Safe Science-Electrical Safety
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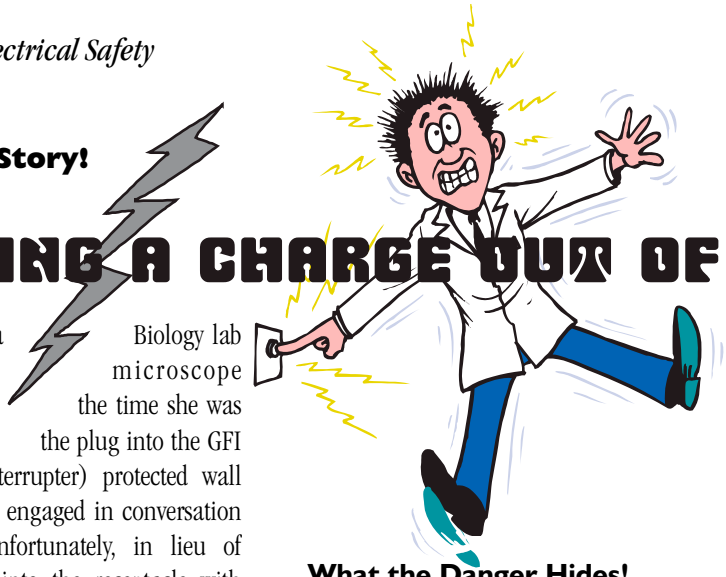

GETTING A CHARGE OUT OF DOING SCIENCE!

A Shocking Story!

A student was in a Biology lab preparing to do microscope work. During the time she was planning to place the plug into the GFI (Ground Fault Interrupter) protected wall receptacle, she was engaged in conversation with a friend. Unfortunately, in lieu of guiding the plug into the receptacle with fingers on the insulated part, she held the two metal prongs and thrust them into the receptacle. Within a picosecond, she was projected across the lab from a shock. Luckily, she only went along for the ride and was not severely damaged. The science teacher was dumbfounded to say the least. He had told students they had the safety electrical system and should not be concerned about getting shocks. How could this happen? And if it could, what other electrical dangers were there in the lab?

Science labs use a variety of electrical devices such as power supplies, hot plates, microscopes, computers, aquaria with lights and heaters, and more. It is critical that they are safe to use, checked often and used appropriately.

Electricity 101!

Electrical hazards in the lab can cause electric shocks and burns. Normally, dry skin forms a layer of insulation with high resistance. Wet the skin or have a cut and the resistance plummets. In that type of situation, dangerous currents can do damage to the body. Normally, voltages over 40 V DC or peak AC warrant protection in the lab. Depending on where the current travels will dictate the degree of harm to the body. For example, finger-to-finger could be minor where as shoulder-to-shoulder could be deadly or fatal. Breathing, heart beat and other critical operations can be directly affected. Bottom-line is, be aware of the potential dangers, assess the potential dangers and take action again potential dangers.

What the Danger Hides!

A lab has hidden electrical dangers, which teachers and students need to be aware of when working on science activities. The following is a partial list of such danger and how to avoid them.

■ Batteries (Dry Cell) – Most middle school science labs use dry cell batteries because they tend to be safe. Unless many of these batteries are linked together, it is not possible to secure an electric shock from the 1.5 volt power source. Do not try to recharge these batteries. Doing so is dangerous, including the potential for explosion.

■ Batteries (Rechargeable) – The plus with rechargeable batteries is the fact that they can be used many times. The negative is that the batteries can get hot if short circuited or charged with an incompatible charger.

■ Batteries (Car/Auto) – Car batteries can be 12 volts or more. They are dangerous for several reasons – high Amperage, hydrogen gas, and more. Such batteries should not be used in the middle school science lab.

■ Power Supplies (Low Voltage) – Low voltage power supplies usually provide a safe voltage up to about 12 volts and cannot drive a current thorough a body to provide a shock. They are cheaper then having to keep replacing batteries if a high frequency of activities is effected.

■ Power Supplies (High Voltage) – High-voltage power supplies can provide significant currents up to 150 mA and voltage between 40 and 500. They are inappropriate for use in middle school labs.

Electrostatic Machines – Wimshurst machines and van de Graaff generators are examples of machines which are found in schools. They can produce electrostatic charges at very high potentials. They can produce hundreds of thousands of volts, but have relatively small amount of charge. These machines can be dangerous and should only be operated by a knowledgeable adult doing demonstrations.

■ Wall Receptacle – Normally labs have GFI protected wall receptacles of around 120 volts. As noted in the initial example of the student getting shocked by a GFI protected wall receptacle, it can be dangerous. No safety device can protect the user against shocks between the line and Neutral. Bottom-line is – never touch metal prongs in a wall receptacle.

Code of Electrical Conduct!

When using electricity, students should be trained on appropriate safety behavior. The following is a simple list to get started:

■ Make students aware of the appropriate use of electricity and dangers of misuse and abuse.

■ When using batteries, always inspect them first for cracks, leaking, etc. Discard if any of these conditions occur.

■ Know where the master switch is for electricity in the laboratory in case of an emergency.

■ Never open a battery. The contents are corrosive and can be toxic or poisonous.

■ When storing batteries, never allow the terminals to touch or short circuit.

■ Be water phobic when working around electricity. Never use water or have wet hands when dealing with cords, plugs, etc. Never run a cord near or over a sink.

■ Utilities pipes such as water and gas are grounded. Do not touch an electrical circuit and utility pipes at the same time.

■ When unplugging cords, never pull them from the wire. Always pull cords from the plug at the socket.

■ Prevent trip/fall hazards by placing wires away from places where people walk.

■ Never plug damaged electrical equipment into a wall receptacle. This includes frayed wires, missing ground pin, bent plugs, etc.

■ Use only ground fault interrupt circuits (GFI) protected circuits!

■ Remove all conductive or metallic jewelry before working with electricity.

■ Never overload circuits. They will over heat and cause power outages or fires.

■ For routine maintenance like changing bulbs, make sure the device is unplugged before initiating the work. Review OSHA Lockout/Tagout standard (29CFR 1910.147 and 1910.333) prior to working on any electrical device.

A Shocking Predicament!

Electrical shocks tend to be quick and localized – e.g. hand, finger, foot. With low currents, the body's nerve reflex kicks in and usually pulls away from the source. With higher currents, releasing the grip is often not possible. Never touch a person being charged. If this happens, you will also get electrocuted. If possible, turn off the breaker, or emergency power shutoff switch. If that is not possible, consider pulling the person away by using an insulated object or nonconductor. If the shock is serious, symptoms such as trouble breathing, pain, numbness, erratic heart beat and more will be present. CPR training may be necessary. Get help immediately.

Fun But Serious!

The study of electricity can be fun for students, especially with all of the applications in their real world. Help make their learning fun in the lab but make sure they understand electricity is serious business – teach them to respect it!

Resources:

OSHA electrical safety site: < http://www.osha.gov/SLTC/electrical/index.html>

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Creatively Speaking:

"Do just once what others say you can't do, and you will never pay attention to their limitations again."

James R. Cook
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