APP N09-1
Nano Brainstorming Stage 2
Engr 1282.02 SP 20

Team Y4

MEP 12:40

Questions:

What disease do you want your device to be able to diagnose? What is the "need" in this area that your device hopes to address? We would like our device to diagnose HIV presence in blood samples. This would be helpful for developing countries without easy access to healthcare, as physicians would no longer need to use complex equipment to detect HIV.

What type of analyte will your device assess? (i.e. what is unique about this disease that you could potentially detect – cell shape, cell surface proteins, DNA, etc. This analyte will depend on the disease you are thinking of targeting.)

This device will analyze proteins on the surface of the HIV virion, specifically the p24 protein. This protein has been shown to generate a striking color change when introduced to a solution containing gold nanoparticles and various antibodies and enzymes. This color change will make it possible to detect the disease with the naked eye.

Will you isolate the target analyte from the other blood components? Alternatively, will you analyze directly from whole blood? Thoughts on how and/or why?

The analyte will not be entirely separated from the blood, however the blood will still be filetered into plasma. This is because the method of detection involves a color change, therefore it is desirable to test a clearer liquid instead of the red blood.

How will the patient blood sample and reagents be loaded into the NANOLYSER?

Through a linear microthrotle pump.

How will samples and reagents be moved around in the NANOLYSER?

Finger pump which will force the plasma into the chamber with gold nanoparticles for detection.

How will the results be read or detected (e.g., fluorescence reader, electrical signal, chemical change, etc.) to determine the diagnosis given by your device?

The results will be read by the naked eye. This is possible due to the color changes that will occur. For example, the solution will turn red in the presence of p24 protein and blue if the p24 protein is absent.

What might be some of the different processing steps your device will need to be able to perform (e.g., cell separation, cell lysis, cell/protein/DNA labeling, etc.)?

The device must be able to filter the blood into plasma, while disposing of the waste. This plasma must then be moved into a pre-prepared solution that will be loaded into the chip.

Will these be performed in the same location on the chip or in different chambers?

The blood will be filtered in one chamber, while the detection of the proteins will occur in a different chamber. The plasma and red blood cells each have their own chamber. The red blood cell chamber has no impact on the device. There is also a filtration chamber and a detection chamber.

Will the NANOLYSER be disposable or reusable? Why?

The NANOLYSER will be disposable because it will be difficult to rinse out the plasma after each trail. There is also no expensive technology or electrical equipment so there would be no loss in throwing the device away each time.

Blood Processing Algorithm:

1.Collect Blood Sample, using finger prick

2.Insert sample via pump that will separate plasma and RBCs through bifurcation and flow into their respective chambers. The red blood cells will stay in the faster flow rate main channel. While the plasma will separate to the slower flow rate side channels.

3.Plasma will flow from the side channels into one chamber.

4.Plasma will be manually pumped, by applying pressure with the finger to another chamber with the gold nanoparticles and enzymes that initiate a color change.

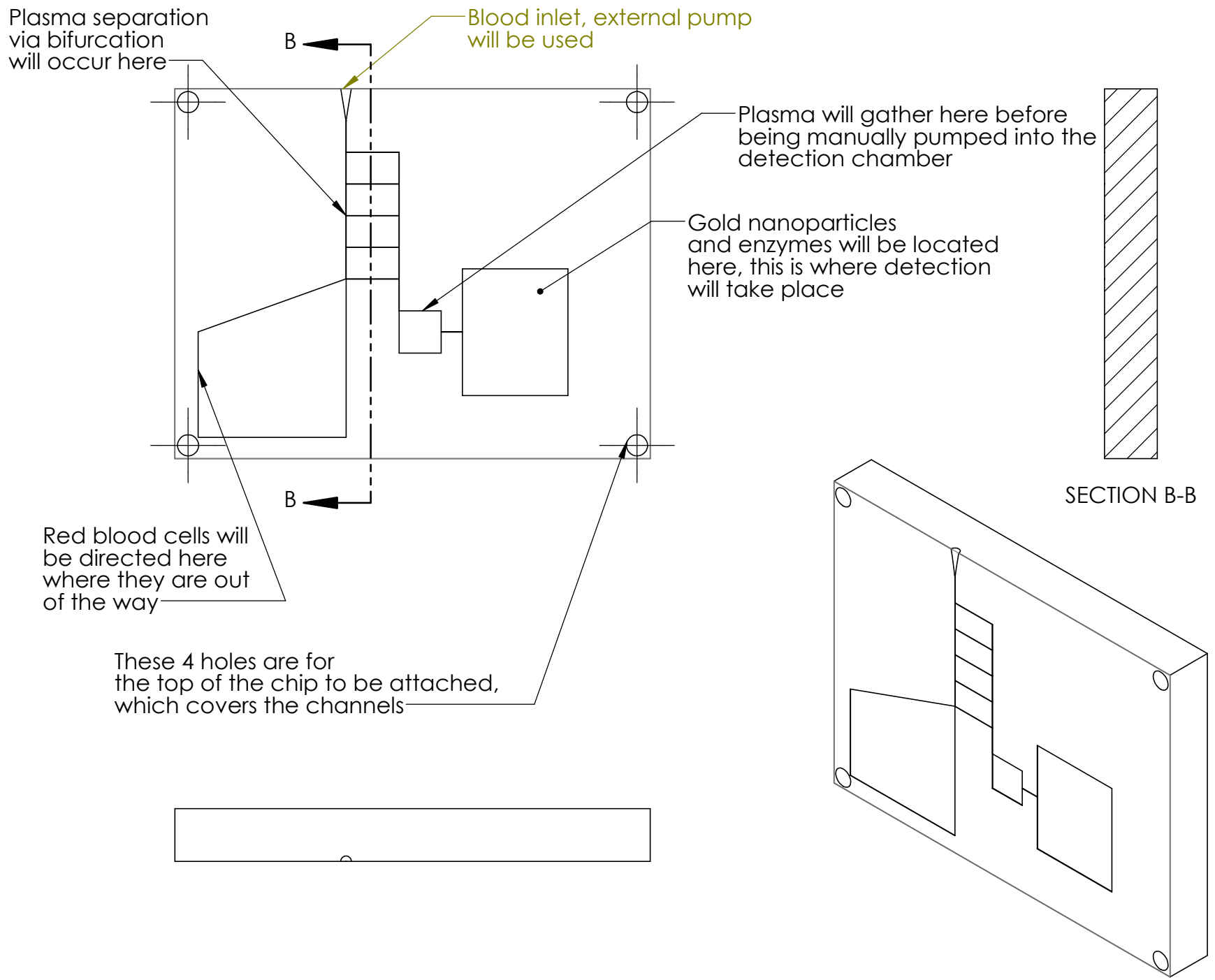
References

Davies, M.J., Johnston, I.D., Tan, C.K.L, Tracey, M.C. “Whole blood pumping with a microthrottle pump.” *Biomicrofluidics* 4.4 (2010): 1-10.

de la Rica, R., Stevens, M. “Plasmonic ELISA for the ultrasensitive detection of disease biomarkers with the naked eye.” *Nature Nanotech* 7 (2012): 821–824.

Zhao, B., Cui, X., Ren, W. *et al.* “A Controllable and Integrated Pump-enabled Microfluidic Chip and Its Application in Droplets Generating.” *Sci Rep* 7.11319(2017): 1-8.

Yang, S., Undar, A., Zahn, J.D. “A microfluidic device for continuous, real time blood plasma separation.” *Royal Society of Chemistry* 6(2006): 871-880.



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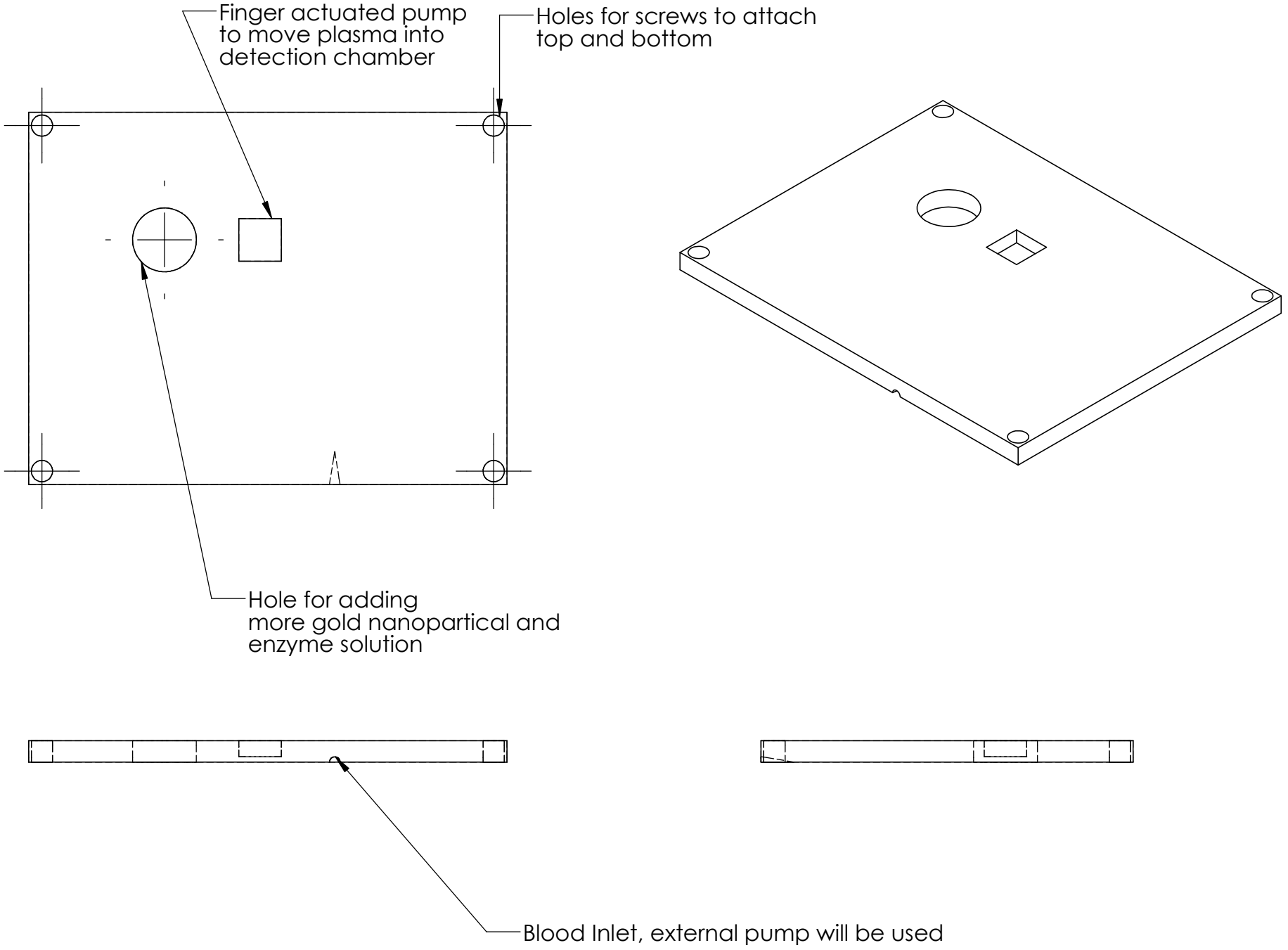
	Drawn By: Team Y4	Hour: 12:40	Units: MMGS	Date: 3/5/20



The Ohio State University First Year Engineering	Dwg. Title: NANOLYSER Top	Inst.: Parke	Scale: 2:1	Dwg. No.: 2
	Drawn Bv: Team Y4	Hour: 12:40	Units: MMGS	Date: 3/5/20