, commercial preparations, grease or any other "remedy."

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Laboratory First Aid

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Only perform first-aid if you are qualified and feel comfortable.
There are no laws in Ontario saying you must administrate first-aid! If you are not sure what to do, call for help.

Chemical Burn Treatment

1) Quickly wash burn area with large amounts of water, using shower or hose at Emergency shower and eye wash least 5 minutes. Remove clothing from areas involved. Emergency shower and eye wash
2) If first aid directions for the specific chemicals are handy, as on reagent bottle label, follow them.
3) Apply a dressing bandage and get medical aid

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

WHMIS Training

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Before working in the Lab, everyone must complete a online WHMIS training.

http://portal.mycampus.ca/mycampusfiles/dc/fieldplacement/WHMIS/story.html

St. John Ambulance: https://sja.ca/sites/default/files/2025-04/SJA-First-Aid-Reference-Guide-English.pdf

Electrical Hazards

In case of an emergency:
Call **911** then Campus security **416-764-0911**

There are three types of hazards in dealing with electricity:

1. Electrical Shock
2. Electrical Arc
3. Electrical Blast

It is important as an engineer to understand the risks and dangers in working with electricity.

Just because we are working in a low voltage laboratory does not mean serious injuries cannot occur.

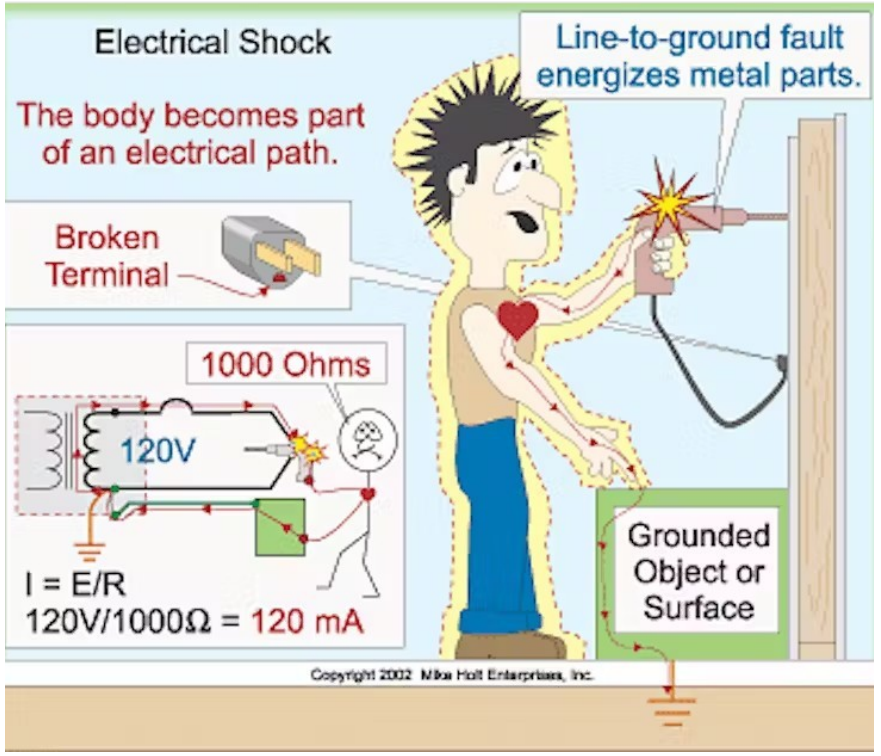


Image Source: https://www.ecmweb.com/content/article/20893758/the-basics-of-electric-shock

Electrical Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Electrical Shock is the physical stimulation that occurs when electric current flows through the human body.

The distribution of current flow through the body is **a function of the resistance** of the paths through which the current flows.

SYMPTOMS OF ELECTRICAL SHOCK:

- Mild tingling sensation
- Violent muscle contractions
- Heart arrhythmia
- Tissue damage

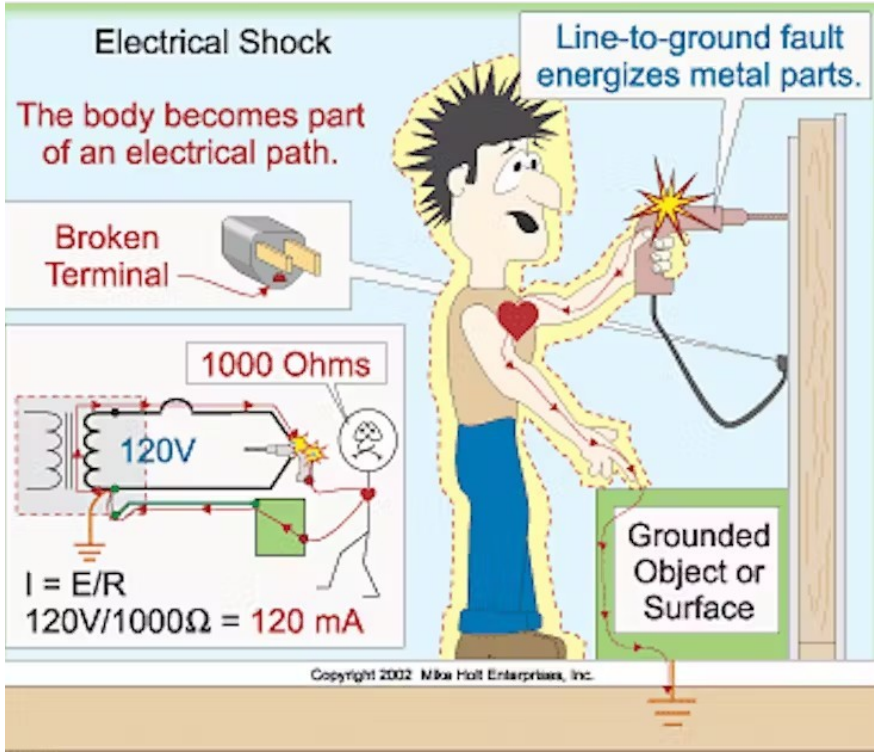


Image Source: https://www.ecmweb.com/content/article/20893758/the-basics-of-electric-shock

Electrical Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Some portion of the externally caused current flow will **tend to follow the current paths used by the human body's central nervous system**.

- Since the external current is much larger than the normal current flow, damage can occur to the nervous system.
- **Damage to the nervous system can be FATAL** even with relatively short durations of current.

Generally, a **longer duration of current through the heart** is more likely to cause ventricular fibrillation.

- Fibrillation occurs when the externally applied electric field overlaps with the bodies natural cardiac cycle.

FIBRILLATION: Rapid and inefficient contraction of muscle fibres of the heart caused by disruption of nerve impulses

Important Frequencies

In case of an emergency:
Call **911** then Campus security **416-764-0911**

TABLE 1.1 Important Frequency Ranges of Electrical Injury

Frequency	Regimen	Applications	Harmful effects
DC–10 kHz	Low frequency	Commercial electrical power, soft tissue healing; transcutaneous electrical stimulation	Joule heating; destructive cell membrane potentials
100 kHz–100 MHz	Radio frequency	Diathermy; electrocautery	Joule heating; dielectric heating of proteins
100 MHz–100 GHz	Microwave	Microwave ovens	Dielectric heating of water
10^{13}–10^{14} Hz	Infrared	Heating; CO_2 lasers	Dielectric heating of water
10^{14}–10^{15} Hz	Visible light	Optical lasers	Retinal injury; photochemical reactions
10^{15} Hz and higher	Ionizing radiation	Radiotherapy; x-ray imaging; UV therapy	Generation of free radicals

AC vs DC Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

- Differences of applied voltage to the human body are apparent even between DC values (0 Hz) and standard power line frequencies (60 Hz).
- When equal current magnitudes are compared (DC vs. AC), DC seems to exhibit two differences:
  - Victims of **DC shock** have indicated that they feel **greater heating from DC than from AC**
  - The threshold voltage where a person can “let go“ tends to be higher for DC shock (ie. DC need higher current and voltage to cause muscle contractions)

AC vs DC Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

- Higher voltages can be more lethal for several reasons, but most notably:
  - For voltages above 400V, the electrical pressure may be sufficient to puncture the epidermis. Since the epidermis (outer skin layer) is the only significant resistance to current flow, the current flow will increase dramatically when the epidermis is punctured.
- Higher voltages are more likely to cause unpredictable arcing.

Body Resistance

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Condition (area to suit)	Resistance	
	Dry	Wet
Finger touch	40 kΩ–1 MΩ	4–15 kΩ
Hand holding wire	10–50 kΩ	3–6 kΩ
Finger-thumb grasp*	10–30 kΩ	2–5 kΩ
Hand holding pliers	5–10 kΩ	1–3 kΩ
Palm touch	3–8 kΩ	1–2 kΩ
Hand around $1\frac{1}{2}$-inch (in) pipe (or drill handle)	1–3 kΩ	0.5–1.5 kΩ
Two hands around $1\frac{1}{2}$-in pipe	0.5–1.5 kΩ	250–750 Ω
Hand immersed	—	200–500 Ω
Foot immersed	—	100–300 Ω
Human body, internal, excluding skin	—	200–1000 Ω

- Notice how drastically the resistance decreases as the surface becomes wet
- Notice how small the internal resistance of the human body (~500 ohms) compared to the external resistance of say a finger touch (~1 Meg Ohm)

Materials Resistance

In case of an emergency:
Call **911** then Campus security **416-764-0911**

TABLE 1.3 Nominal Resistance Values for Various Materials

Material	Resistance*
Rubber gloves or soles	>20 MΩ
Dry concrete above grade	1–5 MΩ
Dry concrete on grade	0.2–1 MΩ
Leather sole, dry, including foot	0.1–0.5 MΩ
Leather sole, damp, including foot	5–20 kΩ
Wet concrete on grade	1–5 kΩ

- Rubber is a fantastic insulator. It is not big and bulky and can virtually ensure nothing bad will happen if you are careful and cover your hands and feet with rubber (Gloves and shoe soles)

Human Response to Electical Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Current (60 Hz)	Physiological phenomena	Feeling or lethal incidence
<1 mA	None	Imperceptible
1 mA	Perception threshold	Mild sensation
1–3 mA		Painful sensation
3–10 mA		
10 mA	Paralysis threshold of arms	Cannot release hand grip; if no grip, victim may be thrown clear (may progress to higher current and be fatal)
30 mA	Respiratory paralysis	Stoppage of breathing (frequently fatal)
75 mA	Fibrillation threshold 0.5%	Heart action discoordinated (probably fatal)
250 mA	Fibrillation threshold 99.5% (≥5-s exposure)	
4 A	Heart paralysis threshold (no fibrillation)	Heart stops for duration of current passage. For short shocks, may restart on interruption of current (usually not fatal from heart dysfunction)
≥5 A	Tissue burning	Not fatal unless vital organs are burned

Human Response to Electical Shock

In case of an emergency:
Call **911** then Campus security **416-764-0911**

A current flow of approximately **10mA @60Hz** is sufficient to cause a person to be in a state of “electrical hold“.

Electrical hold is a condition where the muscles are contracted by the passage of electrical current and the individual is unable to overcome this response.

Like any injury, certain body parts respond very poorly to the flow of electricity and at much lower thresholds.

- Electrical current through **major organs**, such as the heart, can be catastrophic with **75mA @60Hz** of current.
- The cardiovascular system is an easier target, with as little current as 3**0mA can cause the lungs to be paralyzed**.

Electrical Safety

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Under no circumstances is anyone to tamper with, or work with exposed wiring in the designated work areas. Failure to comply with this rule will result in immediate and permanent suspension of access privileges.

To ensure everyone's safety and to meet current Ontario legislation, all electrical equipment must be suitable for its use and certified by:

(i) The Canadian Standards Association (CSA)

Including Phone Charger.

Electrical Safety

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Under no circumstances is anyone to tamper with, or work with exposed wiring in the designated work are electrical hazards can be avoided by following these rules:

- **Only trained, qualified personnel** may repair or modify electrical or electronic equipment.
- Electrical panels and boxes should **NEVER be altered**
- **or tampered** with.
- Access to electrical panels should not be blocked. **Minimum 1 meter clearance.**
- **Never remove the ground pin** of a three prong plug.

Electrical Safety

In case of an emergency:
Call **911** then Campus security **416-764-0911**

- The use of **extension cords should be used only as a temporary source of power**. These cords must be in good condition and protected from mechanical damage. Extension cords on the floor can also become a trip hazard. Care should be taken to cover them with an appropriate cable protector and make them readily visible. Frayed wires or cords must not be used.
- **Should a circuit breaker trip, the reason it tripped should be investigated** before the power is turned on again. If the equipment is at fault or the circuit is overloaded, a qualified electrician must be called to check out the situation.
- Replace a **blown fuse** with the **exact same type and rating**.
- Be aware that unusually **warm or hot outlets** may be a sign that an unsafe wiring conditions exists. Unplug any cords to these outlets and do not use until a qualified electrician has checked the wiring.
- Ensure that all wires are dry before plugging into circuits.
- If your equipment will be used in a damp or possibly wet environment then the circuit being used should have ground fault protection.

Fire Safety

In case of an emergency:
Call **911** then Campus security **416-764-0911**

<u>In case of a fire</u>:

1) Leave room and close the door behind you
2) Pull the nearest fire alarm
3) Exit the building
4) Call 911 and call security (416-764-0911)

<u>In case of a accident</u>:

1) Administer first aid if you are qualified and feel comfortable to do so.
2) Call 911 and/or call security (416-764-0911).
3) Notify your professor and the lab technician immediately

Personal Protection

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Safety glasses (mandatory)

Safety glasses must be worn when any kind of cutting or grinding is performed, or when going into an area where others are doing the same type of work.

Safety shoes (optional)

Safety boots are optional, except when heavy parts are to be moved or worked on. Open toe shoes must not worn at the work site or in the laboratories.

Gloves (optional)

Gloves should be worn when working on sharp objects. No gloves should be worn when working around moving machinery. Gloves can become entangled in machinery leading to injury.

Personal Protection

In case of an emergency:
Call **911** then Campus security **416-764-0911**

Rubber gloves and apron (optional)

When working with chemicals appropriate gloves, apron, and face shield must be worn according to instructions given in the MSDS.

Mask (optional)

When working a dusty environment a dust mask should be worn.

Hearing protection (optional)

Hearing protection must be worn when working in a noisy environment. Please refer to warning labels on the equipment or consult your professor or lab technician.

Question?