Biotechnology Safety

Introduction

Basic biotechnology lab experiments involving the isolation, digestion, and analysis of DNA are an exciting part of the modern biology curriculum. Today's students—the "CSI generation"—are eager to learn about DNA forensics, DNA sequencing, and other biotechnology applications. This safety note discusses the safety issues associated with basic biotechnology equipment, reagents, and procedures.

General Safety Guidelines

The basic safety rules for working with chemicals in the lab apply to biotechnology experiments as well. Wear chemical splash goggles whenever working with chemicals, heat or glassware in the lab. Avoid contact of all chemicals with eyes and skin and wear chemical-resistant gloves and apron as needed. Do not permit students to eat food, drink beverages, or chew gum in the laboratory at any time. Never pipet any liquids by mouth—use a pipet bulb or filler. Instruct students to notify the instructor immediately in the case of any accident, including skin contact with chemicals, and clean up all spilled chemicals or solutions immediately. Reagents and laboratory solutions should be stored or disposed of as directed by the instructor. Make sure students are familiar with the locations of the fire extinguisher and the emergency eyewash or shower. Finally, remind students to wash their hands with soap and water before leaving the lab.

Biotechnology Reagents and Solutions

Please review Material Safety Data Sheets (MSDS) for safety, handling, and disposal information of all reagents or solutions used in the biotechnology lab. Exercise caution in handling methylene blue and other stains or dyes used for DNA or protein electrophoresis— they will readily stain skin and clothing. Ethidium bromide which is used in research labs to stain DNA is a potent mutagen and should not be used in schools. Ethyl alcohol and isopropyl alcohol used to precipitate DNA are flammable liquids. Keep away from flames and other sources of ignition and do not use Bunsen burners in the lab when working with flammable solvents. Polyacrylamide gels for protein electrophoresis are made from acrylamide, a neurotoxin. Purchase precast polyacrylamide gels only.

Electrophoresis

Treat electrophoresis equipment (chamber and power source) like any other electrical source—very carefully! Do not operate the power source with wet hands or in a wet area. Make sure all connecting wires, terminals, and work surfaces are dry before using the electrophoresis unit. Check that the power supply is off before connecting the leads to the electrophoresis chamber. Do not try to open the lid of the unit while the power is on, and turn off the power supply before disconnecting the leads and removing the cover at the end of the experiment.

Heat Safety

Agarose gels for electrophoresis may be prepared by heating agarose powder and water in a microwave, hot water bath, or on a hot plate until the solid appears to be fully dissolved. Do not boil the water, and be careful to avoid superheating the liquid. The solution may not boil until it is disturbed, whereupon it may spontaneously boil and splatter hot liquid. Heat the mixture in a microwave in short increments of 30–40 seconds, then stir and repeat. Heat the solution at a medium low setting if using a hot plate, and do not allow the solution to boil. Wear chemical splash goggles and heat-protective gloves when pouring hot liquids.

Biohazards and Sterilization

Students should not share equipment for spooling human DNA or when using a human source for polymerase chain reaction (PCR) experiments. Advanced level biotechnology experiments such as transformation studies require the use of microbiological organisms—it is important for students to understand the principles and practice aseptic transfer techniques. Although it is assumed only nonpathogenic bacteria will be used in these experiments, all microbiological samples and materials must be sterilized prior to disposal. Biological culture media are designed to foster the growth of microorganisms and thus may also harbor contaminating microorganisms that may be pathogenic. Autoclaving is the best method for the disposal of microbiological materials. Standard sterilization conditions are 121 °C at 15 psi for 15 minutes.

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A pressure cooker may be used if an autoclave is not available. If neither is available, the materials may be sterilized by submerging cultures in 10% household bleach solution for 24 hours.

Make Safety a Habit

Increasing safety awareness is the most important factor in reducing accidents and improving school safety. Take the time to learn as much as possible about the possible hazards of working with biotechnology reagents or equipment. Carefully read MSDS for all chemicals, as well as the operating instructions for equipment or apparatus. Review the safety rules not just on the first day of lab, but on a regular and consistent basis, and incorporate safety instruction into each lab activity.