Let us now examine the difference between the angular velocity and the angular frequency, which unfortunately-- both often have the same symbol, omega.

Let this be a pendulum. This is the equilibrium position. I look at the situation a little later in time-- this angle is theta with length l, and this angle is d theta. This object at this moment here has a velocity-- let's say it has a velocity in this direction, tangential-- I call it V of theta. In the time that this angle d theta takes place, there is a little arc-- I call the arc ds. That little arc ds is d theta in radians times the length l.

It is velocity V theta, which is ds dt, that becomes d theta dt times l. This d theta dt, which is the angular velocity, is often called omega, and so this is omega l. This omega has nothing to do with the omega that is defined as angular frequency, which is 2 pi divided by P. This angular velocity is 0 when the object stands still, when the angle of theta has reached the maximum value of plus theta maximum or minus theta maximum, because the velocity is then 0-- it stands still, so the theta dt better be 0. It is a maximum when it goes through equilibrium either in this direction, or when it goes in this direction.

The angular velocity, this omega, changes in time. Now, the angular frequency: the angular frequency shows up in the equation x equals A times cosine omega t plus alpha, or if you want to write it down in theta, you can do that as well-- it's the same thing. This omega is called angular frequency, and this omega determines the period of the oscillation.

For a given pendulum, and for a given length, this omega is a constant-- it's not changing in time. In fact, we will show that through a good approximation, the omega doesn't even change if you change the amplitude of the oscillation. It's independent of A and independent of alpha-- it's a constant for a given simple harmonic oscillation, and angular velocity is not.

It is extremely unfortunate that angular velocity, which changes in time for a pendulum, is called omega, and that angular frequency, which is a constant for a given simple harmonic oscillation and does not change in time, that they both have the same symbol of omega. It's very confusing, and that's why I spent some time on it. If you keep them completely separate at all moments, and if both occur in the same problem, you may even decide to give one of the two omegas a different symbol, or maybe an omega prime. Keep them apart-- that is an absolute must.