**1st Annual Yost Egg Drop Project**

**Problem:** There is a terrible drought in East Africa. The United Nations is working to get in vitally needed medications into the refugee camps. It takes too long and is too dangerous to bring the medications in by truck. It is also considered too dangerous to land a plane so it has been decided that the medications will be dropped in. You are part of a team of engineers who have been asked to design a container that will protect the medications as they fall to the ground. You will model the problem using a raw egg. There are some volume and mass f=restrictions for the container and height requirements for the drop. It will be important to work well with you team in analyzing the problem; designing and building and testing you container; and analyzing your results.

**Experimental Objective:** the aim of this project is to design a carrier that will prevent an egg from breaking from a 2 story (about 10 meters) fall.

**Question:** How can you protect an egg from a fall of over 10 meters?

**Research and Brainstorm:** What forces and principles of physics will be acting on the egg?

1. **Newton’s First Law—**an object at \_\_\_\_\_\_\_\_\_\_\_\_ will remain at rest unless \_\_\_\_\_\_\_\_\_\_\_\_\_\_ on by an unbalanced force. An object moving continues in motion with the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and in the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ unless acted on by an unbalanced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. **Speed:**  describes how \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an object is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. **Velocity (v) :** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a specified \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Which direction is the egg going to move?
4. **Acceleration (a) :** the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at which an objects speeds \_\_\_\_\_\_\_\_ or slows \_\_\_\_\_\_\_\_\_\_\_\_\_.
	1. How fast will the egg be moving when it hits the ground?

**Vf** = final velocity

**Vi** = initial velocity, which will be 0 m/s

**a** = acceleration due to gravity = 9.8 m/s2

 **t** = time

* 1. **Vf = Vi + a (t)**
	2. What would the final velocity be if it falls for 2 seconds?
	3. What would the final velocity be if it falls for 3 seconds?
1. **Gravity:** it’s main purpose is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ objects to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:** an object’s tendency to move at constant speed along a straight path. A measurement of that tendency is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
	1. **For example:** when you are running full speed straight ahead, how easy is it to turn a corner?
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: the force resisting the relative motion of solid surfaces, fluid layers and material elements sliding against each other.
	1. For example: air resistance.
4. **One last thing to consider: OVERALL FORCE.**

F = force (Newtons)

m = mass (g)

g = gravity (9.8 m/s)

h = height (meters)

* 1. **F = mgh**
	2. What is the approximate Force of an egg if it were dropped from 10 meters? **Show your work.**
	3. Will the size and mass of your device affect how hard it falls? **Explain.**
	4. Will the size and mass of your device affect how fast it falls? **Explain.**

**Specifications:**

* You must use at least three different materials when building your egg saving device.
* Only raw, store bought chicken eggs may be used. You device must not include changing the egg in any way. (no tape on egg, no soaking egg in vinegar, etc.)
* The egg container and all materials must remain intact. For example, no parts—inside or out—can fall or break off during flight or impact.
* You egg saving device must fit on a regular piece of paper (8.5 x 11) sheet of paper. (Note that the height of the container is not a factor—it can be “tall” and still fit on the paper.)
* The container must be able to be opened once we return to the classroom so that we can inspect the egg.
* Must be able to survive multiple drops (1 meter, 3 meters and ~10 meters)

**Brainstorming Session:**

1. What are the forces acting on the egg as it falls through the air? How does this affect the motion of the egg?
2. What force affects the egg as the device impacts the ground? How does this affect the motion of the egg?
3. How can you control the forces that cause the egg to break?
4. List common ways to protect a moving object.
5. How does increasing the mass of your protective container affect the force of gravity on the container?

**Draw** some prototypes below. Circle your final decision.

**Partners’ Names:**

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Materials:**

Make a list of the materials you will need for your project. Who is going to bring what?

* Eggs (at least 3)

**\_\_\_\_\_\_\_\_\_\_ (Ms. Yost’s Initials) Solution Trial #1**

Draw your egg saving device

**Trial 1 Data**

1. **Did the egg survive the fall from 1 meter? \_\_\_\_\_\_\_\_\_\_\_\_**
2. **What was successful in the design?**
3. **What will you change to prepare for 3 meters?**

**\_\_\_\_\_\_\_\_\_\_ (Ms. Yost’s Initials) Solution Trial #2**

Draw your egg saving device

**Trial 2 Data**

1. **Did the egg survive the fall from 3 meter? \_\_\_\_\_\_\_\_\_\_\_\_**
2. **What was successful in the design?**
3. **What will you change to prepare for 10 meters?**

**\_\_\_\_\_\_\_\_\_\_ (Ms. Yost’s Initials) Solution Trial #3**

Draw your egg saving device

**Trial 3 Data**

1. **Did the egg survive the fall from 10 meter? \_\_\_\_\_\_\_\_\_\_\_\_**
2. **What was successful in the design?**
3. **What would you change if you did this again?**

**Project Analysis: (answer in COMPLETE sentences)**

1. What do you think the overall purpose of this project was?
2. Review your packet, if necessary. WRITE ONE SENTENCE that is an overall summary of what your group discovered.
3. Write one paragraph describing the procedure you followed during this project. Include enough detail that someone could recreate what you created.

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1. Write one paragraph that describes the hypothesis you used, what things you controlled, what the independent variable(s) was/were, and what the dependent variable was.

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1. Write one paragraph that describes any problems or errors you had, how your results compared to other groups, and any suggestions for improving this project.

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