# Assignment Summary

For this assignment, your teacher will give you a raw egg and some building materials. You will use these materials to build a device that will keep the egg from cracking when it is dropped from a certain height. You will test the device, determine how well it worked, and make recommendations to improve its design. You will present your final design and the logic that supports it in a lab report, which should include a title, an initial design, observations from your experimental tests, and recommendations for a final design based on impulse and momentum concepts as well as observations from the tests conducted. To help you write your lab report, there is a Student Worksheet on the last few pages of this document.

Background Information

About 2,500 lives are saved every year by airbags. The physics of this lifesaving device is based on the impulse and momentum relationship. Impulse is equal to the change in momentum. The greater the impulse on an object, the greater the change in momentum. Airbags lessen the damage caused by collisions by decreasing the magnitude of the force that is exerted on a person during a collision.

The concept upon which the lifesaving property of airbags is based is the same concept you will use in this project to protect an egg. The shell of an egg is designed to distribute the force of an adult bird sitting on the egg, but it does not retain its form as well when faced with a sudden impact. Unprotected, the egg’s shell cracks and its contents splatter in many directions. During this project, you will design a device to protect an egg on impact by using your knowledge of the impulse and momentum relationship. The egg will be dropped from a designated height and allowed to collide with the ground. This is an engineering challenge because it combines physics principles with real building materials and design constraints. It provides you with the opportunity to think about a problem, construct a solution, and evaluate your solution’s effectiveness.

Safety

* Wear safety goggles, as the egg will be dropped and pieces of the eggshell could break off upon impact.
* The eggs are for experimentation only and should not be consumed during or after the experiment.
* The eggs should be protected from impact until they are loaded in the devices to prevent premature cracks prior to the testing phase.
* Devices should be dropped, not thrown. All actions should be purposeful.

Materials

|  |  |  |
| --- | --- | --- |
| * 4 sheets of 8 ½ x 11 inch paper * 1 meter of masking tape | * 1 resealable plastic bag (sized for an egg) * 1 meter of string | * 3 straws * Eggs * White school glue |

# Assignment Instructions

**Step 1: Gather materials.**

1. Collect the resealable plastic bag and building materials from your teacher.

**Step 2: Design your prototype.**

1. Study your building materials and think about a design that would protect the egg when it is dropped from a set height. Write down some basic ideas for your prototype design using the Student Worksheet.

There are three criteria to consider in your design:

1. The egg must be placed inside the plastic bag. The bag must then be sealed, without any air trapped inside.
2. If the egg breaks, the mess must be contained by the plastic bag. The plastic bag may not be used as part of the device; it should be used only as a containment measure for the egg that will allow the egg to be inspected for breakage after each drop attempt.
3. The device must travel with the egg during its descent.
4. Sketch out at least three ideas on the Student Worksheet for a device that would protect the egg from impact.
5. Consider the advantages and disadvantages of each device and list them under each diagram.
6. Decide on the design you will use for the prototype.
7. Use your knowledge of the relationship between impulse and momentum in the evaluation of each design.
8. Select a design that you can build within the time limit provided by your teacher.
9. Fill in the Student Worksheet to Indicate which design you will use for your prototype and explain your reasoning for selecting that particular design based on physics principles.

**Step 3: Build your prototype.**

1. Use the materials provided by your teacher to construct the device. Write down any modifications that you made to the basic design during the construction process on the Student Worksheet.

**Step 4: Test your prototype.**

1. Make predictions about your device and record them on the Student Worksheet.

* Will your device prevent the egg from cracking upon impact with the ground? If so, how will it do this?
* Will your device increase the time it takes for the egg to impact the ground? If so, how will it do this?

1. Take your bag-enclosed egg and device to the testing area designated by your teacher. You will have up to three opportunities to test your device.
2. Record your observations each time you test your device on the Student Worksheet for later evaluation of your design. If the egg breaks, then your testing opportunity is over.

**Step 5: Evaluate your prototype’s design.**

1. On the Student Worksheet, record what worked well with your design.
2. Record which features can be improved.
3. Recommend at least one suggestion in the design process that would improve your device. Provide a reason, based on at least one impulse or momentum concept, to explain why this change would be an improvement.

**Step 6: Propose a final design for the device.**

1. Draw a labeled diagram of your improved design on the Student Worksheet.
2. Base your improved design on the information gained through testing your first device, as well as from research, observations, and/or further testing.
3. The final design can either use the initial materials list or be expanded to include other materials not included in the first design.
4. This revised drawing should be part of your lab report conclusion.

**Step 7: Write your lab report.**

1. Combine your data and observations to write your lab report.
2. Your lab report should include the following:
   1. Title
   2. Three rough sketches showing your initial design ideas
   3. The advantages and disadvantages of each design idea
   4. The design idea you decided to build and why you chose that design
   5. Data and observations from the experimental tests
   6. At least one suggestion that would improve your device along with a reason this change would be an improvement
   7. One labeled drawing of your final design

**Step 8: Evaluate your lab report using this checklist.**

If you can check each criterion below, you are ready to submit your lab report.

* Does it include a title?
* Does it include three rough sketches of your initial design ideas?
* Does it include the advantages and disadvantages of each design idea?
* Does it include an explanation of why you chose to build your initial design?
* Does it include data and observations from the experimental tests of your device?
* Does it include at least one suggestion of how to improve your device and an explanation of why this suggestion is an improvement?
* Does it include one labeled drawing of your final design?

**Step 9: Revise and submit your lab report.**

1. If you were unable to check off all of the requirements on the checklist, revise your final lab report and save it before submitting.
2. When you have completed your lab report, return to the Virtual Classroom and use the “Browse for file” option to locate and submit your assignment, or turn it in to your teacher if required. Congratulations! You have completed your engineering design challenge.

Egg Drop Student Worksheet

Use this worksheet to design your device and record your data. You can then use this form to help you write your lab report.

Height of egg drop: \_\_\_\_\_\_\_\_\_\_

**Ideas for Prototype Design**

**Preliminary Sketches (attach separate paper if needed)**

Option A:

Advantages: Disadvantages:

● ●

● ●

● ●

Option B:

Advantages: Disadvantages:

● ●

● ●

● ●

Option C:

Advantages: Disadvantages:

● ●

● ●

● ●

Which of the three designs will you move forward with? Explain your reasoning for selecting this design.

**Building the Prototype**

What modifications, if any, did you make to the basic design during the construction process?

**Predictions**

Will your device prevent the egg from cracking upon impact with the ground? How will your device do this?

Will your device increase the time it takes for the egg to impact the ground? How will your device do this?

**Observations**

Record your observations and the results of the experimental tests of your device below.

**Evaluating Your Prototype**

What worked well?

Which features can be improved upon?

**Suggestions**

How could the design of this device be improved?

Why would this change be an improvement? What impulse or momentum principle is this improvement based on?

**Sketch of Final Design**

Draw a well-labeled sketch of the final design.