
Activity: A Micro-Sized Testing Device

Activity Instructor Guide

Notes to Instructor

This activity provides the participants an opportunity to explore microtechnology and MEMS (microelectromechanical systems) applications for Clinical Laboratory Testing and to think about the possibilities for bioMEMS in this area. Participants should read the PK before starting this activity in order to get an understanding of what clinical laboratory testing involves and the types of tests performed.

This activity is part of the Clinical Laboratory Techniques and Microtechnology Learning Module:

- Knowledge Probe (Pre-test)
- Clinical Laboratory Techniques and Microtechnology PK
- **A Micro-Sized Testing Device: Activity**
- Clinical Laboratory Techniques and Microtechnology Assessment

Description and Estimated Time to Complete

In this activity you will use Internet sources to find one clinical test that has been modified or is being modified (still in the research or testing phase) using microtechnology. You will compare the bioMEMS (bio-microelectromechanical systems) device to the current testing method. You will present your results in a PowerPoint presentation.

If you have not reviewed the unit Clinical Laboratory Techniques and Microtechnology, you should do so before completing this activity.

Estimated Time to Complete

Allow at least two hours to complete this activity.

Introduction

Clinical laboratories perform several different types of procedures:

- Analyze body fluids, cells and other components like DNA and RNA.
- Look for the presence of pathogenic entities such as bacteria, viruses and other microorganisms.
- Analyze the chemical content of fluids.
- Match blood for transfusions.

Some of the specific tests and analysis include

- Standard blood tests
- Growing cultures
- Analyzing tissue samples
- Analyzing urine samples
- Looking for specific diseases
- Determining blood type
- Looking for specific genes or cells

Some of these tests lend themselves to miniaturization, some do not. Tests that do are those tests that get a large amount of information from a small sample size. Therefore, sample size is an important factor to consider when developing a micro-sized device or bioMEMS for a clinical test.

Activity Objectives and Outcomes

Activity Objectives

- Demonstrate your understanding of how microtechnology can be used to replace certain clinical techniques by analyzing a specific micro-sized device or MEMS and comparing it to its clinical lab counterpart.

Activity Outcomes

Develop a PowerPoint presentation that contrasts and compares a bioMEMS device with its clinical laboratory counterpart.

Documentation

1. A PowerPoint presentation meeting the procedure requirements below.
2. Answers to the Post-Activity Questions

NOTE: Be sure to include ALL sources and references to data and graphics.

Activity: A Micro-Sized Testing Device

Procedure:

1. Using Internet sources, find one clinical test that has been modified or is being modified (still in the research or testing phase) using microtechnology.
2. Analyze the two tests (the micro-device and its clinical lab counterpart)
3. Using Power Point or another presentation software, create a presentation that meets the following criteria.
 - a. The purpose of the test (what does it test, how common is it, any background information about this particular analyte testing)
 - b. How each test is performed (macro vs. micro)
 - i. What is the sample?
 - ii. What is the sample size?
 - iii. Ease of testing.
 - iv. How is the sample prepared?
 - v. Requirements for laboratory facilities (equipment, tools, devices needed)
 - vi. Cost per test
 - c. Advantages and disadvantages for macro vs. micro-sized testing device
4. Be prepared to present your findings.

Post-Activity Questions

1. Why is "sample size" a contributing factor as to whether or not a particular test can be considered for microtechnology? (Provide specific examples supporting your answer)
2. What types of samples are collected for clinical testing?
3. What are three examples of clinical tests?
4. What does normal or reference range mean in the clinical laboratory?
5. Why are clinical laboratories and personnel certified and periodically recertified?
6. Which specific tests of clinical testing do you think lend themselves best to microtechnology applications? Why?

Post-Activity Questions / Answers

1. Why is "sample size" a contributing factor as to whether or not a particular test can be considered for microtechnology? (Provide specific examples supporting your answer)

Answer: Because MEMS or microtechnology devices are micro-sized devices, the sample size needs to be in the micro or nano-scales. Larger sample sizes cannot be analyzed using micro-sized devices.

For example, a normal red blood cell count for an adult is between 4 to 5 million RBC per mm³. This is a large quantity in a small volume. A perfect fit for the miniaturization. On the other hand, identifying defective cells in a sample where there might be only 1 defective cell / 1 million cells would take much larger quantities to find enough defective cells to make a proper diagnosis.

2. What types of samples are collected for clinical testing?

Answer: Blood, urine, spinal fluid, joint fluid, bone marrow, tissue, feces, sputum, oral fluids, semen.

3. What are five examples of clinical tests?

Answer:

Blood tests (RBC, WBC, platelet), cultures for bacteria, urinalysis, immunology, cell examination, DNA / gene testing, a chemical panel including enzyme concentration to screen for liver and heart disease, the time it takes for a patient's blood to coagulate, the concentration of cholesterol, a biomarker for the predisposition to heart disease, and uric acid concentration, a biomarker for gout.

4. What does normal or reference range mean in the clinical laboratory?

Answer: This range is determined by the results expected from 95% of individuals tested by each testing laboratory.

5. Why are clinical laboratories and personnel certified and periodically recertified?

Answer: To ensure quality and consistent results for standardization between laboratories.

6. Which specific tests of clinical testing do you think lend themselves best to microtechnology applications? Why?

Answers will vary.

7. Out of all of the microtechnology clinical laboratory applications that you found, which one did you find to be the most interesting and why?

Answers will vary.

Summary

Clinical laboratories perform a variety of tests ranging from analyzing body fluids to molecular diagnostic testing. The value of microtechnology to clinical lab testing is a decrease in cost due to miniaturization of the tests, and the possibility of point-of-care testing, allowing for the testing of people who do not have access to modern laboratory facilities.

Reference

Unit: Clinical Laboratory Techniques and Microtechnology

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