Velocity Profile of Blood Flowing in a Cylindrical Pipe - Proposal

1. For my project, I am going to determine the velocity profile of blood flowing in a cylindrical pipe. This is different than standard Poiseuille flow as blood is a non-Newtonian fluid. This problem is important as an understanding of the velocity profile within a cylindrical pipe can be easily applied to blood vessels, and a knowledge of the flow profile could help in the development of toxicological and drug-delivery studies. Specifically for me, I want to go into biological topics in graduate school, and I think this would be an interesting way to apply transport principles.

2. This paper is within the scope of the class as it is a momentum transfer problem. Specifically, it builds upon principles of both Poiseuille and Couette flow and applies them to a non-Newtonian fluid.

3. The paper, *Rheology of Blood* by Merrill (1969), derives different correlations for the shear stress of blood dependent on the strain rate. The paper first goes through the derivation of steady, Newtonian shear stress and strain rate and then applies that developed understand to a personalized Couette flow viscometer to determine the non-Newtonian shear stress and strain rate of blood. They then use two linear correlations that relate the yield shear stress, ultimate Newtonian viscosity, and shear rate valid over two separate ranges.

4. The scope of my project is to be able to use the relationships developed for the shear stress from Merrill's paper to model the flow of blood within a cylindrical tube. Using Merrill's correlation, this will ultimately result in two different profiles depending on the strain rate of the blood. I will take these equations and insert them into the momentum equation to derive the velocity profile for blood flow in cylindrical coordinates. I also plan on exploring the possibility that blood changes between the two strain rate regimes with every pulsating heartbeat.

5. The following chart has my goals for accomplishing this project:

When?	What?	How?
Tuesday, Dec 8th	Have all of my additional papers collected and have begun derivation of fundamental equations.	Work 2.5 hours on both Monday and Tuesday on this
Thursday, Dec 10th	Finish derivations of fundamental equations and begin writing of paper.	Work 2.5 hours on both Thursday and Friday after classes
Saturday, Dec 12th	Finish writing paper and prepare slides for oral presentation	Work 4 hours (or to completion) on Saturday