The Earth/space sciences (ESS) have a truly multidisciplinary character. Topics of study include astronomy, atmosphere, biosphere, hydrosphere, geosphere, pedosphere, and others. Scientists and science educators in the Earth/space sciences use tools from other sciences such as physics, chemistry, biology, and more. When it comes to the hands-on education component in school science labs and experiences in the field, there are a number of safety issues which need to be addressed in order to provide for a safer teaching/learning environment. In this way, teachers in the ESS discipline need to be advocates for not only appropriate science laboratory facilities, field studies, general and specific lab equipment and student oriented activities, but also for safety protocols, engineering controls, standard operating procedures and personal protective equipment.

Zoning In On Safety

So what are some of the concerns safety-wise which Earth/space science teachers should be considering? Below is a list which serves as a good place to start to zone in on on safety:

a. **Laboratory Footprint/Occupancy Load**: Like all labs, there needs to be extra space to work on lab experiments and activities for a safer experience. This is necessary because of the need for the use of large tables and work benches in lieu of student desks or other laboratory equipment requiring a special safety work zone such as stream tables and wave tanks. This type of furniture and equipment is similar to the type found in art studios and technology education labs. With larger furniture and lab hazards, the occupancy load level needs to be enforced as noted in legal sources such as the International Code Council or ICC standards. Like other science laboratories, your ESS lab is not your normal math or history classroom. Most fire and building code standards require about 2.5 times the space (net) for each occupant in a science lab compared to a general classroom.

b. **Storage Room/Preparation Room**: Equipment and hazardous chemicals need to have secured storage areas outside of the laboratory. There also needs to be appropriate shelving and storage cabinets, again based on legal fire code and building standards.

c. **Engineering Controls**: Technology and mechanical controls which help to make for a safer work environment in the lab must be addressed. An example is ventilation. In all labs, ventilation is the key to air quality, health and safety. Air from these labs should not be recycled to any other part of the facility. The authority of local jurisdiction for fire codes and building codes should be approached to make sure appropriate ventilation is achieved. Other engineering controls need to be in place like fire extinguishers, fume hoods, master power controls, ground fault interrupter or GFI protected electrical circuits, etc.

d. **PPE**: Personal protective equipment is critical. This equipment includes items like eye protection, chemical resistant aprons, gloves (nitrile and/or vinyl), close toed shoes, etc. In the case of eye protection, depending on the type of activity, either safety glasses and/or indirectly vented chemical safety goggles must be used. The equipment must meet the ANSI Z87.1 standard or similar credible regulations.

e. **Utilities**: The need for potable water sources, sinks, protected electrical receptacles, heating sources (e.g.: bottled gas), etc. are also needed. Sanitation is especially critical in the lab to prevent health issues. There are various professional best standards and legal codes to addresses utilities in a laboratory.

f. **Lab Equipment/Furniture**: ESS activities require the use of equipment such as hand tools and power tools. They also require specialized items like wave tanks, stream tables, aquariums, ultraviolet light sources, telescopes, weather balloons, etc. Each has its own safety hazards and training is absolutely necessary prior
g. **Safety Protocols:** Prior to any laboratory work, a safety acknowledgement form containing both legal safety standards and professional best practice protocols should be reviewed with students and signed by them. This protects both students (safety-wise) and teachers (legal entanglements). Teachers also should have specific safety training in some instances. For example, if equipment is required on the roof of the school and teachers (not students) need access, they should have fall protection training and equipment. Training for use of power tools also is needed prior to having students work with them.

h. **Field Experiences/Sites:** An integral part of ESS activities should involve field experiences. However, teachers need to make sure the sites are safe for these studies. Always visit the sites first to access any safety issues. Special training may be required, in addition to equipment such as climbing equipment, life jackets, etc. Also make sure any legal issues are addressed and that permission is secured for access to private land. Communications such as cell phones need to be available and operational at the site. Always pretest them before venturing out on the site. Medical first aid procedures and equipment must also be addressed.

**In The End**

The Earth/space sciences unfortunately are often treated as the step child in schools when it comes to instructional site, equipment acquisition, and general safety. Also, in many institutions, ESS teachers often get what's left and available after the other sciences are assigned. ESS teachers need to advocate for their discipline. They also need to make sure all safety protocols and equipment are in place BEFORE doing any laboratory activities for both their safety and that of their students.

**References**


**By Dr. Ken Roy – NSELA Safety Officer**

Royk@glastonburyus.org