Let me [? read ?] you briefly the meaning of angular momentum relative to a point A. It is the position vector relative to that point A cross p. Therefore, if I have a certain momentum P, and I have here a point A so that this is the position vector r of A, then the magnitude of the angular momentum relative to point A equals r A-- that is the length of the vector-- times the sine of theta, if theta is this angle times p. r A sine theta is the vertical distance from point A through the line of p. This is very often called our perpendicular relative to A, which is this part, so you also will see sometimes r perpendicular times p.

The direction of L, because L is a vector in this case-- you can figure it out for yourself by reviewing the idea of a cross product-- it's perpendicular of the paper, into the paper, and I will indicate that with a cross. It's an arrow that goes down in the paper, and you only see the back of the arrow. If I had chosen point B anywhere along this line, then L of B would be 0, and already you see L of A is not the same as L of B. Had I chosen a point C here, then the direction of the vector-- L, the angular momentum relative to point C-- would have this direction, and not this direction. Had I chosen any point D on a line through a parallel to the momentum itself, then L over D vectorially is exactly the same as L of A.

L must be taken about a point. The idea of L about an axis is very unfortunate language. I would almost it's dirty language, and I realize it's being used by the authors of your study guide. I discussed this with Professor [? Bouchard ?], and I think he agrees with me-- it's unfortunate language. What they always mean when they say angular momentum about an axis, they really mean the component of the angular momentum parallel to that axis, but I still think that language should be avoided any price.

If now we go to torque-- torque equals r cross F, and so everything I said holds, except that now you have to replace L by tau, and you have to replace p by F. It's the same idea: again, tau must be taken relative to a particular point. I will obnoxiously indicate that here, because it must be taken relative to a particular point. To talk about the torque about an axis is undesirable language. Whenever the authors talk about the torque about an axis, what they really meant to say is the component of that torque-- torque is a vector, so torque has various components-- it is the component of that factor parallel to the axis of rotation, and that's what they really meant.

Tau, which is a vector, is always dL dt. What this is telling you is that in the absence of any external torque, this tau equals 0, so L is not changing with time. L remains constant-- the vector L remains constant-- and we call that the conservation of angular momentum. The remarkable thing, as you will see in the next problem, is that you sometimes can pick a point about with angular momentum is conserved, and sometimes you can pick other points about which angular momentum is not conserved. That's why all of this is not so intuitive.