The area of projectile motion in a uniform gravitational field is the first place we apply these new ideas. Vector components lead immediately to a way of dealing with multi-dimensional systems: Analyze each coordinate direction separately then combine the results using the rules for vector addition. This basic principle is called superposition and is a cornerstone of physics.

The horizontal distance that the projectile travels from the launch point is defined as range. Range depends on the velocity component in the direction of motion and the length of time during which the projectile is moving through the air. Note that the equations for projectile motion are only valid while the object is in flight.

The time that the projectile is in motion is called the time of flight. We typically solve the equation of motion in one dimension for the time of flight then use those results in the equation of motion for another dimension to determine the range of the projectile.

With some exploration of the topic of relative motion – motion in one frame of reference as defined by an observer in another reference frame – it becomes clear that *the results of analysis depend entirely on the reference frame in which they are analyzed.* This detail will prove to be extremely important in the discussion of special relativity in the modern physics course, and will be essential in understanding the counter-intuitive results. In addition, we will see that the choice of coordinate systems can complicate or simplify a problem solution.