

Lesson 3: Biotechnology Laboratory Safety

Biotechnology researchers use many types of equipment, chemicals, and specimens in their work; the correct use of all three is vital to the safety of the researchers. Laboratory safety is a very high priority in biotechnology laboratories. The ability to handle chemicals and specimens safely and to use equipment correctly is necessary for employment. A knowledge of emergency procedures for chemical spills and fires is also critical. This lesson highlights some of the most important safety precautions and concerns.

Common Biotechnology Laboratory Safety Concerns

Common biotechnology laboratory safety concerns fall into five major categories: microorganisms, chemicals, radioactivity, electrical hazards, and physical hazards. The use of bacteria and fungi is common in biotechnology laboratories. Some microbes, called pathogenic microbes, are dangerous because they are capable of causing disease. These types of microbes require special containment laboratories and are not used in school laboratories. However, all microorganisms should be handled properly, since even nonpathogenic microorganisms can be harmful in certain cases. Care should be taken to follow aseptic techniques strictly in order to contain microorganisms.

Many types of chemicals are used in biotechnology laboratories, including solvents, enzymes, dyes, and buffers. These chemicals are safe if handled correctly. Care must be taken to avoid contact with the skin. Many chemicals can be absorbed through the skin or spread onto other surfaces by contact. Most of the dyes and buffers are toxic if ingested. Use of these chemicals should be limited if a suitable alternative is available.

Radioactivity is used in biotechnology laboratories for probes or markers that verify the transfer of DNA segments. A special permit is required to use radioactive materials. To obtain a permit, researchers must complete training about the safe handling and disposal of radioactive substances. Radioactive materials are not used in school laboratory settings.

Electrophoresis equipment can be an electrical hazard. This equipment is safe if used properly. However, if safety precautions are not observed, electrical shock can occur. An individual should never touch the gel solution while the machine is on.

Centrifuges and ultraviolet lamps used in biotechnology laboratories are considered physical hazards. A centrifuge should have a lock that prevents the lid from opening while the machine is spinning. This safety feature prevents fingers from being caught in the rotating machine, which can cause serious injuries. With prolonged exposure, ultraviolet radiation from a transilluminator can damage retinas and bare skin.

Cleaning Up Spills

The possibility of a spill exists whenever chemicals are handled. When the spilled chemical is known, clean up procedures for that specific chemical should be used. The proper procedures are outlined on a Material Safety Data Sheet (MSDS). Chemical suppliers develop these sheets and ship them with all chemicals. The sheets must be kept in a specific notebook or file for easy reference. The MSDS provides a variety of information about the chemical, including its toxicity level, first aid measures, required personal protective equipment, and disposal procedures.

When specific clean up procedures are not available or the content of the spill is unknown, special procedures must be followed. A spill pillow (Figure 3.1) is used to absorb any liquid chemical. The used spill pillow should be regarded as hazardous waste and disposed of



Biotechnology: Applications in Agriculture

appropriately. If the spill is a solid or a powder, it can be gently swept into a glass container and disposed of as hazardous waste. The spill area should be cleaned with a disinfectant and an ethanol solution to ensure that any remaining traces of the chemical are removed.

Disposal of Biotechnology Laboratory Waste

Biotechnology laboratories commonly produce waste products classified as hazardous waste, which must be disposed of appropriately. Simply dumping everything down the drain is not acceptable. Some of the waste generated by a biotechnology laboratory can be decontaminated and thrown away with other trash to be placed in a landfill. All cultures and equipment that have come in contact with infectious microbes must be autoclaved or disinfected with hospital-type disinfectants before being thrown away. Examples of chemicals requiring special disposal are organic solvents and highly toxic chemicals. The proper disposal method for a chemical substance is found on the chemical's MSDS. Improper disposal of hazardous waste endangers the environment, and a company may receive large fines if OSHA or the EPA discovers that proper disposal procedures are not being followed.

Emergency Fire Procedures

Biotechnology laboratories, like all laboratories, must be prepared for emergencies. A fire exit plan should be posted in the laboratory. In a research laboratory, just as in a classroom laboratory, the fire exit plan should be followed if a fire breaks out and should be practiced during fire drills. Everyone should know the location of the fire extinguisher, the fire blanket, and the fire alarm switch. If a fire occurs in a classroom lab, students should immediately notify the instructor and begin exiting the room.

Personal Protective Equipment

Personal protective equipment (PPE) can help prevent injury to laboratory workers. All laboratories require workers to wear safety glasses or goggles while in the laboratory. They also require latex or other appropriate types of gloves for most laboratory work. Normally, workers use disposable latex gloves. Lab coats or aprons should be worn to protect clothing. Shorts, short skirts, and sandals are not permitted because they expose too much skin to the laboratory environment.

Injuries in the Laboratory

Anyone working in a laboratory should know what to do if an injury occurs. Simple first aid procedures, like applying pressure to stop blood loss or flushing skin or eyes with water if they come in contact with chemicals, should be done immediately. In a classroom lab, the instructor should also be notified without delay so that he or she can follow the school procedure for emergencies. Students should always read and follow any precautions noted in a laboratory exercise to help avoid injury.

Laboratory Ventilation

Most biotechnology laboratories do not require special ventilation. A fume hood vented to the outside is necessary when using chemicals that produce bad odors or harmful vapors. Because it is enclosed, the fume hood may also be used to prevent contamination by serving as a sterile environment for certain laboratory procedures. Some chemicals may only be stored in a lockable ventilated storage cabinet. Ventilated storage cabinets are designed to prevent the buildup of gases that can cause an explosion or fire.

Summary

To work in a laboratory, biotechnology researchers must be able to handle microorganisms, chemicals, radioactivity, electrical hazards, and physical hazards safely. Researchers must wear personal protective equipment and be aware of laboratory hazards.

Credits

Collins, C. H., ed. *Safety in Biological Laboratories*. New York: John Wiley & Sons, 1985.

Peterson, Dennis R., and Thomas Rehberger. *Biotechnology in Agriculture*. Stillwater, Okla.: Mid-America Vocational Curriculum Consortium, 1992.

National Centre for Biotechnology Education. "Safety Guidelines." <http://134.225.167.114/ncbe/safety> (7 September 1997).