

**Southwest Center for Microsystems Education (SCME)
University of New Mexico**

Biomolecular Applications for bioMEMS Learning Module

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This learning module is an overview of biomolecules, what are they, types of biomolecules, and how microtechnology is using biomolecules or exploiting their functions for micro and nano-sized transducers, sensors and actuators. Activities provide the opportunity to better understand the function of biomolecules, their scale and why they are so important for micro and nanotechnologies.

Target audiences: High School, Community College, University

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Website: www.scme-nm.org

Biomolecular Applications for bioMEMS – Knowledge Probe (KP) Participant Guide

Knowledge Probe Description

This learning module is an overview of biomolecules, what are they, types of biomolecules, and how microtechnology is using biomolecules or exploiting their functions for micro and nano-sized transducers, sensors and actuators. Activities provide the opportunity to better understand the function of biomolecules, their scale and why they are so important for micro and nanotechnologies.

The purpose of this knowledge probe is to help you to determine what you already know about biomolecules, their functions and their applications within microtechnologies. There is a matching problem and ten questions. Answer to the best of your knowledge.

Matching (with answers)

Indicate the BEST type of biomolecules to perform each of the bioMEMS functions listed below.

		BioMEMS Function		Type of biomolecule
	1	Recognizing the presence of a pathogen by a unique pathogen DNA sequence	A	Proteins
	2	Filtering large macromolecules from smaller molecules in a complex solution	B	Nucleic acids
	3	Forming a container for a water-soluble drug	C	Lipids
	4	Sensing the presence of an environmental pollutant		
	5	Moving a particle across the surface of a bioMEMS device		
	6	Detection of changes in blood sugar levels in diabetic patients		
	7	Detection of a disease state by changes in expression levels of key genes		
	8	Catalyzing a specific chemical reaction		

Table 1: BioMEMS Functions vs. Biomolecule

1. **Which of the following has the smallest size?**
 - a. distance across a lipid bilayer
 - b. diameter of a microtubule
 - c. diameter of a DNA double helix
 - d. diameter across a liposome vesicle
 - e. diameter of a bacterial flagellum

2. **Which of the following has the largest size?**
 - a. distance across a lipid bilayer
 - b. diameter of a microtubule
 - c. diameter of a DNA double helix
 - d. diameter across a liposome vesicle
 - e. diameter of a bacterial flagellum

3. **Which type of protein has the largest channel diameter?**
 - a. Bacterial membrane porins
 - b. Bacterial S-layer proteins
 - c. Microtubules
 - d. Tobacco Mosaic virus

4. **Which of the following best explains the reason that biomolecules have such specific recognition properties?**
 - a. Nonpolar and hydrophobic interactions
 - b. Polar and hydrophilic interactions
 - c. Both nonpolar/hydrophobic and polar/hydrophilic interactions
 - d. A specific covalent bond in a lock and key type of position

5. **Which of the following properties of biological molecules is NOT an advantage in bioMEMS applications?**
 - a. Ability to self-assemble, based on inherent chemical and surface interactions
 - b. Ability to self-renew, providing a self-assembling and self-perpetuating property
 - c. Precision in the structures that they form
 - d. Their highly discriminating recognition properties
 - e. Nanoscale size of their structures

6. **Which of the following proteins would be best suited for moving particles to different positions on a bioMEMS surface?**
 - a. Kinesin and microtubules
 - b. Kinesin and actin microfilaments
 - c. Flagellin motor proteins and flagellin proteins
 - d. Myosin and flagellin proteins
 - e. ATP synthase and flagellin proteins

7. **Which of the following requires a lipid membrane in order to function?**
- A glucose oxidase enzyme that binds to glucose molecules and oxidize them
 - A DNA microarray
 - A protein microarray
 - ATP synthase
 - Microtubules
8. **Which of the following could be used for transfer of small molecules into or out of lipid vesicles?**
- Bacterial porin and transmembrane channel proteins
 - Bacterial porin proteins only
 - Transmembrane channel proteins only
 - Transmembrane receptor and cell surface receptor proteins
 - Cell surface receptors only
9. **Which of the following would be best suited for a protein microarray?**
- Single-stranded DNA molecules
 - Cell surface receptors
 - Antibodies
 - Bacterial S-layer proteins
10. **Which of the following stimuli could be used to provide power for synthesis of ATP by the enzyme ATP synthase?**
- Binding of a specific activator in the enzyme active site
 - A sudden shift in pH
 - Addition of a proton-carrier protein
 - Coupling this enzyme with another enzyme that makes ADP available

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