

# Biomolecular Functions Activity

## Instructor Guide

### Notes to Instructor

This activity unit provides the participants with the opportunity to explore the function of biomolecules and the parallels to equivalent macroscopic components. This activity can be completed prior to, within, or after the primary knowledge unit for Biomolecular Applications for bioMEMS. The instructor may choose the order in which to use each of these units. One or more of the activities could be used as an inquiry activity prior to the primary knowledge unit.

This activity is part of *Mapping Biological Concepts* which contain the following learning modules:

- DNA Overview
- DNA to Protein Overview
- Cells – The Building Blocks of Life
- Biomolecular Applications in bioMEMS

This unit is one of four activities in the *Biomolecular Applications for bioMEMS Learning Module*:

- Biomolecular Applications for bioMEMS Primary Knowledge
- **Biomolecular Functions - Activity**
- The Scale of Biomolecules – Activities
- Biological Motors – Activity
- Biomolecular Applications for bioMEMS Assessment

### Description and Estimated Time to Complete

This activity is one of three activities for the Biomolecular Application for bioMEMS Learning Module. This activity provides you with the opportunity to think about the functions of biomolecules by comparing them to macroscopic equivalent components. It would be helpful to review the Biomolecular Applications for bioMEMS PK prior to starting this activity.

#### Estimated Time to Complete

Allow at least 30 minutes to complete

## **Introduction**

The three types of biomolecules that can be used in bioMEMS biological interfaces include the following:

- Nucleic acids, such as DNA. These are the molecules that cells use to carry genetic information.
- Proteins, such as enzymes, fibers, molecular motors, channels and pores, vesicles. These molecules are often referred to as the "work horses" of the cell because they perform so many of the jobs of cellular metabolism.
- Lipids, such as phospholipid vesicles and membranes. These are relatively small molecules that self-assemble into very thin membranes in order to make separate compartments in the cell. They also provide a membrane barrier on the outside of all cells.

## **Activity Objectives and Outcomes**

### Activity Objectives

- Demonstrate your understanding of biomolecule functions by comparing their functions to equivalent macroscopic components.

### Activity Outcomes

In this activity you will make the connection between familiar functions and those of biomolecules. The keywords and referenced glossaries in the primary knowledge unit may be useful in completing this activity.

### Activity: Biomolecules' Functions

In the following table, list a function(s) performed by each of the biological molecules and an equivalent macroscopic component.

| Macroscopic components | Function | Molecular example(s)   |
|------------------------|----------|--|
| struts, beams, casings |          | actin microfilament structures                                     |
| cables                 |          | collagen   |
| fasteners, glue        |          | intermolecular forces  |
| solenoids, actuators   |          | conformation-changing proteins, actin/myosin, kinesin/microtubules |
| boat motors            |          | flagellar motor  |
| drive shafts           |          | bacterial flagella   |
| containers             |          | vesicles   |
| pipes                  |          | various tubular structures   |
| pumps                  |          | flagella, transmembrane proteins                                   |
| highways               |          | microtubules   |
| automobiles            |          | kinesin  |
| Clamps                 |          | enzymatic binding sites, cell surface receptors                    |
| Electric generators    |          | ATP synthase   |

**Table 1: Biomolecules and their Functions**

### Activity: Biomolecules' Functions (Answers)

In the following table, list a function(s) performed by each of the biological molecules and its equivalent macroscopic component.

| Macroscopic components | Function                                    | Molecular example(s)   |
|------------------------|---|--|
| struts, beams, casings | <i>Transmit force, hold positions</i>       | actin microfilament structures                                     |
| cables                 | <i>Transmit tension</i>                     | collagen   |
| fasteners, glue        | <i>Connect parts</i>                        | intermolecular forces  |
| solenoids, actuators   | <i>Move things</i>                          | conformation-changing proteins, actin/myosin, kinesin/microtubules |
| boat motors            | <i>Turn shafts</i>                          | flagellar motor  |
| drive shafts           | <i>Transmit torque</i>                      | bacterial flagella   |
| containers             | <i>Hold fluids</i>                          | vesicles   |
| pipes                  | <i>Carry fluids</i>                         | various tubular structures   |
| pumps                  | <i>Move fluids</i>                          | flagella, transmembrane proteins                                   |
| highways               | <i>Tracts for transporting materials</i>    | microtubules   |
| automobiles            | <i>Transporting cargo</i>                   | kinesin  |
| Clamps                 | <i>Hold work pieces together</i>            | enzymatic binding sites, cell surface receptors                    |
| Electric generators    | <i>Transform energy into a useable form</i> | ATP synthase   |

**Table 2: Biomolecules and their Functions**

## Summary

Biomolecules provide functional specificity useful for biosensing, chemical conversions, and separations in bioMEMS design. Most of these functions such as transducing and moving fluids are the same functions as macroscopic components.

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