Up until now, we have been studying the motion of point-like objects.

In this module, we are going to consider the motion of extended objects, specifically objects that are rigid bodies.

By rigid, we mean that the distance between any two points on the object always stays the same.

In other words, the shape of a rigid body does not change or deform.

There is a useful relation known as Chasles' theorem that states that the general arbitrarily complicated displacement of a rigid body can be broken up into two parts-- first, the translational motion of its center of mass, and second, the pure rotation of the object about its center of mass.

We already know how to analyze the center of mass translational motion through our study of point-like objects.

This week, we will consider the rotational motion of rigid bodies, once again distinguishing between kinematics, a geometric description of the motion, and dynamics, the underlying cause of changes in the rotational motion.

On a microscopic level, we can think of an extended rigid body as made up of a very large number of small point-like pieces all attached together.

For rotation about a fixed axis through the center of mass, each little piece will move in a circle about the rotational axis.

The radius of the circle will vary depending upon where in the object, that particular piece sits.

However, because all of these small pieces are moving collectively as part of a single rigid body, they will all have the same angular velocity and angular acceleration at any given instant.

This gives us a way to specify the kinematics or geometrical description of rotational motion using the vector quantities of angular velocity and angular acceleration.

We will also consider the dynamics of rotational motion.

We will see that an applied external force is able to change the rotational motion of a rigid body, depending upon exactly where on the body the force is applied.

This leads directly to the concept of torque, a vector quantity that represents a sort of rotational force.

Finally, we will see that we can link the kinematics and dynamics of rotational motion through a rotational equation of motion, analogous to the role that Newton's second law plays for translational motion.

This relation states that the angular acceleration is proportional to the applied torque and also depends upon how the mass of the object is distributed.