

Diagnostics BioMEMS Research Activity

Instructor Guide

Notes to Instructor

This activity is a research activity on bioMEMS diagnostic devices. This activity and its related primary knowledge and assessment are part of the *Diagnostics BioMEMS Learning Module*.

The *Diagnostics BioMEMS Learning Module* consists of the following units:

- Diagnostics BioMEMS Overview Primary Knowledge (PK)
- **Diagnostics BioMEMS Research Activity**
- Diagnostics BioMEMS Assessment

Introduction

Medical diagnostic techniques have become increasingly sophisticated over time. Wouldn't it be nice to have a medical device that could identify clues within our bodies to tell us what our ailments might be? If you have ever watched Star Trek, you can imagine what such a device would be like – a handheld optical or x-ray scanner that is used externally to “see” what is happening inside. The possibilities of such devices are becoming closer to reality. There are several other bioMEMS devices that perform "science fiction" like diagnostics awaiting medical approval. However, to diagnose particular diseases or conditions, specific biological markers (e.g. antibodies, proteins, genes) need to be identified. Scientists are still in the process of deciphering the biomarker landscape associated with specific disease states.

There are many reasons why the scientific, health, and defense communities are excited about diagnostic bioMEMS technology. BioMEMS tests are cost effective, easier to administer, and can possibly be used for *in vitro* (external) or *in vivo* (internal) monitoring. *In vitro* and/or *in vivo* monitoring means that people who are susceptible to a heart attack or who have had a heart attack can be monitored 24/7 for both the physical and chemical signs that indicate that an attack is preminent.

The areas of diagnostic medicine that will be most impacted are clinical chemistry, patient examinations and monitoring, and medical imaging. BioMEMS in these areas will have a positive impact, particularly in underdeveloped countries that presently do not have the expensive diagnostic medical technology of developed countries. The versatility and portability of bioMEMS will allow for the presence of medical devices in places where none have gone before.

Objectives and Outcomes

Activity Objectives

- Describe at least one example of a bioMEMS diagnostic device and its use/purpose.
- Using your knowledge of diagnostic bioMEMS, describe a possible future application of a bioMEMS diagnostic device.

Activity Outcomes

Upon completion of this activity, you will have gained an understanding of the importance of diagnostics applications and devices in the field of bioMEMS. You will have researched bioMEMS diagnostics applications and the devices used or imagined for these applications.

Research Documentation

Activity Documentation

- 2-3 page synopsis of your research (be sure to include all resources and references)
- A presentation summarizing your findings.

Minimum criteria for your synopsis and presentation:

1. The history behind the bioMEMS' development, clinical testing and implementation, if applicable.
2. Advantages and disadvantages for your bioMEMS' development and implementation.
3. If it was developed from an existing larger test, how the test was successfully miniaturized.
4. Future trends for this bioMEMS diagnostic test.

As part of this assignment, make sure that all of your Internet sources come from reputable sources. Include the proper citation for each source. To ensure up-to-date information, you should use sources no more than 5 years old.

Activity Procedure:

1. Using the Internet and other resources, research the use of bioMEMS for diagnostic tests.
2. Select one bioMEMS diagnostic test to research in-depth. This device should already be in use, and at least being tested.
3. Describe your bioMEMS testing device using the minimum criteria listed under Documentation.
4. Write your synopsis and create a presentation (using a presentation software) summarizing your findings.
5. Answer the Post-Activity Questions.

Post-Activity Questions

1. Some diagnostic tests are a perfect fit for development into a bioMEMS.
 - a. What criteria make a diagnostic test “a perfect fit”?
 - b. What criteria eliminate a diagnostic test from being developed into a bioMEMS?
2. Using the criteria that you listed in question 1a, briefly describe three diagnostic bioMEMS that might be possible, but are not currently being tested (that you know of).
3. How could you benefit from diagnostic bioMEMS?

Post-Activity Questions / Answers

(Answers will vary for the following questions. Participants should demonstrate their knowledge of diagnostic testing and of MEMS in their answers.)

1. Some diagnostic tests are a perfect fit for development into a bioMEMS.
 - a. What criteria make a diagnostic test “a perfect fit”? *(e.g. necessary diagnostic information can be found in a very small sample (less than a microliter), tools exist that can identify the known antigen (target), the need exists for point-of-care diagnostics, current tests are invasive and can be dangerous to the patient)*
 - b. What criteria eliminate a diagnostic test from being developed into a bioMEMS? *(e.g. large sample sizes are needed to identify that a problem exists (e.g. 1 antigen per ml or greater sample), current test is efficient, effective, non-invasive, and cost-effective)*
2. Using the criteria that you listed in question 1a, briefly describe three diagnostic bioMEMS that might be possible, but are not currently being tested (that you know of). *(answers will vary)*
3. How could you benefit from diagnostic bioMEMS? *(shorter time between diagnosis and treatment, earlier diagnosis due to continuous monitoring, less invasive tests such as colonoscopies and endoscopies, better control over existing disease due to continuous monitoring, self-diagnosis using over the counter devices (e.g. pregnancy tests))*

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