**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](http://www.scme-nm.org)

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**Biomolecular Applications for bioMEMS – Knowledge Probe (KP)**

**Participant Guide**

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|  | **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 |

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|  | **Which of the following has the smallest size?** |
|  | 1. distance across a lipid bilayer 2. diameter of a microtubule 3. diameter of a DNA double helix 4. diameter across a liposome vesicle 5. diameter of a bacterial flagellum |
|  | **Which of the following has the largest size?** |
|  | 1. distance across a lipid bilayer 2. diameter of a microtubule 3. diameter of a DNA double helix 4. diameter across a liposome vesicle 5. diameter of a bacterial flagellum |
|  | **Which type of protein has the largest channel diameter?** |
|  | 1. Bacterial membrane porins 2. Bacterial S-layer proteins 3. Microtubules 4. Tobacco Mosaic virus |
|  | **Which of the following best explains the reason that biomolecules have such specific recognition properties?** |
|  | 1. Nonpolar and hydrophobic interactions 2. Polar and hydrophilic interactions 3. Both nonpolar/hydrophobic and polar/hydrophilic interactions 4. A specific covalent bond in a lock and key type of position |

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|  | **Which of the following properties of biological molecules is NOT an advantage in bioMEMS applications?** |
|  | 1. Ability to self-assemble, based on inherent chemical and surface interactions 2. Ability to self-renew, providing a self-assembling and self-perpetuating property 3. Precision in the structures that they form 4. Their highly discriminating recognition properties 5. Nanoscale size of their structures |
|  | **Which of the following proteins would be best suited for moving particles to different positions on a bioMEMS surface?** |
|  | 1. Kinesin and microtubules 2. Kinesin and actin microfilaments 3. Flagellin motor proteins and flagellin proteins 4. Myosin and flagellin proteins 5. ATP synthase and flagellin proteins |
|  | **Which of the following requires a lipid membrane in order to function?** |
|  | 1. A glucose oxidase enzyme that binds to glucose molecules and oxidize them 2. A DNA microarray 3. A protein microarray 4. ATP synthase 5. Microtubules |
|  | **Which of the following could be used for transfer of small molecules into or out of lipid vesicles?** |
|  | 1. Bacterial porin and transmembrane channel proteins 2. Bacterial porin proteins only 3. Transmembrane channel proteins only 4. Transmembrane receptor and cell surface receptor proteins 5. Cell surface receptors only |

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|  | **Which of the following would be best suited for a protein microarray?** |
|  | 1. Single-stranded DNA molecules 2. Cell surface receptors 3. Antibodies 4. Bacterial S-layer proteins |
|  | **Which of the following stimuli could be used to provide power for synthesis of ATP by the enzyme ATP synthase?** |
|  | 1. Binding of a specific activator in the enzyme active site 2. A sudden shift in pH 3. Addition of a proton-carrier protein 4. Coupling this enzyme with another enzyme that makes ADP available |

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