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

Egg Drop Challenge

# Background

How does our body protect our brain, and if not protected what can happen?

Whether it is thinking about the answers to a math problem, feeling the pain of hitting your head on the locker above yours, eating lunch, or creating your next masterpiece in art class, your brain is the organ controlling all of this. It is an amazing organ that helps to process and regulate information from all parts of our bodies. However, for such an important organ, it is extremely soft and fragile. Think about it like an egg. The shell is the skull, the egg whites are the cerebral spinal fluid, and the egg yolk is our brain.

Even though our brain has protection, that is not always enough for the trauma that we put it through. Whether it is in a football game or just hitting your head on a cabinet, the force of impacts to your head can lead to serious injury. Think of an egg again. Accidentally drop it on the floor, and SPLAT. That is why we create things like helmets to protect our brain .

Because eggs, like our heads, are not very flexible, when they hit an object they usually come to a stop. This means that the object’s momentum is changed. By this we mean that during the time of the collision, the object went from moving a specific velocity to having no velocity. We know based on Newton’s first law that in order to have an object stop moving, we need to apply a force. This force comes from the impulse of a collision. The impulse accounts for the force applied and the time the force is applied for and is equal to the change in momentum.

Force \* ∆time= ∆momentum

We can also write this as:

Force \* ∆time= m \* ∆v

## Think about it

Use the information above, to answer the following questions.

|  |  |
| --- | --- |
| **Question/Prompt** | **Your Response** |
| 1. If the force displayed in the equation above is the force on the egg, what is providing that force? |  |
| 1. How does the force experienced by the egg compare to the force experienced by the floor? |  |

# Designing Solutions

In this lab, you will design, develop, and test ways to protect your brain (aka an egg) from the trauma of a very long fall. The protection you create should be able to reduce the impact force experienced by the egg.

One way to reduce the impact force is to decrease the change in momentum. We can do this by slowing the egg down so that it’s velocity before it hits the ground is much lower than it is unaided.

The second way to reduce the impact force is to increase the time of the collision. We can do this by providing surfaces that change shape when exposed to force, like foam, to add time for the egg to come to its final resting position.

## Making Predictions

Use the table below, to record your predictions.

|  |  |
| --- | --- |
| **Question/Prompt** | **Your Response** |
| 1. If you drop the egg from higher heights, how do you think the force of impact on the egg will change? |  |

## Materials

**Required**

* Eggs (can be hard boiled to reduce mess)
* Tape measure or meter stick

**These are some example materials to use in your design. Use any of these or whatever you can find!**

* Bubble wrap
* Newspaper
* Cardboard
* Balloons
* Tape
* Sponges
* String
* Paper bag

## Criteria

In order for your design to be considered successful, you must meet the following criteria.

* You must provide a blueprint or drawing of your design
* Your egg must not break (this includes fractures in the shell)

## Designing

Choose the option you will use to protect your egg and then use the space below to think about your design. Use Google drawings to draw your plans. Be sure to indicate and label the materials being used in your design.

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| --- | --- |
| **Question/Prompt** | **Your Response** |
| 1. How will your design help protect your egg? Highlight your answer. | 1. **Slow down the velocity, decreasing the changing in momentum** 2. **Increase the collision time** |
| **Your Design** | |
|  | |

## 

## Testing Your Design

1. Build your model using the materials indicated in your design plan.
2. Drop the protected egg from 4 ft above a hard surface (tile, wood, concrete, etc).
3. Make observations and notes in the table below.

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| --- | --- |
| **Question/Prompt** | **Your Response** |
| What is the status of your egg? Whole, cracked, broken? |  |
| What was successful in your design? |  |
| What can you change in your design to make it better? Include a new design drawing to show your new plans. |  |

1. If your egg remained whole during the last test, your next drop will be from 6 ft. If your egg cracked or broke, use your new design at 4 ft again.
2. Record your results below.

|  |  |
| --- | --- |
| **Question/Prompt** | **Your Response** |
| What height did you drop your egg from? |  |
| What is the status of your egg? Whole, cracked, broken? |  |
| What was successful in your design? |  |
| What can you change in your design to make it better? Include a new design drawing to show your new plans. |  |

1. If your egg remained whole during a drop from 6ft, your next drop will be from 8 ft. If your egg cracked or broke from a drop from 6 ft, you will use your new design at 6 ft again.

If your egg remained whole during a drop from 4ft, your next drop will be from 6 ft. If your egg cracked or broke from a drop from 4 ft, you will use your new design at 4 ft again.

|  |  |
| --- | --- |
| **Question/Prompt** | **Your Response** |
| What height did you drop your egg from? |  |
| What is the status of your egg? Whole, cracked, broken? |  |
| What was successful in your design? |  |
| What can you change in your design to make it better? Include a new design drawing to show your new plans. |  |

# Evaluating Your Final Design

Answer the questions below to reflect on your design.

|  |  |
| --- | --- |
| **Question/Prompt** | **Your Response** |
| What was the highest height your egg was able to survive? |  |
| Why do you think some materials worked better than others in your design? |  |
| Remember Newton’s Third Law says that for every action there is an equal and opposite reaction.  How did your design reduce the action and reaction force? |  |
| Scientists and engineers at sport equipment companies use the same process to design things like helmets and protective padding. What factors do you think they consider besides reducing force? |  |