UNIT III - BASIC LABORATORY SKILLS

Lesson 3: Biotechnology Laboratory Safety

Competency/Objective: Explain why safety practices should be followed in the laboratory.

Study Questions

1. **What are some of the common biotechnology laboratory safety concerns?**
2. **How is a spill cleaned up?**
3. **What are the methods for disposing of materials used in biotechnology?**
4. **What procedures should be followed in case of fire?**
5. **What personal protective equipment should be worn in the laboratory?**
6. **What should be done if an injury occurs?**
7. **What ventilation is needed in a laboratory?**

References

1. *Biotechnology: Applications in Agriculture (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1998, Unit III.
2. Activity Sheet
    a) AS 3.1: Using a Material Safety Data Sheet (MSDS)

UNIT III - BASIC LABORATORY SKILLS

Lesson 3: Biotechnology Laboratory Safety

TEACHING PROCEDURES

A. Review

Lesson 2 discussed some of the equipment used in biotechnology laboratories as well as aseptic techniques to reduce contamination of laboratory experiments. This lesson will examine the topic of laboratory safety. Laboratory safety is always important, especially in biotechnology laboratories. In the late 1970s and early 1980s, laboratories doing genetic manipulation were contained in a nearly sealed environment because of the fear of releasing pathogens, as well as other unknown risks. Today researchers have a much better understanding of the dangers of such research and take necessary precautions when needed. All laboratory research poses some risks that can be addressed by following a detailed safety plan. Laboratory safety is a top priority in every biotechnology laboratory.

B. Motivation

Before students arrive for class, create a "chemical spill" on a countertop in the laboratory that students will notice as they arrive. The chemical spill can simply be water mixed with a few tablespoons of baking soda and a teaspoon of lemon juice. Do not use an actual laboratory chemical or something that will stain the countertop. When students arrive, explain that the spill must be cleaned up, but the correct process must first be determined. Ask them how they would go about cleaning up the spill. Have students speculate as to what types of spills might occur in a biotechnology laboratory.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask students to list the safety concerns that they would have if they were working in a biotechnology laboratory.

What are some of the common biotechnology laboratory safety concerns?

a) Microorganisms - Pathogenic microbes are dangerous because they can cause disease, and even nonpathogenic microorganisms can be harmful in certain cases.
b) Chemicals
c) Radioactivity - Researchers must be trained to handle and dispose of radioactive materials safely.
d) Electrical hazards - Electrophoresis equipment can cause electrical shock.
e) Physical hazards - Centrifuges can injure fingers, and the ultraviolet light from transilluminators can damage retinas and skin.

2. Ask students to list the types of substances that might be spilled in a biotechnology laboratory (acids, bases, stains, microbe cultures, buffer solutions, etc.). Discuss the clean up procedure and demonstrate the procedure by cleaning up the spill.

How is a spill cleaned up?

a) When the spilled chemical is known, the Material Safety Data Sheet (MSDS) outlines the proper clean up procedures.

b) When the substance is an unknown liquid, it should be absorbed using a special spill pillow; the spill pillow should then be disposed of as hazardous waste.
c) If the spill is an unknown solid or powder, it can be gently swept into a glass container and disposed of as hazardous waste.
d) Next, the spill area should be cleaned with a disinfectant and an ethanol solution.

3. Discuss with students the different types of waste generated in a biotechnology laboratory and how wastes should be discarded.

What are the methods for disposing of materials used in biotechnology?

a) All cultures and equipment that come in contact with microbes should be autoclaved or disinfected with hospital-type disinfectants before being thrown away.
b) The MSDS should be followed for chemicals.

4. Ask students to if they know the classroom fire plan. Discuss the procedures to be followed if a fire breaks out.

What procedures should be followed in case of fire?

a) The fire exit plan should be practiced during fire drills and followed when a fire occurs.
b) Everyone should know the location of the fire extinguisher, fire blanket, and fire alarm switch.

5. Ask students to describe the personal protective equipment (PPE) needed for handling pesticides. Compare this list with the PPE needed for most biotechnology laboratories.

What personal protective equipment should be worn in the laboratory?

a) Safety glasses or goggles
b) Disposable latex gloves
c) Lab coat or apron

6. Ask students if they know what to do for various types of injuries.

What should be done if an injury occurs?

a) 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.
b) In a classroom lab, the instructor should also be notified without delay so that he or she can follow the school procedure for emergencies.

7. Ask students to list some of the airborne hazards found in biotechnology laboratories (gases, fine powders, microbes, etc.).

What ventilation is needed in a laboratory?

a) Fume hoods are used to remove bad odors or harmful vapors from the laboratory and to maintain a sterile environment for certain laboratory procedures.
b) Ventilated lockable chemical storage cabinets prevent the build up of gases that could cause an explosion or a fire.

F. Other Activities

1. Show a video on laboratory safety, such as the video *Beginning Chemistry Laboratory* available from Carolina Biological Supply Company.

2. Use Glo-Germ to show the need for correct manipulation of bacteria and fungi. Glo-Germ is a substance that is visible only under a black light. Place Glo-Germ in a petri dish to represent a culture. Have students perform tasks such as culture transfers, adding nutrients or changing the culture media, or tissue culture procedures. The spread of Glo-Germ to other surfaces represents "contamination" of work areas. If the Glo-Germ is not present on any surfaces, then the students have been successful.

G. Conclusion

Safety in the biotechnology laboratory is critical. Careful, safe working habits help produce successful research results. If chemicals, cultures, or equipment are mishandled, the research is exposed to unnecessary hazards and may fail. Researchers can work safely and effectively if proper precautions are taken in the laboratory.

H. Answers to Activity Sheet

AS 3.1

1. Students may list any five of the following: chemical product and company identification; composition, information on ingredients; hazards identification; first aid measures; fire fighting measures; accidental release measures; handling and storage; exposure controls, personal protection; physical and chemical properties; stability and reactivity; toxicological information; ecological information; disposal considerations; transport information; regulatory information; and other information.

2. In a manner consistent with federal, state, and local regulations

3. Strong oxidizing agents; may form an explosive mixture with fluorine or potassium nitrate

4. It is not listed as a carcinogen.

5. Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

6. Odorless to a slightly acetic-like odor

7. Safety glasses with side shields, gloves, protective clothing to prevent skin exposure, and a NIOSH/MSHA-approved air purifying dust or mist respirator

8. It may cause respiratory and digestive tract irritation. It may also cause eye and skin irritation.

I. Answers to Evaluation

1. b
2. d
3. a

4. The fire exit plan should be practiced during fire drills and followed when a fire occurs. Everyone should know the location of the fire extinguisher, fire blanket, and fire alarm switch.

5. Safety glasses or goggles, disposable latex gloves, and a lab coat or apron

6. Spill pillow

7. Flush the area with water and notify the instructor.

8. d
9. c
10. e
11. b
12. a

 Name _____

Lesson 3: Biotechnology Laboratory Safety Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. What equipment is used in a laboratory for ventilation?

   a. None
   b. Fume hood
   c. Fume cabinet
   d. Open window

2. An MSDS contains important information about:

   a. Radioactive substances.
   b. Specialty laboratory equipment.
   c. Cultures of microorganisms.
   d. Chemical substances.

3. Before microbial cultures are disposed of they should be:

   a. Autoclaved.
   b. Sterilized.
   c. Sealed in an airtight container.
   d. Carefully scrubbed.

Complete the following short answer questions.

4. What procedures should be followed in a laboratory to safeguard against fires?

5. What personal protective equipment (PPE) should be worn in the laboratory?

6. What should be used to clean up an unknown liquid that has spilled?

7. What should be done if acid is spilled on a student's hand in the laboratory?

Match the following hazards with an action in the second column that will help to protect the biotechnology researcher from the hazard.

8.	_____ Physical hazards	a.	Aseptic techniques
9.	_____ Electrical hazards	b.	Following the MSDS
10.	_____ Radioactivity	c.	Careful use of electrophoresis equipment
11.	_____ Chemicals	d.	Careful use of centrifuges and transilluminators
12.	_____ Microorganisms	e.	Special training

Lesson 3: Biotechnology Laboratory Safety Name _____

Using a Material Safety Data Sheet (MSDS)

Objective: Identify important information from an MSDS.

Using the MSDS provided, answer the following questions.

1. What are five of the major sections common to an MSDS sheet?

2. How should the chemical be disposed of, according to the MSDS sheet?

3. With what materials is the chemical incompatible?

4. Is the chemical a known carcinogen?

5. What first aid measures should be taken if the chemical comes in contact with the skin?

6. Does the chemical have an odor?

7. What personal protective equipment should be worn when using the chemical?

8. What are the health effects of this chemical?

ACC# 20860

Fisher Scientific

Print Date: 10/23/97

Material Safety Data Sheet

Sodium acetate, anhydrous

Section 1 - Chemical Product and Company Identification

MSDS Name:
Sodium acetate, anhydrous

Catalog Numbers:
BP333 1, BP333 500, BP333-1, BP333-500, BP3331, BP333500, S207 10, S20710, S210 2, S210 500, S210-2, S210-3, S210-500, S2102, S2103, S210500, S78228, S782291

Synonyms:
Acetic acid,sodium salt, Sodium acetate

Company Identification:
Fisher Scientific - Fairlawn
Fairlawn, NJ 07410

Company Phone Number:
(201) 796-7100

Emergency Phone Number:
(201) 796-7100

CHEMTREC Phone Number, US:
(800) 424-9300

CHEMTREC Phone Number, Europe:
(202) 483-7616

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	Percent	EINECS/ELINCS
127-09-3	Sodium acetate	100	204-823-8

Hazard Symbols:
Risk Phrases:

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: white
Caution! Hygroscopic. May cause respiratory and digestive tract irritation. May cause eye and skin irritation.
Target Organs: None.

Potential Health Effects

Eye:
May cause mild eye irritation.

Skin:
May cause skin irritation.

Ingestion:
May cause irritation of the digestive tract.

Inhalation:
May cause respiratory tract irritation.

Chronic:
Prolonged or repeated skin contact may cause irritation.

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Section 4 - First Aid Measures

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid.

Skin:
Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.

Notes to Physician:
None

Antidote:
None reported

Section 5 - Fire Fighting Measures

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dusts at sufficient concentrations can form explosive mixtures with air. Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products.

Extinguishing Media:
For small fires, use water spray, dry chemical, carbon dioxide or chemical foam.

Autoignition Temperature:
607°C (1,124.60°F)

Flash Point:

NFPA Rating:
Not published.

Explosion Limits:
Lower: Upper:

Section 6 - Accidental Release Measures

General Information:
Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Vacuum or sweep up material and place into a suitable disposal container. Avoid generating dusty conditions.

Section 7 - Handling and Storage

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation.

Storage:
Store in a cool, dry, well-ventilated area away from incompatible substances.

Storage Code:
Gray

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Section 8 - Exposure Controls, Personal Protection

Engineering Controls:
Good general ventilation should be sufficient to control airborne levels.

Exposure Limits

Chemical Name:	ACGIH	NIOSH	OSHA
Sodium acetate	None listed.	None listed.	None listed.

OSHA Vacated PELs

Personal Protective Equipment

Eyes:
Wear safety glasses with side shields.

Skin:
Wear appropriate gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
A NIOSH/MSHA approved air purifying dust or mist respirator.

Section 9 - Physical and Chemical Properties

Physical State:	Solid
Appearance:	white
Odor:	odorless to slight acetic-like odor
pH:	No information available.
Vapor Pressure:	No information available.
Vapor Density:	No information available.
Evaporation Rate:	No information available.
Viscosity:	No information available.
Boiling Point:	@ 760.00mm Hg
Freezing/Melting Point:	324.00°C
Decomposition Temperature:	No information available.
Solubility:	1190 g/l (20 c)
Specific Gravity/Density:	No information available.
Molecular Formula:	C2H3O2Na
Molecular Weight	82.03

Section 10 - Stability and Reactivity

Chemical Stability:
Stable.

Conditions to Avoid:
Incompatible materials.

Incompatibilities with Other Materials
Strong oxidizing agents. Explosive mixtures may be formed with fluorine or potassium nitrite.

Hazardous Decomposition Products
Carbon monoxide, carbon dioxide, toxic fumes of sodium oxide.

Hazardous Polymerization
Has not been reported.

Section 11 - Toxicological Information

RTECS:
CAS# 127-09-3: AJ4300010.

LD50/LC50:
CAS# 127-09-3:
Oral, mouse: LD50 = 6891 mg/kg
Oral, rat: LD50 = 3530 mg/kg.

Carcinogenicity:
CAS# 127-09-3: Not listed as a carcinogen by ACGIH, IARC, NIOSH, NTP, OSHA, or CA Prop 65.

Epidemiology:
No data

Teratogenicity:
No data

Reproductive:
No data

Mutagenicity
No data

Neurotoxicity
No information reported

Section 12 - Ecological Information

Ecotoxicity:
No information reported
Acute aquatic effects: 96-hour LC50 for fathead minnow: GT 100mg/L, 96-hour LC50 for water flea: GT 1000mg/L.
This chemical has a low potential to affect aquatic organisms.

Environmental:
This chemical is readily biodegradable and is not likely to bioconcentrate.

Physical:
None.

Other:
This chemical has a high biological oxygen demand, and it is expected to cause significant oxygen depletion in aquatic systems.

Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

RCRA D-Maximum Concentration of Contaminants
None of the components are on this list.

RCRA D Series - Chronic Toxicity Reference Levels
None of the components are on this list.

RCRA F Series Wastes
None of the components are on this list.

RCRA P Series Wastes
None of the components are on this list.

RCRA U Series Wastes
None of the components are on this list.

RCRA Substances Banned from Land Disposal
None of the components are on this list.

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Section 14 - Transport Information

	US DOT	IATA	IMO	RID/ADR	Canadian TDG
Shipping Name:	No information available.	No information available.	No information available.	No information available.	No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15 - Regulatory Information

US Federal

TSCA
CAS# 127-09-3 is listed on the TSCA Inventory.

Health and Safety Reporting List
None of the components are on this list.

Chemical Test Rules
None of the components are on this list.

TSCA Section 12b
None of the components are on this list.

TSCA Significant New Use Rule (SNUR)
None of the components are on this list.

CERCLA Reportable Quantities (RQ)
None of the components are on this list.

SARA Threshold Planning Quantities (TPQ)
None of the components are on this list.

SARA Hazard Categories
None of the components are on this list.

SARA Section 313
None of the components are on this list.

Clean Air Act - Hazardous Air Pollutants (HAPs)
None of the components are on this list.

Clean Air Act - Class 1 Ozone Depletors
None of the components are on this list.

Clean Air Act - Class 2 Ozone Depletors
None of the components are on this list.

Clean Water Act - Hazardous Substances
None of the components are on this list.

Clean Water Act - Priority Pollutants
None of the components are on this list.

Clean Water Act - Toxic Pollutants
None of the components are on this list.

OSHA - Highly Hazardous
None of the components are on this list.

US State

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State Right to Know

California Prop 65

California No Significant Risk Level
No information available.

European/International Regulations

European Labelling in Accordance with EC Directives:
Hazard Symbols:
Risk Phrases:
Safety Phrases: S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)
No information available.

Canadian DSL/NDSL
CAS# 127-09-3 is listed on Canada's DSL/NDSL List.

Canadian WHMIS Classifications
This product has a WHMIS classification of D2B.

Canada Ingredient Disclosure List
CAS# 127-09-3 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

Section 16 - Other Information

Color information has been reworded.
MSDS Creation Date: December 13, 1994
Revision Date: October 23, 1997