Basic Biotech Methods
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Biosafety

Instructors' Guide

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About these materials:

Biosafety is a unit in Madison Area Technical College's introductory Hazardous Materials. These materials, therefore, particularly focus on safety concepts and concerns that are unique to biohazards. The course:

- introduces the tools students will need to work safely in the laboratory.
- helps students develop the mindset to plan and carry out work safely.

The lecture material in course is based on:
Basic Laboratory Methods for Biotechnology (3rd ed.) (Lisa A. Seidman, Cynthia J. Moore, and Jeanette Mowery) ISBN: 9780429282799

The labs come from:
Laboratory Manual for Biotechnology and Laboratory Science: The Basics (Lisa A. Seidman, Mary Ellen Kraus, Diana L. Brandner and Jeanette Mowery) (2nd ed.) ISBN: *9781032419916*

Lectures

LECTURE 1: Introduction to Biohazards: Risk Management

(provided as a PowerPoint document with notes)

Time allotted: 45 – 60 minutes.

Objectives:

- Define “biohazard”
- Explain the characteristics of a pathogen
- Discuss routes of infection
- Understand the risk associated with bioaerosols
- Explore how to assess the level of risk associated with a particular
- biohazard
- Identify ways of obtaining laboratory-acquired infections
- Identify the Standard Microbiological Practices and their purposes
- Discuss the different types of containment that are used with biohazards
- Differentiate between the four Biosafety Levels (BSL-1 through BSL-4)

Comments: This is a reasonably dense lecture and may be best broken up into parts. I focus on the process of risk assessment in an activity presented later. A couple of labs that support this material are also presented later.

LECTURE 2: Hazards of Working with Biological Organisms and Material

(provided as a PowerPoint document with notes)

Time allotted: 45 minutes.

Objectives:

- Identify hazards associated with working with fungi
- Identify hazards associated with working with viruses
- Discuss how to assess the risk level associated with biohazards
- Define “Universal Precautions”
- Differentiate between the risks associated with primary cell cultures and established cell lines
- Illustrate how to choose an appropriate disinfectant or a particular Biohazard
- Differentiate between “sanitization” and “sterilization”
- Review how to handle BSL-1 and BSL-2 spills

Comments: This lecture can also be edited to discuss the most relevant topics. Students seem to particularly enjoy the risk assessment discussion regarding viruses, and this could be a good springboard for class research projects and presentations. Various labs are available to look at how well disinfectants work, but we prefer to instead focus on aseptic technique in this course. If students have good aseptic technique, then they will certainly be more prepared to handle BSL-2 organisms. Most are unlikely to ever touch a BSL-3 or BSL-4 organism anyway (although the students do enjoy learning about them!).

LECTURE 3: Working with rDNA: Safety Considerations

(provided as a PowerPoint document with notes)

Time allotted: 30 - 45 minutes

Objectives:

- Define “recombinant DNA”
- Discuss safety considerations associated with host organisms
- Discuss safety considerations associated with expression of rDNA
- Sequences

Comments: This lecture may be beyond the scope of your course. However, it is appropriate for any molecular biology course. Generally, from a safety standpoint, students do not think about the expression of the product as a consideration, nor do they generally think about vectors. This could be a good lecture to introduce gene therapy and the hazards of viral vectors from a case study standpoint (such as the case of Jessie Gelsinger in the late 1990s).

Labs

LABORATORY EXERCISE: Bioaerosol production in the laboratory

Laboratory Exercise 2: *Production of Bioaerosols and Factors Affecting Bioaerosol Production*

(in Seidman, Kraus, Brandner and Mowery)

Time allotted: 60 - 90 minutes

Objectives:

- Demonstrate how aerosols are produced
- See how aerosols scatter over a flat surface
- Design an experiment that demonstrates aerosol production

Comments: This laboratory can take more or less time as desired. If you have already completed Laboratory Exercise: Tracking the Spread of Chemical Contamination, you may want to move more quickly, and focus on the additional hazards associated with biohazards.

LABORATORY EXERCISE: Hazards associated with gel electrophoresis

Laboratory Exercise 32: Using Agarose Gel Electrophoresis to Perform an Assay ***(in Seidman, Kraus, Brandner and Mowery)***

Time allotted: 2 hours

Objectives:

- Use Safety Data Sheets to investigate chemical hazards associated with
- agarose gel electrophoresis
- Identify the various hazards associated with pouring, running, staining and viewing agarose gels

Comments: This lab can be presented at a more or a less biological level depending upon the needs of the group. If your class does use a non-hazardous DNA stain, you can use it as a “mock” ethidium bromide. It is a challenge for the students to figure out how to avoid spreading the ethidium bromide around. Additionally, this lab presents the hazards of superheated solutions and electricity, which have not yet been addressed. The accompanying worksheet can summarize this laboratory.

LABORATORY EXERCISE: Aseptic technique

Aseptic Technique on an Open Lab Bench ***(in Seidman, Kraus, Brandner and Mowery)***

Time allotted: 60 - 90 minutes

Objectives:

- Perform manipulations aseptically
- Practice proper workspace cleanup

Comments: Aseptic technique is a skill that applies directly to safety. When students see contamination in their samples, it is a very visual realization that they “lost track” of their microbes. Without good aseptic technique, students can easily spread biohazardous agents to places that are harmful to themselves and their coworkers.