FSEA PROJECT PLANS

March 29, 2000

EGG DROP
ED1

Applicable Grades	4th through 12th
Number of Members Per Team	Two
Number of Drops Per Team	One
Number of Sessions	Two to Four

SKILLS AND ENGINEERING CONCEPTS DEVELOPED:
Inertia, mass, primary and secondary impacts, gravity, the concept of the dissipation of force

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Opinions expressed are those of the authors and not necessarily those of the foundation.

INTRODUCTION

Gravity is a powerful force that has a fundamental impact on the way we live our lives. Even walking, which we take for granted, is not possible without gravity. Gravity provides the necessary downward force on our bodies which creates friction between our feet and the ground, allowing us to walk (push our body weight forward with one leg and then the other). When astronauts tried to walk on the moon, they found it extremely difficult, as the gravity on the moon is approximately one sixth of what it is here on earth. When we jump into the air, even though it is only for a second or two, we can be said to be momentarily overcoming the force of gravity. Engineers have designed many ways to overcome the effects of gravity. For instance, in a Dodge Truck commercial, a truck is dropped to the ground from a height of perhaps three feet. The truck should be damaged by this fall, but the truck is equipped with shock absorbers and springs. The shock absorbers and springs of the truck dissipate the kinetic energy of the truck falling, compressing them almost to the point where the bottom of the truck hits the ground. The truck, because of the shocks and springs, finally returns to its designed position, with the bottom of the truck a foot or so off the ground.

When other forces are combined with gravity, such as motion (the movement of an object), inertia (the tendency of an object to resist change with regard to movement based on its mass), or power (the ability to exert energy over time), it may be impossible to prevent an impact which will cause damage. For instance, if you roll an egg along the ground downhill at considerable velocity towards a wall, you can reasonably expect the egg to break. Your arm provided the force (power) to accelerate the egg to a certain velocity (motion). That motion is being increased due to the acceleration of the egg down the hill (gravity). The egg will not drastically vary its direction and avoid the wall (inertia tends to keep it moving in a straight line). The combination of power, gravity, motion and inertia will probably be sufficient to result in an impact between the egg and the wall that breaks the egg. This impact is called the primary impact.

There is a further impact which takes place when the egg hits the wall, this is when the mass inside the egg impacts against the inside of the wall of the egg. The egg white and egg yolk are usually in liquid form, and though liquid has considerable mass, the liquid inside the egg will rarely be the cause of the egg shell breaking. If you put a steel ball bearing into a plastic egg, and then shake the egg, you can hear the impact of the ball bearing hitting the inside of the egg, and it is easy to imagine the egg cracking because of the steel ball bearing. The impact resulting from the ball bearing striking the inside of the plastic egg due to the motion or change in motion of the egg is called the secondary impact.

Scientists and engineers have been working for many years to reduce the effect of impacts, primarily in the automobile industry. Efforts to reduce the primary impact (energy absorbing bumpers, crumple zones, modified chassis construction) and efforts to reduce the secondary impact (airbags, padded dashboards, collapsing steering wheels, seatbelts) are commonplace.

OBJECTIVE

The objective of the project is to successfully drop a packaged egg from a predetermined height without breaking the egg.

PROJECT DESCRIPTION

Teams might want to research the latest discoveries on how best to dissipate force. Teams should then decide on the concept they want to employ, and begin the design process. Once the prototype egg container has been designed, teams should create a list of materials required for the construction of their design. This Materials List should be submitted to the mentors. If the mentor approves the design, and the materials fall within the established criteria (see Design Constraints), the mentor will supply the material. Teams should then construct their egg container, and begin testing.

RESEARCH REQUIRED

Students should be encouraged to research aspects of this project that they find interesting. Learning mathematical formulas to calculate the force of an impact, researching the impact absorbing capability of different materials, identifying the most stable geometric structures, or even studying the basic egg are all research opportunities related to this project.

CONSTRAINTS

Materials must be readily available. It is a good idea for mentors to discuss this project before it is introduced to the students. Mentors can then limit the material available to students. In one club, mentors limited available material to plastic straws only. Since the weight of all of the resultant egg containers was hard to distinguish on ordinary scales, the winner was the team that used the least number of straws and still prevented the egg from being broken. Will teams be able to utilize a parachute, perhaps completely foregoing the need to develop an energy-absorbing container? If so, perhaps a three foot target ring could be employed in the impact area, and landing inside the target ring could be a scored or qualifying criteria. For a listing of material supplied by FSEA with this project, see the Facilities and Equipment section. More of any of these items can be requested as needed at no additional charge.

It is critically important to locate the competition site in advance. The Competition Site information is necessary for teams, who need to know the approximate impact their egg containers will need to absorb. Second floor windows, balconies, stadium walls, second floor landings or stairwells, all these are places where the competition could be held. It is often the case that many of the egg containers preserve the egg intact, and although this reinforces success, it is often harder for the winner to be determined. One club, having just completed CT1 (The Beginning Catapult), modified a catapult and launched the egg containers at point blank range into a wall. As long at the method used in the competition is verifiably consistent from one egg container to the next, it will suffice. Teams may be able to practice at a location different than the competition location, it is up to the mentors to decide.

A final constraint is the allowable size of the egg containers permitted in the competition. It is reasonable to require that no single dimension of the container exceed six inches. Again, the mentors can decide what is most appropriate for their club.

CONSTRUCTION AND TESTING

Teams will construct their impact absorbing containers according to the designs they submitted to the mentor. Should they discover flaws in their design during the test phase, they should go back to the drawing board and resubmit a design or a design modification. Depending on what mentors have decided under the Constraints section above, teams can be issued new material (if material is being limited in any way, ALL remaining material from the previous design must be turned in prior to the issuing of new material). Students may utilize the plastic eggs and #2 fishing weights in determining the effectiveness of their prototype containers. If mentors are in agreement, it might be possible for students to bring material from home for use in their prototypes, but ALL CONSTRUCTION OF THE EGG CONTAINERS MUST BE DONE IN THE CLASSROOM DURING THE WEEKLY FSEA CLUB MEETING. Testing may be conducted at the competition site, but if that is impractical for weekly usage, an alternate location can be established which will still give teams the ability to submit their prototype containers to adequate impact stress.

COMPETITION

The competition determines whose method enables an egg to survive a drop from a readily available height (second floor window or balcony, stadium wall, 2nd floor landing or stairwell, etc). Each package will be weighed before drop (including the egg). All packages will be dropped from the same height. In the event there is more than one successful drop, winners will be based on the lightest weight package.

LESSON PLAN BY SESSION

This is a guide only.

Session #1

- Mentor discusses the project and some approaches.
- Form teams of two.
- Announce the egg drop location and height.
- Students illustrate their concepts and make a list of material that the mentor must **approve.**
- The teams or mentor may provide materials, as appropriate.

Session #2

- Build and test the designs

Session #3

- At the Competition Site:
  - Demonstrate how the egg is dropped
  - Last minute tuning
  - Weigh packages including the egg
- Hold the Competition:
  - Drop the eggs and record results

Session #4

- Awards and Post-Competition discussion. Student teams discuss what did and did not work, and why.

FACILITIES AND EQUIPMENT

Provided by FSEA

- Plastic Eggs
- Sandwich Bags
- #2 Fishing Weights
- * Packing Popcorn
- * Masking Tape
- * Straws
- * Rubber bands
- * String

Items with an asterisk (*) may be ordered in greater quantity as required

Provided by Mentor or Student

Real Eggs

Other materials as needed.

Samples: Rags, newspapers, cotton, balloons (air), bubble wrap, packaging materials.

FSEA will reimburse mentors for the actual costs (not to exceed $2 per student). Receipts must be submitted to FSEA.

Supplies may be purchased at a local hardware or office supply store.

Determined by the Mentors

Competition location

FAX (714) 229-2228

NAME♦	PHONE♦	
ADDRESS♦		
CITY♦	ST♦	ZIP♦
MY SCHOOL IS♦		
TODAY'S DATE♦ / /	DATE NEEDED♦ / /	

FILL IN YOUR ORDER BELOW. STEPS 1,2,3 (SEE CATALOG FOR PROJECT INFORMATION)

PROJECT NAME	CODE	NUMBER OF STUDENTS
STEP 1 (EXAMPLE) LAND YACHT	STEP 2 LY1	STEP 3 30

PLEASE, NO MORE THAN TWO PROJECTS PER ORDER FORM

T-shirts	SM	MED	LG	XLG	
Girls					Total
Boys					

Hats	One size fits all	

Membership Cards	Count
Engineer Technician	
Junior Engineer	
Engineer	
Senior Engineer	
Engineer Specialist	

Miscellaneous	Sets
Extra Ribbons - One set = One 1st, 2nd, 3rd	
Extra Certificates	
Portfolios	

Other (Please Note)
