Newton's Law of Friction

SPEAKER Bob Holmes: Okay, so a fluid is a substance that can flow. It continually deforms as long as there's a shearing stress applied. Well, let's talk about the concept of stress. If I have a normal stress, that can be demonstrated as my fist pushes against my hand. The force of my fist pushing against my hand divided by the cross-sectional area, or this area here of my fist, if I divided that force by that area that would be the normal stress. Now contrast that with the shearing stress. If I rub my palms together, the force that I apply with my right hand rubbing against my left hand, if I divide that force by the area that my hands are in contact with each other, that would be the shear stress.

Now the internal fluid stress between the fluid particles, that's a function of the rate of deformation as opposed to the amount of deformation. So it's not the amount of deformation that I have between fluid particles, it's how fast they deform, or the rate of that deformation. If I look at that with Newton's Law of Friction, I can see that that is characterized by the shear stress, which has the Greek letter tau as its abbreviation, is equal to the dynamic viscosity, which is the Greek letter mu, multiplied by the rate of deformation, which is DVDY. The DV is the change in velocity over a particular distance, and DY is the distance. So don't let the calculus, the differentials fool you there into being confused or a little worried that we're gonna get too far into calculus in this class because this is one of the only differential equations you'll see. We can actually abbreviate that DV. Instead of DV, we could actually say delta V, or the change of velocity over a particular distance, DY.

Now, that dynamic viscosity has units of second-pounds per square foot. That's a measure of the resistance of the deformation. That is a property of the fluid and will depend on the fluid and also the temperature, how warm or cold the fluid is. If you get into--you can think of motor oil in your automobile. The warmer the oil is, the less viscous it is. You've heard, maybe in the oil commercials, the discussion of viscosity and viscosity breakdown. When you have higher temperatures that viscosity becomes less, and so it's easier flow between the fluid particles. If it's colder, then it flows slower. So there is more of a resistance to that deformation. I hope that

particular illustration makes it a little clearer for you. Now, if we talk about the kinematic viscosity, that's where we take the dynamic viscosity and divide it by the density. That has units of feet square per second.

In the textbook that you're provided with this class, there's a table that has the various values for dynamic and kinematic viscosity for various fluids and at various temperatures. Okay, that concludes this lesson, or this section on Newton's Law of Friction. I hope you'll now go to the example problem.