UNIT III: BASIC LABORATORY SKILLS

Lesson 2: Laboratory Equipment and Techniques

Competency/Objective: Demonstrate the proper use of laboratory equipment and techniques.

Study Questions

- 1. What equipment is commonly used in a biotechnology laboratory?
- 2. What are the parts of a microscope, and how are they used?
- 3. What are the procedures for manipulating microscopic specimens?
- 4. What is meant by aseptic techniques?
- 5. Why is it important to follow aseptic techniques?

References

- 1. *Biotechnology: Applications in Agriculture (Student Reference).* University of Missouri-Columbia: Instructional Materials Laboratory, 1998, Unit III.
- 2. Activity Sheet
 - a) AS 2.1: Parts of a Microscope

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TEACHING PROCEDURES

A. Review

Researchers must be familiar with biotechnology laboratory equipment to select the proper experimental methods to use to accept or reject a hypothesis using the scientific method discussed in Lesson 1. This lesson reviews equipment commonly found in a laboratory, the parts and use of the microscope, and aseptic techniques.

B. Motivation

Swab a school drinking fountain or a tabletop with a sterile cotton ball or cotton swab. Place this swab in a petri dish containing autoclaved agar in an incubator or another warm space (such as in a greenhouse out of direct sun, in a 1' \times 1' cardboard box heated by 10 watt bulb, or on a shelf a foot away from a warm radiator). The resulting bacterial growth will appear overnight, displaying the need for aseptic techniques. Use an autoclave or pressure cooker to kill the bacteria before disposal.

- C. Assignment
- D. Supervised Study
- E. Discussion
 - 1. Discuss the various pieces of equipment commonly used in a laboratory. Display any available laboratory equipment. Use pictures in catalogs from lab equipment suppliers (such as Fisher Scientific) to show equipment that is not available.

What equipment is commonly used in a biotechnology laboratory?

- a) Pipettor used to measure and transfer amounts of liquid smaller than one milliliter (ml)
- b) Plastic ware and glassware
 - 1) Pipette tips
 - 2) Test tubes
 - 3) Centrifuge tubes
 - 4) Petri dishes
 - 5) Beakers
 - 6) Flasks
 - 7) Test tubes
- c) Autoclave used to sterilize glassware, plastic ware, etc.
- d) Fume hood vents air to the outside, getting rid of fumes
- e) Incubator used for tissue culture and the propagation of bacteria
- f) Electrophoresis unit uses an electric current to separate DNA fragments by size
- g) Transilluminator used to view an electrophoresis gel
- h) PCR equipment may be hot water baths or a thermocycler; used to cause the replication of DNA
- i) Microcentrifuge separates solids from liquids
- j) Vortex mixes a solid with a liquid in test tubes
- k) Microscope used to enlarge and view microorganisms or specimens not visible to the naked eye
- 2. Display an actual microscope and identify each part. Have students complete AS 2.1.

What are the parts of a microscope, and how are they used?

- a) Ocular or eyepiece initial point for viewing a specimen that contains the first lens system, usually magnifying 10 times
- b) Objective second lens system that magnifies the image and projects it up to the ocular
- c) Nosepiece rotating piece that holds the objectives
- d) Body tube holds the ocular and objective the correct distance apart
- e) Arm curved support connecting the body tube and base
- f) Base stand on which the microscope rests
- g) Stage place where the specimen is placed for observation
- h) Disc diaphragm contains a series of openings of different sizes that control the amount of light shining on the specimen
- i) Light source usually a mirror or electric lamp
- j) Condenser focuses light from the lamp on the specimen
- k) Coarse adjustment Large dial, used first to focus the low-power objective
- I) Fine adjustment Small dial, used to refine the focus or to focus the high power objective
- 3. Ask students who have used a microscope to recall how to view a specimen slide under a microscope. Demonstrate and explain the procedures used when viewing specimens.

What are the procedures for manipulating microscopic specimens?

- a) The specimen must be mounted on a glass slide, with a drop of water added for a wet mount.
- b) A cover slip is usually placed on top of the specimen.
- c) Some specimens may need to be stained.
- d) The slide is placed on the stage and secured by the clips.
- e) The light source is turned on and adjusted.
- f) The low-power objective is selected, and the coarse adjustment is used to focus the image.
- g) If needed, the high-power objective is selected and the fine adjustment is used to focus the image by moving the objective up and away from the stage.
- 4. Ask students why hospital operating rooms are kept sterile. Compare biotechnology techniques such as tissue culture to surgery. Discuss the aseptic techniques used in research in biotechnology.

What is meant by aseptic techniques?

Aseptic techniques are procedures used to create and maintain a working area free of bacteria and other microorganisms that might contaminate delicate experiments.

- a) Controlled air movement The researcher works in an enclosed chamber, which allows the flow of air to be controlled.
- b) Disinfection The work area is disinfected with a 10 percent bleach solution. Then the instruments and work area are sprayed with a 70 percent ethanol solution and allowed to air dry.
- c) Scrubbing up The researcher scrubs his or her hands and arms thoroughly and allows them to air dry. He or she then sprays them with a 70 percent ethanol solution.
- d) Sterilization Researchers use an autoclave to sterilize all materials and instruments. An ultraviolet light kills microorganisms in the work area.
- 5. Ask students why aseptic techniques are important. Remind students about the motivation for this lesson.

Why is it important to follow aseptic techniques?

Experimental procedures like tissue culture and most DNA analysis techniques require proper aseptic techniques to be successful. Contaminants can disrupt many biotechnology experiments.

- F. Other Activities
 - 1. Using a microscope and a prepared slide, have students practice focusing it in the proper manner.
 - 2. Watch a sterile and a non sterile test tube containing fruit for several days to observe bacterial growth.
- G. Conclusion

Many different types of laboratory equipment used in biotechnology have been introduced in this lesson. The microscope has been examined in detail, since it is a common tool used in examining microorganisms. The importance of aseptic techniques has been described as well. These basic laboratory skills are important, and all researchers must master them.

H. Answers to Activity Sheet

AS 2.1

- 1. Ocular or eyepiece
- 2. Body tube
- 3. Nosepiece
- 4. Objective
- 5. Stage
- 6. Disc diaphragm
- 7. Condenser
- 8. Arm
- 9. Fine adjustment
- 10. Coarse adjustment
- 11. Light source
- 12. Base
- I. Answers to Evaluation
 - 1. a
 - 2. c
 - 3. c
 - 4. b
 - 5. d
 - 6. a
 - 7. d
 - 8. Students may list any two of the following: controlled air movement, disinfection, scrubbing up, or sterilization.
 - 9. Experimental procedures like tissue culture and most DNA analysis techniques require proper aseptic techniques to be successful. Contaminants can disrupt many biotechnology experiments.

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Name ______
Date _____

Lesson 2: Laboratory Equipment and Techniques

EVALUATION

Circle the letter that corresponds to the best answer.

- 1. The lens system that is found at the top end of the body tube and normally magnifies 10 times is called the:
 - a. Ocular.
 - b. Objective.
 - c. Disc diaphragm.
 - d. Arm.
- 2. The part of a microscope that controls the amount of light placed on the specimen is called the:
 - a. Ocular.
 - b. Objective.
 - c. Disc diaphragm.
 - d. Coarse adjustment.
- 3. Which of the following should be used to adjust the high-power objective?
 - a. Ocular
 - b. Objective
 - c. Fine adjustment
 - d. Coarse adjustment
- 4. Which of the following is <u>not</u> a common piece of biotechnology equipment?
 - a. Transilluminator
 - b. Electrotransfectionator
 - c. Electrophoresis unit
 - d. PCR equipment
- 5. A microcentrifuge is used in the biotechnology laboratory to:
 - a. Mix substances in a test tube.
 - b. Separate DNA fragments of different sizes.
 - c. Increase the quantity of a DNA sample.
 - d. Separate solids from liquids.
- 6. Pipettors are used to:
 - a. Measure and transfer amounts of liquid smaller than one milliliter.
 - b. Measure and transfer amounts of liquid larger than one milliliter.
 - c. Mix substances in a test tube.
 - d. Maintain a suitable environment for the propagation of bacteria.

- 7. Which of the following is <u>not</u> a procedure for manipulating microscopic specimens?
 - a. The specimen must be placed on a glass slide.
 - b. A light source must be used so that light passes through the specimen.
 - c. The low-power objective and the coarse adjustment are used to obtain the initial focus.
 - d. The microscope should be refocused using the coarse adjustment and the high-power objective.

Complete the following short answer questions.

8. What are two aseptic techniques?

9. Why is it important to use aseptic techniques?

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Parts of a Microscope

Objective: Identify the parts of a microscope.

Label the parts of the microscope in the spaces provided.

