

## **Bungee Egg Drop (Coach Scheduled Testing - 45 Minutes)**



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**Description:** Design and construct a bungee cord system to protect a raw egg from breaking that jumps from the top of a two-story stairwell. They will also answer questions on a written assessment on the principles of the law of conservation of energy, elastic potential energy, gravitational potential energy, and kinetic energy.

### **Participants per assigned Team Number: 2**

- If your school has 1 team you will send 2 students
- If your school has 2 teams you will send 2 students per team number; team numbers may not intermix
- If your school has 3 teams you will send 2 students per team number; team numbers may not intermix

### **Spirit of the Problem:**

- The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect (see Science Olympiad Pledges below). Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage).
- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

### **Safety Teams Must Bring:**

- **ANSIZ87 D3 Splash/Droplet standards; goggles must be worn during all event testing.**
- **If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.**
- **If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.**

### **Category C: Indirect Vent Goggles**



**Eyeglasses and Safety Glasses are not safety rated for this event!**

### **Materials Provided at Event:**

- An assortment of rubber bands length sizes #64, #33, #19, and #117B.
- 50 cm of 2.54 cm masking tape
- 1 large egg
- 1 sandwich or snack sized plastic bag

## **1. Construction Phase: Timed 25 Minutes**

### **a. Building**

- i. The Event Supervisor will announce the Target Drop Distance (TDD) from the second-floor railing to the artificial horizon at the start of the construction phase.
- ii. The artificial horizon is a line drawn at a zero point in the middle of a paper chart labeled from +100 cm to -100 cm.
- iii. The partners:
  - a. will choose and connect rubber bands to create a bungee cord. They may cut the rubber bands to any size or leave them whole and may tie them together in any manner they choose
  - b. choose a room temperature egg from those provided
  - c. seal their egg in the provided plastic bag. Any egg leakage upon breaking will be a tier violation
  - d. attach their bungee cord to the bag by tying a knot, using the masking tape or both. No masking

- tape may be used to support or strengthen the egg or the plastic bag.
- e. announce to the Event Supervisor their estimate of how close to the artificial horizon their egg will stop on its best drop.

**b. Written assessment**

The pair will answer assessment questions **simultaneously with the 25-minute building phase** on the principles of the law of conservation of energy, elastic potential energy, gravitational potential energy, and kinetic energy. On their assessment paper the team will state their estimated difference their egg will stop before hitting the floor.

**2. Competition Phase:**

- a. At the direction of the Event Supervisor, the partners will:
  - i. attach their bungee end opposite the encased egg to the Retaining Hook on the Bungee Jump Platform, making sure that the rest of their rubber bands are hanging loose over the front of the platform
  - ii. place and hold the egg at the end of the jump platform in a vertical position
  - iii. announce to the Event Supervisor they are ready to drop and wait for a reply from the supervisor that they have the camera ready, then count down from 3 and open their hand letting the egg free fall forward off the platform. **DO NOT PUSH THE EGG!**
- b. The event supervisor will set their video recording device to show the entire Artificial Horizon Chart (marked in 1 centimeter increments from -100cm to +100 cm) and record the fall in slow motion.
- c. The students will receive two drops and may make changes to their bungee in between the drops.
- d. An egg is deemed to be broken if there is visible leakage from its shell. An egg may have cracks and still not leak. To determine if there is no leakage the egg will be removed from the plastic bag by the team and rolled on a paper towel. Any wet areas on the towel will indicate leakage

**3. Event Supervisor Records:**

- i. The estimate given by the pair
- ii. Slow motion video of the egg with the Artificial Horizon Chart in the background
- iii. The distance from the horizon, plus or minus, to the nearest centimeter mark
- iv. Written assessment scores

**4. Tier Violations**

- a. A tier violation is a penalty to a team for not following the build guidelines or the spirit of the problem as judged by the Event Supervisor. Teams placed in tiers 2 or 3 will receive scores reduced by 20% and 30% respectively.
  - i. Tier 1. The team device meets all the building requirements, the egg remains unbroken, and the team follows the Spirit of the Problem guidelines
  - ii. Tier 2. The team device is deemed to have a construction or time fault violation, and the team follows the Spirit of the Problem guidelines
  - iii. Tier 3. The team did not follow the Spirit of the Problem guidelines.

**5. Scoring:**

- a. Score Computation
  - i. Final Score (FS) = AS + max(DS1, DS2)
  - ii. Assessment Score (AS) =  $50 \times \text{RAS} \div \max(\text{RAS for all teams})$
  - iii. Raw Assessment Score (RAS) = team's score on the assessment in whatever point system is awarded by the assessment's questions.
  - iv. Drop Score 1 (DS1) =  $50 \times (\text{TDD} - \text{DD1}) \div \max(\text{TDD} - \text{DD1} \text{ and } \text{TDD} - \text{DD2 for all teams})$

- v. Drop Score 2 (DS2) =  $50 \times (TDD - DD2) \div \max(TDD - DD1 \text{ and } TDD - DD2 \text{ for all teams})$
- vi. Target Drop Distance (TDD) = the announced distance from the drop location to the artificial horizon. The minimum TDD will be 200cm.
- vii. Drop Distance 1 (DD1) = 200cm if the egg drops below the artificial horizon, otherwise the distance from zero (the artificial horizon) to the lowest point of travel of the egg on the first egg drop. If the egg's lowest point is too high to be measured, then DS1 = 200cm.
- viii. Drop Distance 2 (DD2) = 200cm if the egg drops below the artificial horizon, otherwise the distance from zero (the artificial horizon) to the lowest point of travel of the egg on the second egg drop. If the egg's lowest point is too high to be measured, then DS2 = 200cm.

b. Example

- i. The team's raw assessment score is 6, and the best raw assessment score is 9. (AS) for the team =  $50 \times (6 \div 9) = 33.33$  points
- ii. The team's first drop distance is below the artificial horizon, and their second drop distance is 13 cm. The best drop distance among all the teams is 7 cm, and the target drop distance is 400 cm. Then  $DS1 = 50 \times (400 - 200) \div (400 - 7) = 25.45$ , and  $DS2 = 50 \times (400 - 13) \div (400 - 7) = 49.24$
- iii. FS =  $33.33 + \max(25.45, 49.24) = 82.57$

6. Tiebreakers

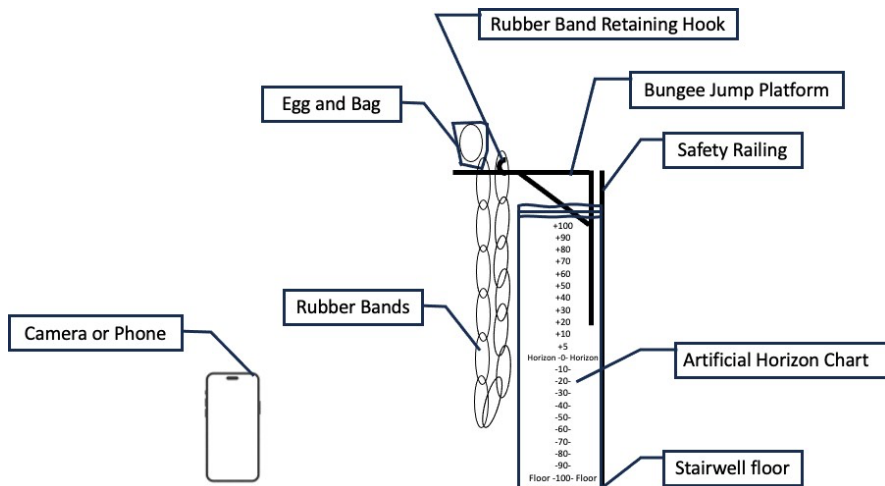
- i. The smallest difference between the actual and estimated distances
- ii. Correct answers on selected written assessment questions

Possible Resources:

- b. Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events.
- c. **Use the listed resources and study guides as starting points. The study guide was created using Gemini AI and is meant as a beginning foundation! It may or may not contain topics occurring within the competition. It is up to the competitor to research further.**
  - [Egg Bungee - Griffin Museum of Science and Industry](#)
  - [Bungee-Jumping Egg – Flinn Scientific \(.pdf download\)](#)
  - [Egg Bungee Teacher Notes – Science Scope, February 2005 \(.pdf download\)](#)

Competition Diagram (not to scale):

Note: The paper chart does not have to be placed so that the -100 is at the stairwell floor.



## Bungee Egg Drop Study Outline

**Caution, this is a sample outline. It was Gemini AI generated and is meant as a starting point! It may or may not contain topics occurring on the written test.**

### I. Core Concepts

- Law of Conservation of Energy:
  - Understand the principle: Energy cannot be created or destroyed, only transformed from one form to another.
  - Identify different forms of energy involved in the egg drop:
    - Gravitational Potential Energy (GPE): Energy stored in an object due to its height.
    - Kinetic Energy (KE): Energy of motion.
    - Elastic Potential Energy (EPE): Energy stored in a stretched or compressed elastic material (like the bungee cord).
- Gravitational Potential Energy (GPE):
  - Formula:  $GPE = mgh$  (where  $m$  = mass,  $g$  = acceleration due to gravity,  $h$  = height)
  - Factors affecting GPE: Mass of the object and its height.
- Kinetic Energy (KE):
  - Formula:  $KE = \frac{1}{2}mv^2$  (where  $m$  = mass,  $v$  = velocity)
  - Factors affecting KE: Mass of the object and its velocity.
- Elastic Potential Energy (EPE):
  - Understand how EPE is stored in the bungee cord.
  - Recognize that the amount of EPE depends on the stiffness (spring constant) of the cord and how much it is stretched.

### II. Bungee Cord System Design

- Materials:
  - Gather necessary materials: Rubberbands, metric measuring device, plastic sandwich bags, plastic eggs for size filled with clay for weight, tape.
- Design Considerations:
  - Cord Selection:
    - Experiment with different band thicknesses and lengths.
  - Testing and Refinement:
    - Conduct initial tests from lower heights.
    - Adjust the cord length.

### III. Experimental Procedure

- Safety Precautions:
  - Wear safety goggles.
  - Ensure a clear drop zone with no obstacles.
  - Have a spotter to assist during the drop.
- Data Collection:
  - Measure the height of the drop.
  - Record observations during the drop (e.g., cord stretch, egg movement).
- Data Analysis:
  - Analyze the results of the egg drop.
  - Determine if the egg survived the jump.
  - Identify areas for improvement in the design.

### IV. Written Assessment

- Questions on Energy Concepts:
  - Explain the Law of Conservation of Energy in the context of the egg drop.

- Describe how GPE, KE, and EPE change throughout the jump.
- Calculate GPE, KE, or EPE at different points in the jump (if applicable).
- Analyze how changes in height, velocity, and cord stretch affect energy transformations.
- Design and Procedure:
  - Explain the design choices made for the bungee cord system.
  - Describe the experimental procedure and any modifications made during testing.
  - Discuss the successes and failures of the design.
- Analysis and Conclusions:
  - Analyze the data collected during the experiment.
  - Draw conclusions about the effectiveness of the bungee cord system.
  - Identify areas for future improvements.

#### V. Tips for Success

- Work as a team: Collaborate to brainstorm ideas, conduct experiments, and analyze data.
- Sketch and diagram: Draw diagrams of the bungee cord system and the energy transformations.
- Use a table: Organize data and observations in a clear and concise table.
- Practice calculations: Practice calculating GPE, KE, and EPE using sample problems.
- Review notes and concepts: Thoroughly review the concepts of energy, forces, and motion.

Note: This is a general outline, and the specific content and depth of the study guide may vary depending on the grade level and the specific learning objectives of the activity.

Remember to:

- Consult with your teacher for specific instructions and requirements.
- Ask questions if you are unsure about any of the concepts or procedures.
- Have fun with the experiment!