BIOLOGICAL FRAMEWORKS FOR ENGINEERS

Laboratory Experience #2 <Write-up> (due 10/26/12)

Write up a 2 - 3 page memo report on the lab-on-chip blood typing laboratory exercise. Memo reports can vary in format style, but your main objective is to communicate in a <u>clear</u>, <u>concise</u>, and <u>comprehensive</u> manner.

I.   Abstract: state the goal of the lab and the general outcome.

II.   Introduction:
        a. Discuss blood typing, the immune response, and genetic heredity.
        b. Describe the advantages of lab-on-chip devices.

III.   Experiment procedure: diagram each major step of the procedure. Start with universal precautions and end with viewing the blood typing results from the *ABO card*. You can either draw this as a flow chart with labels or write it out descriptively.

IV.   Results:
        a. Describe the nature of the results obtained from the ABO card
        b. List the blood types of the tested individuals in a table.

V.   Analysis and Discussion
        a. Blood donors: An adverse reaction can occur during a transfusion reaction of the wrong blood type. Diagram who can give blood to whom based upon the blood type results.
        b. Paternity/maternity testing: Each person genetically inherits their blood type from the genetic make-up of their parents. The allele for 'Type A' and 'Type B' are equally dominant and the gene for 'Type O' is recessive. For the Rh system, the dominant allele is 'positive' and the recessive allele is 'negative'. For **one** individual tested, list the possible pairs of blood types that their mother/father could have. For example, an individual with "Type AB-" could have parents with the following blood types: AB-/AB-, AB-/AB+, AB+/AB+, A-/B-, A+/B-, A-/B+, or A+/B+.

        c. Microfluidics: Reynolds number (Re) is the ratio of inertial forces to viscous forces and is given by:

$$\mathrm{Re} = \frac{\rho U h}{\eta}$$

where ρ is the fluid density, U is the average fluid velocity, η is the fluid viscosity, and h is the height of the microchannel. When Re is small, viscous forces are dominant and the fluid moves smoothly in layers (laminar) with no mixing of molecules between layers. At Re > 2000, the fluid does not flow in layers but chaotically mixes (turbulent). Determine the Reynolds number for the flow of blood in the microchannels of the *ABO card*. Dimensions are approximately 100 μm in height and 1.2 mm in width. The flow rate generated by the vacuum of the finger-pump is approximately 0.14 mL / min. Assume that blood at room temperature has a viscosity of 3 x 10^{-3} Pa*s and density of 1125 kg/m^3. Also, discuss the importance of the serpentine microchannels that are upstream of the viewing window.

VI.   Recommendations: provide a wrap-up of the lab experience and suggest improvements for the *ABO card*.