**BIEN 235 2018W ASSIGNMENT 2**

Due by 10:00 am on Thursday 3/28/2019 (maximum of 60 Points)

***Answering questions***. You can find answers in one or more sources: our textbook, PPT slides, and your lesson and lab notes and observations. Note, short answers are preferred.

***Assignments are evaluated as individual work***. If you work in a group, use your own words and calculations for your homework assignment. Doing this will help you to understand better and to retain what you have learned.

**Cells, proteins and biocompatibility.** Review your class notes and PPT slides and read Chapter 16 (pages 529 – 543 and 546 – 551).

1. (a) Draw or describe the hydrophobic and hydrophilic parts of the molecule that form the plasma membrane of cells. (b) How do the hydrophobic and hydrophilic parts align in the membrane?

Much of the plasma membrane is made up of a lipid bilayer, which is a wall of lipids that consist of a hydrophobic tail and a hydrophilic head.

The hydrophobic tail makes up the inside of the membrane, while the hydrophilic head makes up the outer wall on both sides.

2. Calcium ions are crucial for intracellular signaling; yet too much calcium is cytotoxic. The body maintains an extremely high extracellular to intracellular concentration gradient of these ions (it is 10,000:1). Ions will diffuse readily in aqueous solutions (containing water) because they are electronically charged. Why do calcium ions (Ca2+) not diffuse across the outer cell bilayer into a cell even though the concentration is many orders of magnitude higher outside of the cell?

The plasma membrane can selectively control the flow of certain particles, like Calcium ions, to ensure a healthy cell state.

3. Passive diffusion relies on solutes passing freely through the cell’s outer membrane “down a concentration gradient” (from higher concentration to lower concentration). (a) What is the name of the other transport mechanism that relies on a concentration gradient? (b) What is embedded in the outer cell membrane that permits these molecules to pass through the cell’s outer lipid bilayer?

Facilitated diffusion

Micro-scale channel proteins

4. (a) What is the name of the mechanism that transports ions across a cell’s outer membrane against its concentration gradient (from low to high concentration)? (b) How do these ions get across the cell’s membrane?

Active Transport

ATP is expended as a source of energy to move ions against entropy.

5. Cell death: (a) What is natural (gene-programmed) cell death called? (b) What is unnatural (and/or premature) cell death? (c) What are two conditions that can cause necrosis?

Apoptosis

Necrosis

Disease or physical trauma to the cell

6. (a) When a less specialized cell can produce more than one cell type, is known as a stem cell. (Fill in the blanks.) (b) When a less specialized cell becomes more specialized, it is called cellular differentiation.

7. (a) Pick ***one*** of the following conditions: heart attack, emphysema, large bone defects, cirrhosis, full skin burn, or articular cartilage damage. (b) What is a *potential* source of adult stem cells to treat that condition?

Bone defects can be treated with stem cells found in bone marrow.

**Class activities and lab notes.** Use a few words or 1-2 sentences to answer the questions below. I posted the safety PPT, “20181206 BMEB Safety Rules,” on Moodle. Use this PPT, your class notes, and your observations from the lab tour to answer the following questions.

8. (a) If there is a fire in our building and you are the *first person* to leave the building, what should you do on your way out of the building? (b) What should *everyone* do after you exit the building?

Locate a safe way to exit the building.

Everyone should go to spirit park and wait for further instructions.

9. In the event of a fire or a major, toxic chemical spill, call the campus emergency number (police). What is the telephone number?

3182574018

10. What is the (a) name of the device that protects users from airborne, toxic chemicals (or simply smelly, offensive odors away from users)? (b) What is the name of the device used to handle cells and tissues for experiments? (c) Describe difference between the airflow of these two devices with respect to the air in the room.

Fume hood

Tissue Culture Cabinet

The fume hood vents air outside to keep internal air clean, while the tissue cabinet recycles air.

**Polymers** (Use your class and lab notes, this week’s PowerPoints and Chapter 8 from our text to answer questions.)

1. Hydrogel: (a) What ion was used to crosslink the polyvinyl alcohol (PVA) chains? (b) What type of bond is formed between the crosslinker and the PVA? (c) What do the spaces created by crosslinking allow the polymer chains to do? (Hint: Think about the term “hydro.” I mentioned this just before we broke into groups for the lab.)

Borate

Ionic

Hold water

1. Hydrogel: Why does a slow gentle pull result in a large change in shape of the hydrogel, but a quick pull breaks the gel in half? Answer in terms of the chains in the hydrogel.

The PVA chains are subject to constant breakage and reformation due to the presence of Borate. When the hydrogel is slowly stretched, new breaks in the chain can reform such that the whole of the hydrogel maintains a single contiguous structure. When the hydrogel is pulled quickly, these breaks are not allowed to reform, and a tear occurs.

1. PDMS: The PDMS base solution was much more viscous than the curing solution (activator). (a) Each solution contains polymer chains, so what is the difference in the chains that makes the base more viscous? (b) What do you think happens to the chains in the base that makes it more difficult to pour? (c) If you were to use PDMS in a biomedical device that undergoes long-term cyclic stress, why would it be important to prevent tiny bubbles from forming as the base and activator are mixed?

The chains are longer.

The chains get tangled around each other which makes them harder to move independently.

Tiny bubbles could get trapped among the polymer chains, which would be very difficult to remove completely.

1. PMMA: The powder and liquid that were mixed to make PMMA were from a bone cement kit for orthopedic implants. The powder is polymethylmethacrylate (very short chains of methylmethacrylate). A liquid activator was mixed into the powder; it joined the very short chains into long ones. (a) Based on what you saw in the cup (or did not see), what type of polymerization forms the long chains? (Types of reactions are on slides 24-25 of the polymer PPT.) (b) What is the other type of polymerization? (c) Why do you think it was not this one? (d) What was the temperature (compared to room temperature) after the PMMA began to solidify? (e) It the reaction exothermic or endothermic.

Addition polymerization

Condensation polymerization

Condensation polymerization would imply the release of some condensate

The temperature dropped

endothermic

1. PMMA: This polymer solidifies into a dense, rigid polymer without crosslinks or covalent networks. How can long, floppy chains form such a rigid solid?

As the long chains are formed, it is easy for them to get tightly knotted among each other due to the indiscriminate nature of the reaction. The result of this tangling is that the chains will move together.

1. What are the three types of tacticity? Briefly describe how the side chains are arranged. (Ch 8 or PPT slides)

* Isotactic: side chain direction is constant
* Syndiotactic: side chain direction oscillates
* Atactic: side chain direction is random