**Egg Drop Experiment (F=MA)**

**Approved materials list**: (Note - you don’t have to use all of these but you many only use materials from this list)

|  |  |
| --- | --- |
| * Raw egg (1) | * Plastic bag (2) |
| * Paper/Styrofoam cups 3-5oz (4) | * Balloons (3) |
| * Notebook paper or Newspaper (2 sheets) | * String or Yarn (1 meter) |
| * Straws (10) | * Masking or Scotch Tape (1 meter) |
| * Toothpicks (25) | * Construction paper (2 sheets) |
| * Popsicle sticks (15) | * Rubber bands (10) |
| * Q-Tips (20) | * Plastic silverware (3) |
| * Wire (30 cm) | * Paperclips (20) |
| * Water bottle (1-20oz) | * Glue (Elmer’s only) |
| * Cardboard (1 ft2) | * Paper plate (1) |

**Instructions**: Choose up to 12 items from the list above (each bullet point counts as one item). You must provide the teacher with a list of the materials you will use. You must bring the materials to class before the build-day.

**Procedure**: Phase 1 – Design. Outline/sketch a design that you think will protect the egg from breaking. Phase 2 – Build/Test your device. Phase 3 – Drop.

**Hints**: Use a simple apparatus, don’t overcomplicate the design. Don’t use heavy materials. Bring a small repair kit (tape, left-over material etc.) to the drop zone

**Rules**: Egg must be accessible to see if it breaks upon impact. Eggs must be raw. Do Not use a parachute, wings, or anything designed to “catch” air slowing the decent. The egg must be placed into a Ziploc bag and there must be at least part of the egg visible at all times. Your structure is limited in size to 12 in3 (12x12x12)

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**Procedure**: Phase 1 – Design. Outline/sketch a design that you think will protect the egg from breaking. Phase 2 – Build/Test your device. Phase 3 – Drop.

**Hints**: Use a simple apparatus, don’t overcomplicate the design. Don’t use heavy materials. Bring a small repair kit (tape, left-over material etc.) to the drop zone

**Rules**: Do Not attach any material directly to the egg. Eggs must be raw. Do Not use a parachute, wings, or anything designed to “catch” air slowing the decent. The egg must be placed into a Ziploc bag and there must be at least part of the egg visible at all times. Your structure is limited in size to 12 in3 (12x12x12)

**Egg Drop Experiment (F=MA) Your Name: Group Members:**

**List** the 12 (max) materials you are going to use.

**Describe** your design.

**Draw and Label** a picture of your apparatus. (use the back of this paper if necessary)

**Egg Drop Experiment (F=MA) Your Name: Group Members:**

**List** the 12 (max) materials you are going to use.

**Describe** your design.

**Draw and Label** a picture of your apparatus. (use the back of this paper if necessary)

**Egg Drop Experiment (F=MA): Report**

**Data Collection - Before Dropping**

1. Mass of your device =
2. Distance your device will fall =
3. Force of Gravity =

**Data Collection – During Drop**

1. Time of descent =
2. What occurred upon impact?
3. Use the following data table to record/calculate the information necessary to create a distance vs. time graph depicting the motion of your device.

|  |  |  |
| --- | --- | --- |
| **Distance (m)** | **Time (sec)** | **Velocity (m/sec)** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. Use the following data table to record/calculate the information necessary to create a velocity vs. time graph depicting the motion of your device.

|  |  |  |
| --- | --- | --- |
| **Velocity (m/sec)** | **Time (sec)** | **Acceleration (m/sec2)** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Use the attached graph paper to construct a distance v. time graph AND a velocity v. time graph.

**Data Collection – After Drop** (**Show all work**)

1. Describe the condition of the device and the condition of the egg.
2. What was the average velocity of your container as if fell? (V=D/T)
3. What was the average acceleration of your container? A=(FV-BV) / Δt
4. What was the force with which your container hit the ground? (F=MA)
5. Using the impulse equation (F = m x ΔV/Δt) determine the force on the egg for both 0.01 seconds of stopping time and for 0.05 seconds of stopping time.
6. Would the impulse on an egg be the same, greater, or less if an egg is dropped on concrete compared to being dropped on a pillow from the same height? Would the force of impact be the same? Explain your answer.
7. What were the strengths and weaknesses of your design? Did your device perform as you expected it to?
8. What components of your design would you change to get a better result?
9. How does Newton’s First Law relate to this experiment? (include the terms inertia, mass, and force)
10. How does Newton’s Second Law relate to this experiment? (include the terms force, mass, and acceleration)
11. How does Newton’s Third Law relate to this experiment? (include the terms action force and reaction force)
12. Construct a distance vs. time graph showing how your object’s distance changes over time (be sure to label your axes and title the graph)
    1. According to your graph, what was the average velocity of your device?
    2. According to your graph, what was the instantaneous velocity of your device at T=2sec?
    3. On a distance vs. time graph, what is the slope telling us?
13. Construct a velocity vs. time graph showing how the acceleration of your device changes over time. (be sure to label your axe and title the graph)
    1. According to your graph, what was the average acceleration of your device?
    2. Was the acceleration of your device positive, negative, or both? If both, when was it positive and when was it negative?
    3. On a velocity vs. time graph, what is the slope telling us?
    4. Was the acceleration of your device constant acceleration or was it increasing/decreasing acceleration?
14. Use Newton’s Third Law in combination with Newton’s Second Law to complete the following statements.
    1. A 2.0 kg cannon ball is loaded into a 200.0 kg cannon and fired. The force experienced by the cannon ball is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the force experienced by the rifle. The resulting acceleration of the cannon ball is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the resulting acceleration of the cannon.
       1. Explain your choices in terms of Newton’s Second & Third Laws. Include the terms force, mass, and acceleration in your answer.
    2. A 150 kg linebacker collides with a 50 kg halfback at midfield. The force experienced by the linebacker is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the force experienced by the halfback. The resulting acceleration of the linebacker is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the resulting acceleration of the halfback.
15. Explain your choices in terms of Newton’s Second & Third Laws. Include the terms force, mass, and acceleration in your answer.
    1. The 10-ball collides with eh 14-ball on the billiards table (assume equal mass). The force experienced by the 10-ball is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the force experienced by the 14-ball. The resulting acceleration of the 10-ball is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less than, greater than, equal to) the resulting acceleration of the 14-ball.
       1. Explain your choices in terms of Newton’s Second & Third Laws. Include the terms force, mass, and acceleration in your answer.