

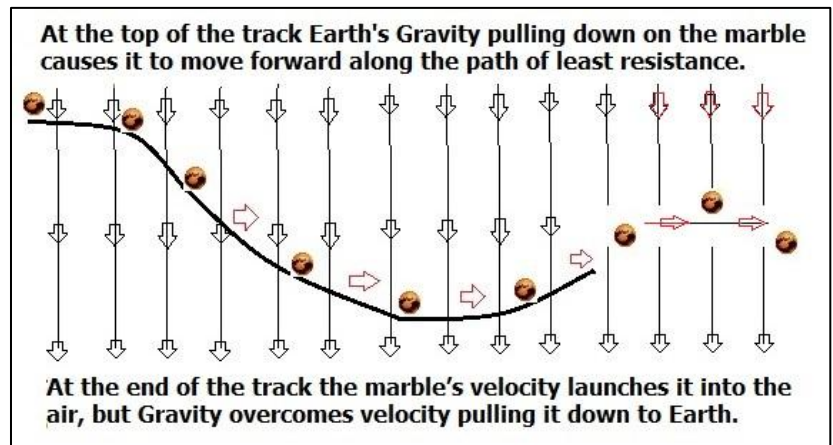
# Marble Run Talking Points

## Watch for the invisible forces at work.

The invisible force of **Gravity**, which attracts everything toward Earth, is constantly pulling straight down on the marble on the track.

This gravitational force creates **Potential Energy** in the marble. Resting on the track this Potential Energy is just sitting there ready to do something. The higher the elevation of the marble on the track, the greater the gravitational force and the more energy it has stored inside.

**Conversion of Energy** occurs when marble is released and starts moving from the top of the hill. The marble's (stored) Potential Energy converts to another form of Energy called **Kinetic Energy** – energy in motion. The downward force of Gravity draws the marble down the hill. The steeper the hill, the faster the marble can move, creating more and more (Kinetic) Energy - Acceleration, Velocity and Momentum.



Approaching a hill, some (Kinetic) Energy is taken away (converted back to Potential Energy) so the marble slows down, but hopefully it has **Conserved** enough energy to make it all the way to the end of the track.

**Friction**, anything on the track's surface that resists the marble's forward movement, especially track rails that are not straight and running parallel, will slow the marble down.

At the end of the track the upward lift force from the ski-jump type ramp launches the marble into the air, following an arching curved flight path called a **Parabolic Curve**. Instead of going straight, Gravity shows up, pulling it down.

Three forces affect the marble's flight path – its Trajectory: Momentum, Gravity and the angle of the ramp.



## Three Laws of Motion (Sir Isaac Newton (1642-1727))

1. An object moving in a straight line will keep moving in that direction unless acted on by an outside force.
2. If an object is moved by a force, it will move in the direction of that force; the greater the force, the faster the object will move.
3. For every action or force there is an equal and opposite reaction or force in the opposite direction