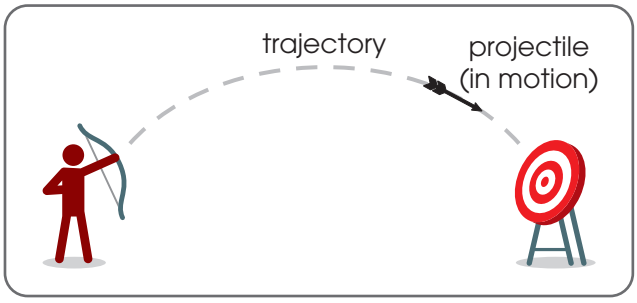
To understand what projectile motion is, consider what would happen to an arrow if an archer shot it into the air. The arrow would begin its flight upward, peak at some point, and start to fall until it reached the target or the ground. In this scenario, the arrow is referred to as a projectile because it was launched by an external force and then continued to move under the influence of gravity.



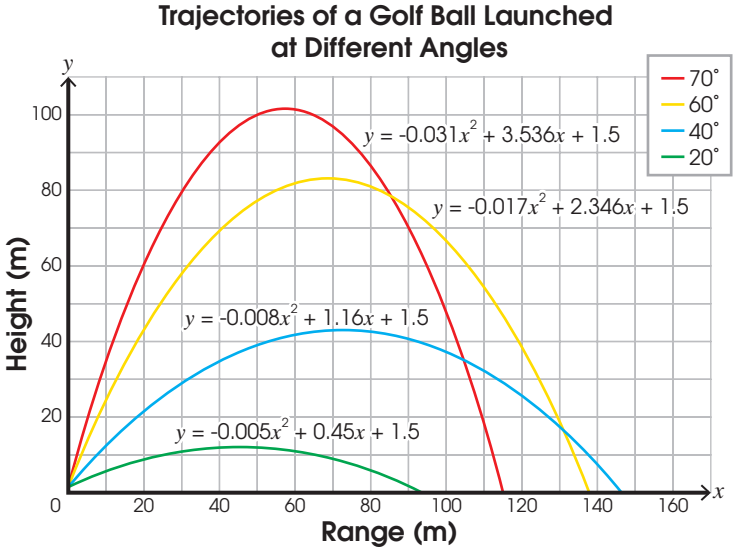
The arrow's motion is called projectile motion. This type of motion involves an object being launched and experiencing solely the gravity until it reaches the ground, at which point the motion ends. The arrow's path is referred to as a trajectory. A trajectory, often known as a flight path, is the path that a projectile follows while it is in the air. This path is often parabolic and can be closely modelled by a quadratic equation.

A quadratic equation usually has two unique solutions which are the points on the x-axis where the parabola crosses. These two points correspond to the projectile's starting and landing locations in a parabola that represents the projectile's trajectory. The mass and initial height of the projectile, the launch angle, force of gravity, air resistance, time, and speed are all variables to consider while modelling a trajectory. Often times, uncertain forces such as wind resistance are ignored when representing a trajectory using a quadratic equation.

Golf

The sport of golf is another example of projectile motion. Golf balls feature dimples all over their surfaces that are deliberately designed to achieve the precise projectile motion required for golf. The golf ball's trajectory can be low, medium, or high. It is determined by the launch angle, speed, and direction of the stroke.

The parabolas on the right show the golf ball's different trajectories with a change in the launch angle only. It can be observed that the launch angle has a substantial impact on the trajectory and the horizontal distance the golf ball travels. Note that a higher launch angle does not always send a golf ball farther, so determining the perfect angle is just one of the many variables that goes into the calculation for a perfect stroke. Variables, such as spin rate, club face impact position, and shaft position, all affect the trajectory of a golf ball. Therefore, a golfer must take into consideration many variables. For a talented golfer, a carefully calculated stroke can send the golf ball through the air right into the hole.



Fireworks

The application of projectile motion can be demonstrated through fireworks. Fireworks must be carefully controlled and timed in order to present a magnificent display. The trajectories, duration of flight, and range of the fireworks are all calculated. When timed correctly, the end result is a beautiful blend of mathematics, science, and art.

Rockets

Rockets are designed to send spacecraft into space. To do so, a rocket must be powerful enough to break free from Earth's gravity. The trajectory of a modern rocket requires complex calculations, but it is similar to that of other projectiles. A rocket's engine provides the initial thrust and the spacecraft is subsequently launched into space.

The applications of projectile motion in physics and engineering are numerous and there are many examples where projectile motion may be applied in daily life – a launched paper plane, a high jump, and water from a water fountain are only a few of the many circumstances in which projectile motion can be observed.