CBEE 101 Fall 2016 Microfluidic Membrane (LFT) and Pregnancy Test Kit Lab

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Lateral Flow Test (LFT)

Materials:

- Whatman #2 filter paper (9cm diameter with 8 μm pores)
- 4 wide (approx. 8 mm x 8cm) Whatman paper test strips
- 4 thin (approx. 4 mm x 8cm) Whatman paper test strips
- Vis-à-vis water soluble black pen (share)
- DI water, weigh boats, ruler, pencil, stopwatch

Experiment #1 Paper Chromatography – Separation of Colors in Black Ink

1) Take one *wide* and one *thin* Whatman paper test strip and make a black line with Vis-à-Vis pen approximate 0.5 cm from the bottom on each.
2) Place the test strip in DIW up to a point BELOW your black line. Begin timer.
3) Make observations on separation of colors, time for the separation, etc. Sketch the result. Take a picture if you feel it is necessary.
4) Repeat for accuracy.

Experiment #2 Lateral Flow Test (LFT)

In the first section of the lab you will be investigating
(i) the transport of fluid through different constant width strips of porous material
(ii) how the speed of the fluid front changes as a function of distance into the paper.

1) Use ruler and pencil to mark Whatman paper strips (thin and wide) every 0.5cm for 4 cm.
2) Take a weigh boat and fill it with water. Work as a team to make and record the following measurements. Have one of your teammates take the thin (or wide) strip and quickly, but ***carefully*** dip 0.5cm of the strip into the water filled weigh boat, while the other teammate starts the stopwatch. Figure 1 shows a picture of the setup.
3) Record the time on the data sheet as the fluid passes each 0.5cm up to 4 cm.
4) Repeat for both thin and wide strips.

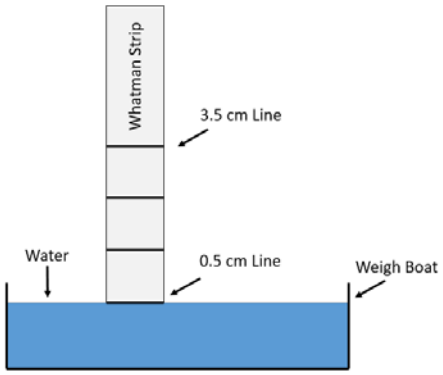

Figure 1. Strip of Whatman paper with marks every centimeter for 0.5 cm. The strip is held 0.5 cm deep into a weigh boat filled with water.

Questions

1) How does the width of the strip affect the time it takes water to flow through the strip?
2) How does the distance the water has flowed through the strip affect capillary flow time?
3) Test the ***Lucas-Washburn*** flow using the data you collected and recorded for *thin and wide strips*.

Are your results consistent with the Washburn flow equation?

Experiment #3 Pregnancy Test Kit Analysis and Reverse Engineering

Materials:

- 1 Pregnancy Test Kit
- Urine sample (male or female, pregnant or not…you'll never know!)

In this section of this lab, you will be looking at how a **pregnancy test kit is engineered** and the purpose of each of the pieces within the test. Remember, this must be as foolproof as possible!

Pregnancy Test (HCG test)

NOTE: The test looks for the analyte HCG. https://en.wikipedia.org/wiki/Human_chorionic_gonadotropin

1) Open the box containing the pregnancy test kit and READ the directions! VIP now and in your future!
2) Each team member should record the important steps, including volume of fluid needed, time, what you should expect to see and how to interpret the results. Sketch figures as needed for reference later.
Remember that these results are being observed by average people, not engineers.
3) Using the urine sample provided, **follow the directions exactly.**
4) Watch carefully and record your results, including time.
5) What are your conclusions? Pregnant or Not?

Reverse Engineering Pregnancy Test Kit

Once test is complete, open (take-apart) the pregnancy test and ***draw a clearly labeled schematic of all the parts you see, including dimensions***. Hypothesize what each component found within the test is used for. Remember, no company would put superfluous parts into a test (more parts = more money), therefore all components will have a significant role. Also remember that fluid only passes through the porous media; therefore, think about why plastic cover tape is present within the pregnancy test design.
Refer to the Figure below for the names of the parts within the pregnancy test kit.

Questions

1) What is the reason for having two lines (test and control), and specifically a line that is supposed to appear regardless of whether the person is pregnant or not (control line)?
2) Where should the control and test lines be placed and why?
3) What do you think is immobilized at the control line? Consider what molecular species should be captured at the control line.

Microfluidic Lateral Flow Test Schematic

(Left) Diagram of a labeled captured analyte. The analyte is bound to the gold nanoparticle conjugated antibody and is captured by the immobilized antibody at the test line.
(Right) Schematic of common immunoassay lateral flow test process. Analyte from the sample rehydrates and binds to gold nanoparticle conjugated antibodies. This compound flows down the device to be captured by the immobilized antibodies at the test line. The collected gold nanoparticles can be visually detected.

NOTE: The test looks for the analyte HCG. https://en.wikipedia.org/wiki/Human_chorionic_gonadotropin