Egg Crash Vehicle

Objective:
You and your partner(s) will design a restraint system and a bumper for an egg transporting vehicle with the supplied materials. The egg must survive a head on collision.

Materials:
- Existing MTV (Base only)
- 2 sheets of computer paper
- 1 egg carton spot
- 4 rubber bands
- 80 cm piece of masking tape
- 14 wooden coffee stirrers
- 10 cm x 15 cm piece of foamboard
- 2 paper Dixie cups
- 4 Large paper clips
- 10 Cotton Balls
- 5 straws (With wrappers)
- 50 cm of string
- 1 Quart sized Ziploc bag
- 4 Popsicle sticks
- **1 item brought from home**
  - No larger than 10 cm x 20 cm x 1 cm
  - Approved by Mr. Gunkelman or Mr. Martin

Other information:
- Your lab report points will represent your grade AND as currency in this lab
  - You may use these points to "purchase" replacement materials
  - You will start with 3 bonus points
- You will lose 2 points for each part of your restraint system and/or bumper that does not reflect the draft
- You may "spend" a point to change your draft after Mr. Gunkelman has signed off on it but you will have to explain why you are making the change.
- Restraint systems, bumpers, and vehicles are NOT allowed to leave the school
- You must be able to set the egg into the vehicle on testing day AND remove the egg after the test
- You will have **2 CER's** for this project!

Brainstorming Day 1

- You cannot modify ant materials or start construction!
- Create a rough drawing of your restraint system AND explain, using scientific principles, how it will help save the egg (Mr. Gunkelman MUST sign off on this)
  - Your explanation is your hypothesis (Use this for your CER)
  - Make sure you put time into this because your restraint system must look like your drawing
  - Make sure you KEEP this so you can turn it in at the end of the project
- Create a rough drawing of your bumper AND explain, using scientific principles, how it will help save the egg (Mr. Gunkelman MUST sign off on this)
  - Your explanation is your hypothesis (Use this for your CER)
  - Make sure you put time into this because your bumper must look like your drawing
  - Make sure you KEEP this so you can turn it in at the end of the project

Brainstorming Day 2

- If there are any final changes you came up with overnight, you must re-draw your restraint system or bumper and have Mr. Gunkelman sign off on it

Building Day 1

- Mr. Gunkelman MUST SIGN OFF ON YOUR PLANS BEFORE YOU START BUILDING
- Remember, your vehicle <u>**MUST**</u> look like your drafts!!!
- Have Mr. Gunkelman sign off on your item you brought from home
- Start construction of the restraint system and/or bumper
  - Chose which part you are going to construct first
    - Does it matter which part you construct first?
  - Figure out who is going to do what
  - Remember, you may purchase replacement materials

Testing Day

- You will roll your car down a straight ramp that is 1 -3 meters in length
  - You will have to record this distance in centimeters
- You will record the mass of your vehicle and egg BEFORE you test
- Make sure you record the TIME!!

Using the time and mass data collected, you will calculate:

- The weight (N) of the vehicle
- the speed (m/s) of the vehicle
- the acceleration (m/s^2) of the vehicle
- the force (N) of impact of the vehicle
- the momentum (kg*m/s) of the vehicle

What you need to record on Test Day

Mass of your vehicle and egg

_____________________grams

____________________ kilograms

Distance your vehicle traveled:

_____________________centimeters

_____________________meters

Time for your vehicle to reach the wall:

_____________________seconds

Mass Conversion Math

Length Conversion Math:

Math Sheet

Write down your Givens, Show your work and CIRCLE your final answer

Weight (N):
Speed (m/s):
Acceleration (m/s^2):
Force (N):
Momentum (Kg*m/s):

Rough Draft and Hypothesis for the Restraint System:

Hypothesis: ____

____

____

____

____

Rough Draft and Hypothesis for the Bumper:

Hypothesis: ____

____

____

____

____

CER Example

Hypothesis

You hypothesis must relate to the problem and you must support your hypothesis with your own reasoning. I must sign off on your hypothesis **BEFORE** you start the lab.

Data

Your data should be copied in the correct format (data table, graph, etc.)

Conclusion

You will report your conclusion in the CER format. (See Table Below)

Claim	Your "conclusion"
Evidence	Supporting data (quantitative and qualitative)
Reasoning	Justification that connects your evidence to your claim.

CER Rubric

Component	5	4-2	1-0
Claim	States hypothesis and indicates if it was supported or not supported Claim is accurate and complete	Claim does not state if hypothesis was supported or not supported Claim is accurate but not complete	Claim does not relate to hypothesis Does not make a claim or inaccurate claim
Evidence	Evidence is supported and appropriate Evidence related to the recorded data	Includes inappropriate evidence or not enough evidence	Evidence not provided or evidence does not support the claim
Reasoning	Reasoning links evidence to the claim Includes related scientific principles	Provides inadequate reasoning Insufficient scientific principles included	Reasoning does not link evidence and claim Insufficient (No) scientific principles included

Example of a full credit CER conclusion

Claim: Our hypothesis stated that Acceleration and Force are directly proportional. This hypothesis was supported.

Evidence: As we increased the distance we pulled the rubber band back, the faster the marble reached the target.

Reasoning: Since the marble reached the target faster, this would lead us to believe it was moving faster when it reached the target. After recording the amount of time it took the marble to reach the target we notice that as the rubber band was stretched farther back, the marble reached the target in a smaller amount of time. This means the marble had a larger acceleration because $a = \Delta v/t$. We also measure the amount of force the rubber band was producing when we pulled it back. The data showed that as you pulled the rubber band back further it produced more force. According to Newton's 2nd Law, $a = F/m$ (or $F = ma$). Our data supported this because as the force increased, the acceleration of the marble also increased.