Physics Integration Lesson 4 – Friction and Motion

S. Gollmer (2020)

How we think about motion, and in turn friction, has changed significantly over the past millennium. Prior to Galileo (1564-1642 A.D.) the discipline of physics was strongly influenced by the writings of Aristotle (350 B.C.). In his manuscript titled *Physics*, which consists of eight books, Aristotle discusses two types of motion: natural and violent. Natural motion is due to the tendency of an object itself. For example, smoke tends to rise and rocks tend to remain at rest. Violent motion is that which is unnatural and is the result of a 'mover' applying a force. Therefore, any unnatural motion must be the result of a chain of interactions that lead back to an initial cause. Action of the initial 'mover' may be diminished between interactions and over time. Therefore, an inanimate object experiencing violent motion will tend to come to its natural state of rest.

Although we currently think of motion as a chain of events that occur over time, the reason objects come to rest is not due to their natural tendency, but to the effect of friction. This was clearly demonstrated by Galileo in his inclined plane experiments (Galileo, 1638. *Two New Sciences*). By increasing the smoothness of surfaces, Galileo found that balls rolled a larger distance once leaving an inclined plane. He proposed that if the surface were completely smooth, the balls would continue rolling indefinitely. Therefore, the natural tendency of objects is to maintain their current state of motion, which we call inertia, and the reason objects come to rest is due to the force of friction acting continuously during the motion.

In the time of Aristotle, as well as today, we are confronted by initial causes: the 'why' something happens. At the end of Aristotle's *Physics* he discusses an unmoved 'mover' that is the ultimate source of all natural and violent motion and he concludes that this 'mover' must be eternal and unchanging. Thomas Aquinas (1225-1274 A.D.) used this concept as one of his five proofs for the existence of God. Today philosophers call this the Cosmological Argument and it is used extensively by Dr. William Lane Craig in his apologetics ministry.

1. Since friction acts continuously during motion, we are able to include it as a force, such as gravity, contact forces and tension in strings. Do you think our quantitative approach to solving mechanics problems would be possible if we still used Aristotle's paradigm of physics? Why or why not?
2. How familiar are you with the Cosmological Argument? How do you think it could be used to engage an unbeliever in a discussion about God?