

Curriculum topics:

- Motion & Forces
- Energy Transfer
- Design Challenges
- Properties of Materials
- Brainstorming
- Problem-Solving
- Creativity

Subject:

Physical Science

Grade range: 4 – 12

Who we are:

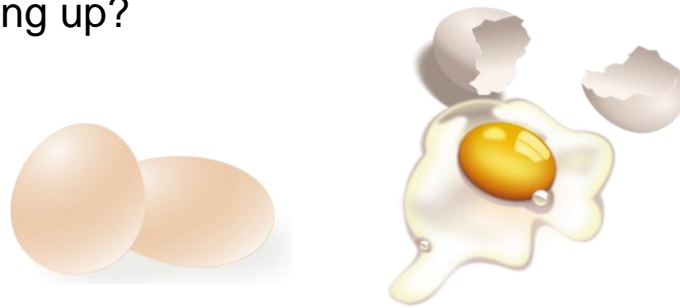
Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable “hands-on” activities that engage students and inspire the joy and discovery of learning.

For more ideas and to see RAFT Locations

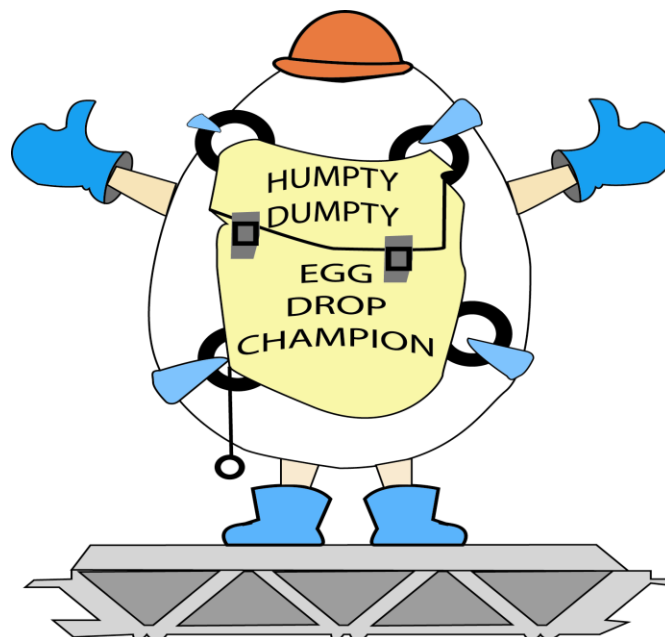
www.raft.net/visit-raft-locations

EGG DROP

How do you prevent a dropped egg from cracking up?



Students build a “vehicle” designed to prevent a dropped egg from breaking. In the process, they discover that combining simple materials with a little creative thinking and teamwork will reveal many ways to solve this intriguing challenge!



Materials required

Per team of 1-4 students: (a set of assorted materials – the RAFT kit includes)

- Raw eggs, 3 per team (not supplied in kit)
- Plastic “Easter” egg, standard size, 1
- Plastic cellophane sheet, ~60 cm x 60 cm (2' x 2'), 1
- Resealable bags, ~8 cm x 13 cm (3" x 5"), 3
- Cloth samples, ~20 cm x 20 cm (8" x 8"), 2
- Hanging file folder hangers, letter sized, with 2.5 cm (1") of file folder left on, 6
- Hanging file folder, bottom portion (with hangers cut off – see above), 1
- Straws, clear, ~21 cm (8"), 6
- Craft sticks, jumbo, ~21 cm (8"), 6
- Labels, ~2.5 cm x 6.7 cm (1" x 2 5/8"), 12
- Chenille stems, 6
- Double stick tape, ~11 cm (4½") wide, length ~1 m (3 ft)
- Crochet thread, #10, 1.8 m (6 ft) long
- Streamer or cloth, ~10 cm x 1.8 m (4" x 6 ft), 1
- Balloon, 12.7 cm (5"), 1
- Optional: Tape measure or ruler
- Optional: Large plastic garbage bag or tarp
- Optional: Glue gun or stapler

Caution: Rubber bands and balloons contain natural rubber latex which may cause allergic reactions.



WARNING:
CHOKING HAZARD—Children under 8 yrs. can choke or suffocate on uninflated or broken balloons. Adult supervision required.

Introducing the Design Challenge

To transform a classic Egg Drop activity into an even more powerful design challenge experience:

Take time to “set the stage.” Before you dive into the challenge, help students see how protecting an egg relates to real-world challenges faced by engineers who design things like bike helmets and Mars landers. As a group, get the students to brainstorm other things that absorb impact (car bumpers, air bags, foam balls, football pads, etc.).

Customize the materials to suit your group. For students who need an extra challenge, add a few of your own unusual materials to the mix, like feathers or silk flowers. For novice builders, consider including some obvious cushioning materials like foam cups or packing beads. (But not too many, because these materials can take the challenge out of the challenge!)

Preparation / Hints and Tips



CAUTION:

Raw eggs may contain harmful bacteria. To prevent illness from bacteria, put each egg into a sealable bag prior to use. Wash hands after touching eggs.



CAUTION:

If a ladder is used, have an adult drop the devices or provide supervision. Do not allow students to lean out windows, or go on roofs to test their devices. Keep spectators out of the landing zone.

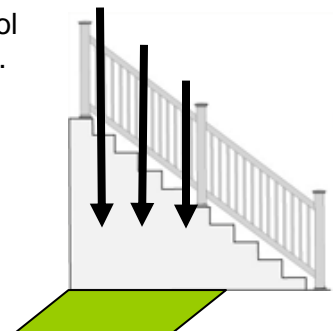
1

Set up the test zone prior to the activity. It can be as simple as a stepstool or a stairwell. A test zone with several intermediate drop heights is ideal. Students will feel more successful if they can test their device from a low height first, and then gradually increase the height until the egg breaks.

Tip: To make clean-up easier and to protect the floor, create a larger “drop zone” using a plastic garbage bag or tarp.

2

Set up the workspace in advance. Students will need plenty of room to spread out their materials and share ideas with their design team.

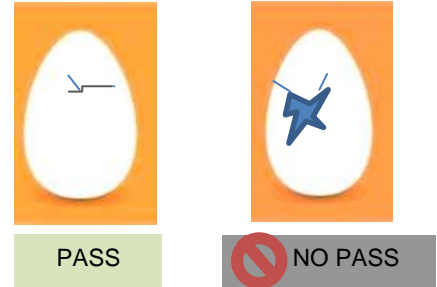


To do and notice

1 Share the challenge and the constraints. Express the challenge very simply: “Your team needs to drop an egg from X feet onto a hard floor without breaking it.” (For younger students, “breaking” can be defined as creating a hole in the shell. For older students, a hairline crack can count as a break.) Express the constraints very simply: “You can only use the materials I supply.”

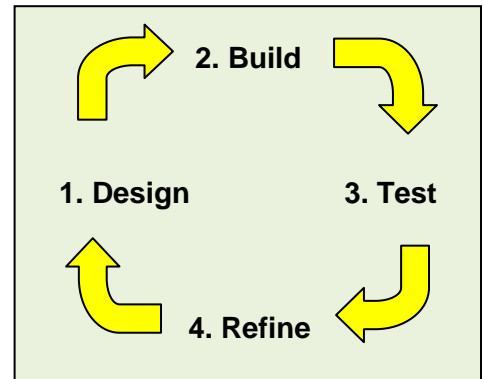
2 Reveal the materials. Now that the students are intrigued by the challenge and understand what their device needs to do, show them what they have to work with. This will surprise them! Their first reaction may be “What are we supposed to do with that?” Distribute the materials equally so that teams start with similar types and amounts of material. You may allow teams to trade unneeded items for materials they seek.

3 Define success: Provide the students with illustrations or examples of what a pass or a no pass egg looks like. (Some examples on the right.)



4 Facilitate the engineering process:

- Phase 1:
Brainstorm possible designs.
- Phase 2:
Build a quick prototype.
- Phase 3:
Test prototype at test zone.
(Teams take turns. To allow rapid inspection after testing, each vehicle must be easily opened without damaging the egg. Consider designating a neutral “egg inspector”.)
- Phase 4:
Refine design based on results of test.



Design-Build-Test-Refine Cycle

Set a short time frame for the first cycle – “You need to build and test your first prototype in 15 minutes.” Each team repeats Phases 1-4 with a new or refined concept. Guide them without giving detailed instructions – no hints on how to do it.

5 Show and Tell: When students have optimized their devices (or the allotted design-build-test time has run out), gather all the teams together at the test zone. Give each team a fresh egg, and invite each team to describe their device and then demonstrate it for all to see at the height of their choice. It is very important for all the teams to see what the others did. They will notice similarities and differences. For older students, have them “sell” the best features of their design. Draw out and celebrate examples of creative thinking, especially good ideas that were unique. Celebrate “spectacular failures” (great ideas that did not work).

6 Reflect: Invite the students to talk about the process. How long did they spend brainstorming? How did they divide the tasks? How did they react when their first prototype failed? This is the most important phase of the learning experience!

The science behind the activity

An egg raised above the ground has potential energy due to the force of gravity. When dropped, the egg’s **potential energy** is converted into the **kinetic energy** of motion. On landing, the egg must come to a stop without experiencing a **stress** (stress = force / unit of area) strong enough to break the shell.

Curriculum Standards:

Forces & Motion
(Next Generation Science Standards: Physical Science, Middle School, 2-2; High School, 2-1)

Gravity
(Next Generation Science Standards: Grade 5, Physical Science 2-1)

Minimize force on object during a collision
(Next Generation Science Standards: High School, Physical Science 2-3)

Compare Multiple solutions
(Next Generation Science Standards: Engineering Design, Grades 3-5, 1-2; Middle School, 1-2 & 1-4)

Design criteria & Test variables
(Next Generation Science Standards: Engineering Design, Grades 3-5, 1-3; High School, 1-3)

Science & Engineering Practices
(Next Generation Science Standards: Grades 4 – 12)

Additional standards at: <http://www.raft.net/raft-idea?isid=131>

Learn more

Extend this activity with the following suggestions:

- Add other constraints such as: limits on the weight, vehicle starting volume, amount or type of materials used.
- Encourage innovation by awarding prizes for the longest drop, the most successful drops with the same egg, the lightest vehicle, etc.
- After doing this as an in-class activity, offer extra credit to students who continue to work on the activity after school.

To learn how to transform this and other activities into Design Challenges, see the RAFT Idea Sheet [Designing Design Challenges](#).

Related activities: See RAFT Idea Sheets:

Design Challenges:

Leonardo's Arched Bridge -

[http://www.raft.net/ideas/Leonardos Arched Bridge.pdf](http://www.raft.net/ideas/Leonardos%20Arched%20Bridge.pdf)

Motion and Forces:

Car on a Roll -

[http://www.raft.net/ideas/Car on a Roll.pdf](http://www.raft.net/ideas/Car%20on%20a%20Roll.pdf)

Retractor a Go-Go Car -

[http://www.raft.net/ideas/Retractor a Go-Go Car.pdf](http://www.raft.net/ideas/Retractor%20a%20Go-Go%20Car.pdf)

Rollback Can -

[http://www.raft.net/ideas/Rollback Can.pdf](http://www.raft.net/ideas/Rollback%20Can.pdf)

Roller Racer -

[http://www.raft.net/ideas/Roller Racer.pdf](http://www.raft.net/ideas/Roller%20Racer.pdf)

Catapults: Motion (force, push or pull):

Craft Stick Catapults -

[http://www.raft.net/ideas/Craft Stick Catapults.pdf](http://www.raft.net/ideas/Craft%20Stick%20Catapults.pdf)

Flingy Thingy -

[http://www.raft.net/ideas/Flingy Thingy.pdf](http://www.raft.net/ideas/Flingy%20Thingy.pdf)

Staple Remover Catapult -

[http://www.raft.net/ideas/Staple Remover Catapult.pdf](http://www.raft.net/ideas/Staple%20Remover%20Catapult.pdf)

Rockets: Motion (force, push or pull)

Foam Tipped Stomp Rocket -

[http://www.raft.net/ideas/Foam Tipped Stomp Rocket.pdf](http://www.raft.net/ideas/Foam%20Tipped%20Stomp%20Rocket.pdf)

Puff Rocket -

[http://www.raft.net/ideas/Puff Rocket.pdf](http://www.raft.net/ideas/Puff%20Rocket.pdf)

Stomp Rocket -

[http://www.raft.net/ideas/Stomp Rocket.pdf](http://www.raft.net/ideas/Stomp%20Rocket.pdf)

Resources

Visit www.raft.net/raft-idea?isid=131 for “how-to” video demos & more ideas!

See this website for more information on the following topic:

- **Egg Drop from PBS Kids** – <http://pbskids.org/zoom/activities/sci/eggdrop.html>