I now want to discuss with you the parallel axis theorem, which comes in very handy sometimes when you have to calculate moment of inertia.

Let us take our potato again-- a three dimensional object-- and this potato, we will rotate about an axis through this point P. It's a random points P-- we rotate it about this axis. This is the center of mass, and let's suppose we also rotated about an axis which is parallel to this axis, but this axis goes through the center of mass. The object has mass m, and the separation between these two axes is d.

The parallel axis theorem now tells you, and I give this to you without proof, that if I call this axis 1 through the center of mass, and I call this axis 2 through point P, parallel to this x-- and it's very important that they are parallel-- that the moment of inertia about axis 2 is the moment of inertia about the center of mass. x is 1, and these two have to be parallel, and now I have to add Md squared. It's a very powerful theorem, because very often you find in tables moments of inertia about centers of mass, because they are often axes of symmetry like cylinders, rods, and spheres.

Now you can rotate about an axis which doesn't go through the center of mass, and this parallel axis theorem is very, very powerful. I could also have rotated this potato about an axis through the center of mass, which would be perpendicular to the paper. Then if I were to rotate it about an axis perpendicular to the paper through this point, I would get the same results. I would first have to calculate what the moment of inertia is about this axis through the center of mass, and I add now-- md squared, and this is now d, then I have the moment of inertia about this axis. It's a very powerful tool.