BioMEMS Applications Activity: Nanomachines
Participant Guide

Description and Estimated Time to Complete

This is one of three activities for the BioMEMS Applications Learning Module. You can complete this activity either before or after reviewing the BioMEMS Applications Overview PK.

Some biomolecules are nanomachines. For example, there are proteins and enzymes that perform the same functions of rotary and linear motors, or act as filters by identifying and separating molecules. Many bioMEMS applications could utilize nanomachines that already exist as biomolecules. This activity provides the instructions for accessing an on-line tutorial on nanomachines.

This activity has some post-activity questions that allow you to demonstrate your understanding of the information presented in the tutorial.

Estimated Time to Complete
Allow at least 30 minutes to complete.

Introduction

Imagine a device that restores sight when implanted in the retina of the eye, or a "skin patch" chip capable of detecting an invading microorganism before symptoms develop. These two applications of bioMEMS devices are already being tested for the commercial market.

Applications for bioMEMS devices exist in clinical medicine, environmental, biological and chemical analysis. Applications from one area often overlap with other areas. Applications can be broadly placed into the categories of clinical diagnostics and therapeutics, environmental applications including Homeland Security, food safety, and bioprocessing.

Many of these applications could utilize nanomachines that already exist as biomolecules. Such nanomachines include biomolecular rotary motors (e.g. ATP synthase enzyme in the cell membrane) and biomolecular linear motors (e.g. myosin proteins that assist with muscle contraction). Designing bioMEMS can be just a matter of knowing how these biomolecules work and exploiting their mechanical characteristics.

Activity Objectives and Outcomes

Activity Objectives

- Interact with nanomachines using Molecular Workbench
- Explain the forces that allow nanomachines to work
- Demonstrate your understanding of these forces by designing and building a nanomachine

Activity Outcomes

Upon completion of the Molecular Workbench activity "Nanomachines", you will have observed and interacted with nanomachines, including biological nanomachines. You will use the information gained from these interactions to design and build your own nanomachine.

This activity relates to the BioMEMS applications described in the *BioMEMS Applications Overview* Primary Knowledge unit.

Resources

Computer with high-speed Internet access.

Documentation

Your documentation should include all of the questions asked during each stage of this activity and your answer to each of these questions.

Documentation should also include the Post-Activity Questions and your answers.

Activity: Playing with Nanomachines

This activity will help you better understand how nano-sized devices are used to move and manipulate molecules and atoms. You will utilize the tutorial at The Molecular Workbench.

1. Go to The Molecular Workbench at http://workbench.concord.org/database
2. In the upper right hand corner, "Jump to Activity" #276. Select "Student". This should take you to an interactive called Nanomachines. (*NOTE: If you have a problem with the link, do a search within Molecular Workbench for Nanomachines.)*
3. "Go to Activity" (It may take a few minutes to download.)
4. Complete the activity by selecting all links on all pages.
   Some links are games. Some links are demonstrations.
5. During this activity, record all questions and your answers to these questions.
6. Answer the Post-Activity questions.

Post-Activity Questions

a. What is a monolayer?

b. How can Coulomb forces be used in the self-assembly of a monolayer?

c. What are Van der Waals forces?

d. Nanomachine –
- What did you make?
- What did it do?
- What might be a possible application for your nanomachine?

Summary

BioMEMS exploit the characteristics of biological molecules to perform tasks that improve diagnostics and therapeutic applications within the medical field. As engineers and designers of bioMEMS understand more about the workings of nanodevices and nanomachines, everyone will benefit through improved and more efficient healthcare.

References

[1] The Molecular Workbench at http://mw.concord.org/ (Program funded by the National Science Foundation)

[2] SCME's BioMEMS Applications Overview Primary Knowledge unit

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