PROFESSOR: What is a conservative force, and what is a non-conservative force? Let me start with an example of a conservative force: gravity is a conservative force.

Let this be point A, and this is point B. We have a mass-- little m-- that's going to be moved from A to B. If the work done by gravity is independent on routing that I choose from A to B, which is the case, then the force is called a conservative force, and that is the case.

If I go from A to B with that object little m, I go vertically down-- gravity is in this direction-- and then I go horizontally, the work done by gravity will be plus mgh if the vertical separation between A and B equals h. If I go this way, no work will be done by gravity. If I move this object horizontally, and then I go down, the work done by gravity will be mgh, but if I go this way the work done by gravity will also be plus mgh. If I go this way, and I finally arrive at B, the work done by gravity will also be plus mgh. Whenever the work done by a force in going from A to B is independent of the [UNINTELLIGIBLE], we call that force-- a conservative force, and in Newtonian mechanics, gravity is a conservative force. it

If the work done does depends on the routing, we call the force non-conservative. Friction, air drag-- which are resistive forces-- are non-conservative. Let's look at this little bit closer. I go from A to B. I have an object here-- I have my purse here, there it is. There's friction, and I'm moving this along in a horizontal direction, and I want to go from A to B.

I can go to in different way-- I can do this, and finally end up at point B. The work done by friction now does depend on the path.

What is the work done by friction? Let's first take some paths in this direction, and we mark like so. The frictional force always opposes the direction of the velocity, so right here the frictional force would be in this direction. Right here, the frictional force would be in this direction, and right here, the frictional force would be in this direction.

The work done by the frictional force is the dot product between the frictional force and dl is the path that it takes. There's a little element dl, and here, this is a little element dl. Work is a scalar. I have the friction-- the force is constant in magnitude-- and it really obvious that the work done by the frictional force depends very strongly on the path, whether I go this way, or whether I would go this way.

In the case of my purse, the frictional force would be the mass of my purse-- it's not too much, is it-- times g times the kinetic friction coefficients. It's the normal force which the pad pushes up so that the object stays in place. A side view: this is my purse, there's a gravitational force down, mg is normal [? force up ?] these two are the same in magnitude. The frictional force is normal force times the kinetic friction coefficient, as long as this object is moving around.

If the trajectory from A to B is a straight line, and if this distance equals d, then the work done by the frictional force would be minus f frictional force times d. It's negative because the l is in this direction, and the force is in this direction-- friction always does negative work. The work done by Walter Lewin-- if I push in a horizontal direction, I'm not pushing down on it, I'm pushing in a horizontal direction. That work done by me is plus frictional force times d.

If now I choose a different [UNINTELLIGIBLE] so that the total length of this path equals 2d, then this would equal minus 2 f friction times d. The work done by Walter Lewin would have been twice as much-- 2 f friction times d.

The net work on this object going from A to B is 0-- there is no change in potential energy, and there's no change in kinetic energy, because the net work done on the object is 0. I'm doing positive work-- what happens with that positive that I am doing? That goes into heat-- the friction with the paper will produce heat, and maybe a little bit of noise, but it'll be largely heat.

When we deal with air drag-- with cars and airplanes which move-- the engines do positive work. The air drag, which is a resistive force, is doing negative work. If you drive your car from Boston to New York, and the work done by friction is very, very different than if you go from Boston to New York via Washington. The engine has to do positive work, and it is immediately obvious if you go from Boston to New York that the engine does much less work than if you go from Boston to New York via Washington.

I hope I have convinced you that frictional forces, resistive forces in the form of air drag, are non-conservative forces. The work they do in moving an object from A to B depends on the path. If the work done going from A to B does not depend on the path, or not depend on the routing, then that force is called a conservative force.