

The Physics of an Egg Drop

Forces to consider during the Egg Drop:

1. **Gravity:** This is the force that pulls objects towards each other. On our planet, objects are pulled towards the center of the earth, which causes them to fall downwards.
2. **Drag:** Often this is also called “Air Resistance.” Drag is when forces are acting in the opposite direction of the motion of an object.
3. **Impact:** Impact is the high force (or shock) applied over a short period of time when 2 or more objects collide. The effect depends on the relative velocity (or speed) of the two objects to one another.



How do Newton's Laws apply to an Egg Drop?

1. *An object at rest tends to remain at rest and an object in motion tends to continue moving in a straight-line at constant speed, unless an outside force acts upon it.*

The egg will not fall unless it is dropped (an object at rest). While at rest, the egg has **potential energy**. The egg gains **potential energy** as it is transported to a higher elevation for performing the egg drop experiment.

Once dropped, it will fall. This demonstrates **kinetic energy**. It will be acted upon by the following forces:

- a. **Gravity:** which will pull it toward the earth and cause its speed to accelerate.
- b. **Drag:** depending upon how the egg protector is built, this will vary, but **drag** will slow the fall of the egg down. **Drag** does not destroy **kinetic energy**, but instead creates **friction** (between the air and the object creating **drag**) and as a result transfers the energy into **heat energy** (another form of **kinetic energy**).
- c. **Impact:** ultimately, the egg (and its protector) will hit the ground. The size and amount of the **impact** will depend upon the speed with which the egg and protector were falling.

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2. *Force = Mass times acceleration.*

The egg will accelerate based on the pull of **gravity**. How much it accelerates depends on the height from which the egg was dropped and the **mass** of the egg and protector. Force will increase with larger masses and higher heights.

3. *For every action, there is an equal and opposite reaction.*

The egg will hit the ground. It will exert some amount of force on the ground when it hits (the **impact** force). The ground will, in turn, exert that same amount of force on the egg.



How does the first law of thermodynamics apply to an egg drop?

Energy cannot be created or destroyed.

The **potential energy** the egg has when it is at rest is converted into **kinetic energy** as it falls because of the force of gravity. Energy can be transferred from one kind to another, but it is never destroyed. When the egg hits the floor, the **kinetic energy** is transferred again, this time to the egg and the packaging materials used in building the egg protector.

So, what's the objective in building the egg protector?

1. Maximize drag. What can you do to slow down the fall of the egg protector?
2. Minimize impact. What can you do to help “soak up” some of the impact energy so it all doesn't end up going into (and breaking) the egg?