Laboratory Electrical Safety

SAFE SCI: Be Protected!
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I. A Shocking Lab Activity?

What do science laboratory sink faucets, ripple tanks, aquariums and other water sources have in common? All have the risk of providing an electrical shock or even worse – electrocution. This is why all science labs need to have every electrical receptacle protected with ground fault circuit interrupters (GFCI or GFIs). In most cases this is required by legal safety standards and in all cases by better professional safety practices.

II "Grounding" is no fault?

Unfortunately, many school employees including science teachers mistakenly believe the circuit breakers in the electrical panels protect the science lab and building from electrical harm. In reality, they are designed to prevent electrical fires by tripping if too much electricity tries to flow through the circuit's wires. Too much electricity means too much resistance. Too much resistance means too much heat. Too much heat means FIRE!

Although the human body is a poor conductor of electricity, a wet surface and as little as 1/5-Amp can cause serious injury in the right situation. The job of protecting the body of the teacher or student is that of a ground fault circuit interrupter (GFCI or GFI), not the building circuit breakers. The GFCI has the function of constantly comparing current flowing from the "Hot" wire to "Neutral" wire. If the GFCI senses an imbalance of approximately 5 milliAmps in the current flow, the switch is open and the current stops flowing in about 1/40 of a second.

Like all mechanical devices, preventative maintenance is a must. GFCI electrical devices, if not "exercised" on a scheduled basis, may corrode and not "trip" if called on to do their task over time. Preventative maintenance is important in this situation. This can easily be done by simply flipping the breaker several times every month or two. Users of the circuit should be advised, in case computers or other technologies are being operated during the exercising of the breaker.

III. Is Your Lab GFCI Protected?

Occupational Safety and Health Standards for General Industry (OSHA) states the following in 29 CFR part 1910.303(b): "Electrical equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees." (OSHA Electrical Standard - https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9880&p_table=STANDARDS) Application of this electrical standard by OSHA should be the basis of science labs in middle and high schools requiring GFCI protection. Teachers and supervisors involved with renovations or new science laboratory facilities need to ensure that such protection is provided. Existing laboratory facilities should also have such protection for teachers and students. Again, remember this is not only legal safety standard in most cases, but also better professional safety practice.

There are three different locations where the installation of GFCI protective devices can be placed. A standard electrical receptacle can be replaced with a GFCI receptacle. This is the usual location in labs where GFCI receptacles are installed. The second option is to install a GFCI circuit breaker in the service panel. The third option (though temporary) is a "portable" GFCI device, which can be placed between the wall receptacle and the electrical device. It plugs into an existing three prong grounded outlet and converts that receptacle to a ground fault protected receptacle. Remember however that the GFCI will only provide protection downstream from the GFCI to the end of the circuit.

IV. One "Fault" With the Ground Fault System!

This is a true story that happened years ago in one of the author's science labs. A student in a biology lab. plugged in a microscope lamp into a GFCI protected receptacle. The student began actively dancing around and was being shocked according to the horrified science teacher. The teacher was perplexed in that the GFCI had just been tested and proved to be fully operational. Yet, the student was not protected from being shocked.

The flaw in a GFCI system is that it does not protect the individuals from line-to-line contact hazards. This is what happens when a person holds two "hot" wires or a "hot" and a "neutral" wire at the same time. In the case of the student, he was not paying attention and had his fingers on the metal prongs of the plug when pushing it into the wall receptacle. This constituted a line-to-line contact. Students and teachers need to be made aware of this danger in safety training workshops.

V. GFCI Protection – A Requirement!

Is your science lab. GFCI (Ground Fault Circuit Interrupter) protected? If unsure, two things can be done. First, the supervisor of facilities should be contacted and asked to inspect the lab for GFCI protection. Secondly, hardware or electrical stores usually carry GFCI test devices for about $15.00. They are very simple to operate and a whole lab can be tested within a few minutes.

GFCI protection is the law and better professional safety practice as noted previously. It needs to be enforced for the protection of all lab occupants - teachers and students - from being shocked or electrocuted. Be an advocate and work with

administration to bring your lab into code compliance. It is highly recommended that either the teacher, administrator or facility director check with a licensed electrician or local building inspector for applications of the National Electrical Code and OSHA standards in your school facility.

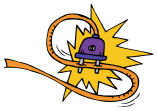
VI. General Safety Guidelines!

The following list are several suggested safety guidelines when working with or near electrical sources:

- Always first inspect portable cord-and-plug connected equipment, extension cords, power bars, etc. for damage or wear before each use. Pull damaged equipment immediately out of service for repairs.
- In order to prevent trip/fall and electrical hazards, always tape extension cords to walls or floors when necessary. Do not use nails and staples because they can damage extension cords and cause fire and shocks. Disconnect live cords at the end of the school day. They can over heat and cause fire during the night!
- Only use extension cords or equipment that is rated for the level of amperage or wattage being used.
- Unusually warm or hot outlets or cords are a sign of potentially unsafe wiring conditions. Unplug any cords or extension cords from these outlets and do not use until a qualified electrician has checked the wiring.
- Use caution with halogen lights. Keep them away from combustible materials such as cloths or curtains. Halogen lamps can become very hot and may be a fire hazard.
- Risk of electric shock is greater in areas that are wet or damp. Install Ground Fault Circuit Interrupters (GFCIs) as they will interrupt the electrical circuit before a current sufficient to cause death or serious injury occurs.

- Use a portable in-line Ground Fault Circuit Interrupter (GFCI) if you are not certain that the receptacle you are plugging your extension cord into is GFCI protected.

- Know the location of the emergency electrical shut-off button, electrical panel and circuit in case of an emergency.
- Never use outlets or cords that have damaged/ exposed wiring.



- Per the National Fire Protection Association—NFPA electrical standard, always have a minimum 6-foot clearance for access to panels and circuit breakers or fuse boxes.
- Do not touch a person or electrical apparatus in the event of an electrical incident. Always disconnect the power source first.

Resource:

Electrical Safety in the Workplace – OSHA Safety Manual -

https://www.osha.gov/sites/default/files/2018-12/fy11_sh-22230-11_ElectricalSafetyManual.pdf

Electrical Safety – Princeton University - https://ehs.princeton.edu/book/export/html/75

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WANTED: ELECTRICITY - GFCI

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