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| Name: | **[insert name]** | Period: | **[insert Period]** | Date: | **[insert date]** |

Egg Drop Challenge

# Background

According to Newton’s Third Law, the force of a collision must be conserved. This means that the force imparted on an object is the force that it will experience as well. To reduce the force of the collision materials can be added to reduce the length of time of a collision, and therefore reduce the force of impact.

Since we know that impulse is equal to the change in momentum of an object we get this equation:

**Force \*Δtime = Δmomentum**

Momentum is a change in an object velocity, so we can write the equation to be:

**Force \*Δtime = mass \* Δvelocity**

And since we want to focus on the force experienced, we can rearrange the equation to be:

**Force = (mass \* Δvelocity) / Δtime**

We will use a simulation to see how each variable (mass, velocity, and time) play a role in changing the force an object experiences during a collision.

# Using a Simulation

This experiment will use the [Egg Drop Interactive](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Egg-Drop/Egg-Drop-Interactive) by Physics Classroom to perform egg drop experiments. For each simulated experiment, you will change different **variables** to test how they affect the result of the experiment. A variable is a factor that can be changed. When performing experiments, it is important to minimize how many variables you change so you can better understand the results.

The variables you will change in this simulation are mass, height, and landing surface.

##

## Simulation 1: Small egg on a hard floor

1. Open the [interactive](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Egg-Drop/Egg-Drop-Interactive).
2. Make sure the egg size selected is “small”, the height is set to 1m, and the landing surface is set to “hard floor”
3. Select “Drop Egg” and collect your force, velocity, and time data below.
4. Repeat the experiment with a drop from 5m and 10m and record your data below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1 meter** | **5 meters** | **10 meters** |
| **Change in Velocity (ΔV)** |  |  |  |
| **Time (s)** |  |  |  |
| **Force (N)** |  |  |  |
| **Question/Prompt** | **Your Response** |
| Does changing the height the eff is dropped from affect the egg’s end result? |  |
| How does the force on the egg change as the height of the drop is increased? |  |

## Simulation 2: Small egg on a 1-inch foam

1. Open the [interactive](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Egg-Drop/Egg-Drop-Interactive).
2. Make sure the egg size selected is “small”, the height is set to 1m, and the landing surface is set to “1-inch foam”
3. Select “Drop Egg” and collect your force, velocity, and time data below.
4. Repeat the experiment with a drop from 5m and 10m and record your data below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1 meter** | **5 meters** | **10 meters** |
| **Change in Velocity (ΔV)** |  |  |  |
| **Time (s)** |  |  |  |
| **Force (N)** |  |  |  |
| **Question/Prompt** | **Your Response** |
| At what height(s) can you safely drop the small egg onto 1-inch foam? |  |

## Simulation 3: Large egg on a 1-inch foam

1. Open the [interactive](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Egg-Drop/Egg-Drop-Interactive).
2. Make sure the egg size selected is “large”, the height is set to 1m, and the landing surface is set to “1-inch foam”
3. Select “Drop Egg” and collect your force, velocity, and time data below.
4. Repeat the experiment with a drop from 5m and 10m and record your data below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1 meter** | **5 meters** | **10 meters** |
| **Change in Velocity (ΔV)** |  |  |  |
| **Time (s)** |  |  |  |
| **Force (N)** |  |  |  |
| **Question/Prompt** | **Your Response** |
| At what height(s) can you safely drop the large egg onto 1-inch foam? |  |
| How do the forces in this test compare to those of Simulation 2? |  |

## Simulation 4: Eggs on Foam Box

1. Open the [interactive](https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Egg-Drop/Egg-Drop-Interactive).
2. Make sure the egg size selected is “small”, the height is set to “5m”, and the landing surface is set to “foam box”
3. Select “Drop Egg” and collect your force, velocity, and time data below.
4. Repeat the experiment for the large egg and jumbo egg.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mass** | **Change in Velocity (ΔV)** | **Time** | **Force** |
| **Small Egg** |  |  |  |  |
| **Large Egg** |  |  |  |  |
| **Jumbo Egg** |  |  |  |  |
| **Question/Prompt** | **Your Response** |
| How does mass affect the force experienced by the egg? Why increasing mass, what other physical property is changed? |  |

# Challenge: Unknown object

We have an unknown object of 60 grams, and we want to be able to drop it from 5 meters without cracking. Perform different simulations to determine what would be the minimum amount of protection we could use to prevent it from breaking.

|  |
| --- |
| **Your Response** |
|  |