We would now like to discuss drag forces in a fluid.

Now remember that fluids can be both a liquid or air.

And drag forces are actually quite complicated depending on a lot of factors.

If we had an object falling in a fluid, the drag forces can depend on both the properties of the object-- and in that case, it might be the speed or the size or the shape of the object-- and it also can depend on the properties of the fluid.

It can depend on the density of the fluid.

It can depend on a property that measures the resistance of a fluid, something which we'll refer to as viscosity, and also a property about the compressibility of a fluid.

So in general, this is quite complicated.

And this is done empirically.

There's a few very special cases that we'll discuss that can be solved exactly.

Now let's begin our modeling by considering what we call air drag.

Now in air drag, objects that are moving-- and we'll consider objects that are moving rapidly.

So our objects are moving very fast.

Now in that case, we can model-- make a rough model of the air drag as follows.

The magnitude of this force is going to be proportional to the speed squared.

There'll be a factor where it's the cross-sectional area that the object presents in the motion, perpendicular to the plane of motion.

It can depend on the density of the air.

And traditionally there are a couple of coefficients in here that are dimensionless that are empirically determined by the shape of the object.

And that's called the drag coefficient.

And in fact, there's also a factor 1/2 in the way this law is traditionally written.

So what we have here is a resistive force which is proportional to the speed squared and depends on the properties of the air, the density of the air, and some physical parameters-- properties of the object itself.

Now this drag coefficient-- we can have a table that can represent that.

And you can see here that for a variety of different shapes, the drag coefficient is somewhere on the order of 1.

So this is an example of what we refer to as air drag.

When we drop objects in a fluid at very slow speeds, we have a different effect than what we talked about air drag.

For example, if we drop a marble in molasses and drop the same marble in water, we see a very different motion.

And that depends on a property of the fluid which we'll refer to as viscosity.

Now we'll denote a coefficient of viscosity by the symbol n, eta.

Now when we drop an object in a fluid, that the drag force in magnitude will be proportional to both viscosity-- will be proportional to the speed and it will be proportional to the viscosity.

And now, for various special cases, so for the special case which is a sphere of radius r, if you study fluid dynamics, we can get an exact solution for this drag force.

And we'll describe that as-- it's going to be opposite the direction of the velocity, so there's a minus sign.

There turns out to be some coefficients-- 6 pi times the viscosity of the fluid times the radius of the sphere.

And this particular law, which we'll known as Stokes' law, is exactly applicable to the motion of a sphere.

Now in fact, by experimental measurement, this is a method for determining eta experimentally by dropping objects-- spheres-- in various different media with different viscosities.

So we can use this to experimentally determine the viscosity of the medium.

And what's important to realize, too, is that this is applicable to many different examples.