Trajectory
Division B & C

General Idea

- Construct a launch device that can shoot a projectile of certain mass and size at a target at variable distance and altitude

- Develop calibration graphs to deal with the above variables

Space Requirement

NEW

- Device must fit into cube with 0.7 m side lengths for Div. B and 0.6 m for Div. C (before and after launch!)

- Device must be placed in 1m x 1.5m launch area and triggered from outside area

1 m

1.5 m
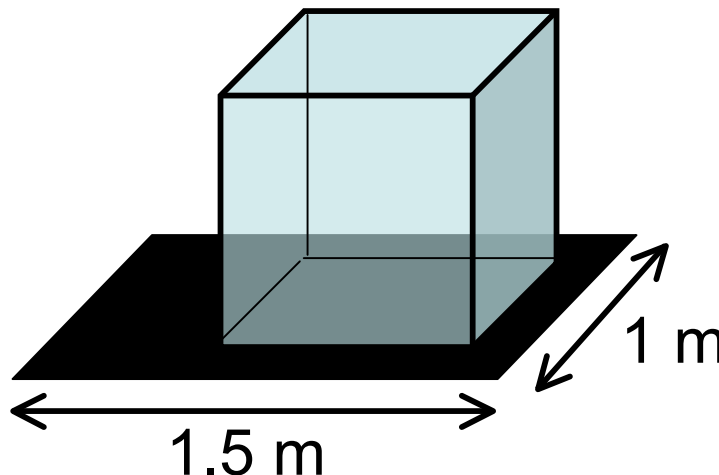
Boundary Conditions

- You bring the projectile: "unmodified (labeling is permitted) tennis balls, racquetballs, ping-pong balls, **or plastic practice golf balls** to be used as projectiles. *Different* projectiles may be used for each launch."

  NEW

- Launch force must be provided by "non-metallic elastic solids"
  - No: springs
  - No: counterweights
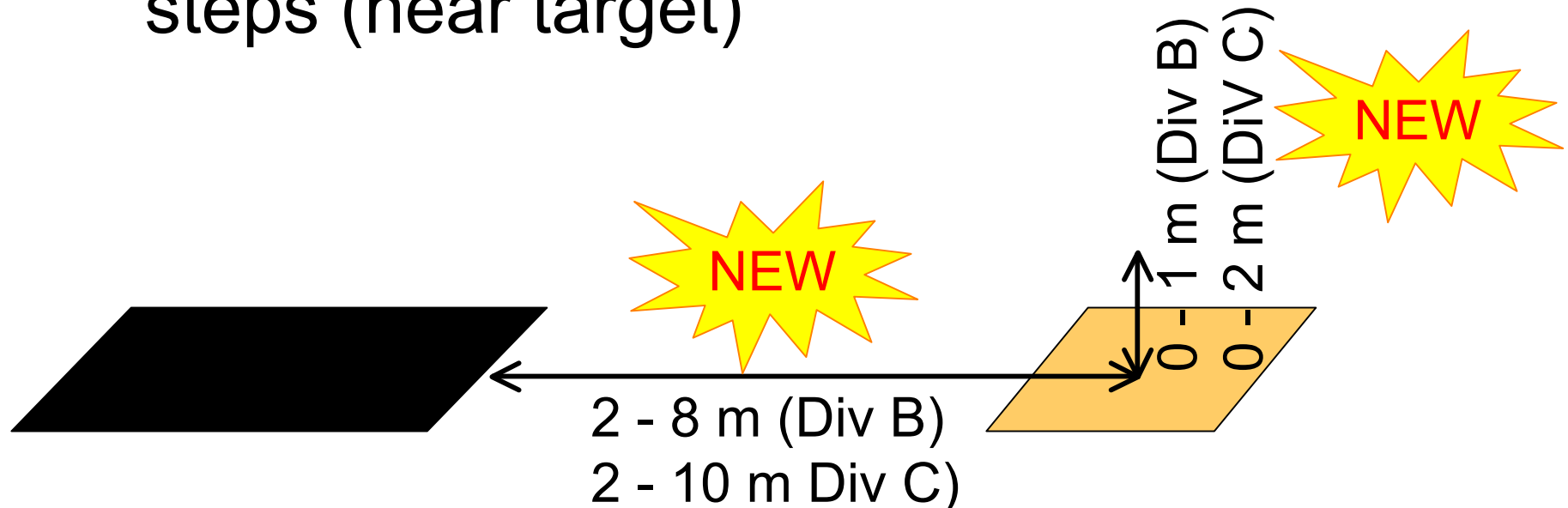 - Yes: rubber tubing, bungee cords, …

Target

- 1 m x 1m area, with center marked
- Filled with sand to depth of 1 cm
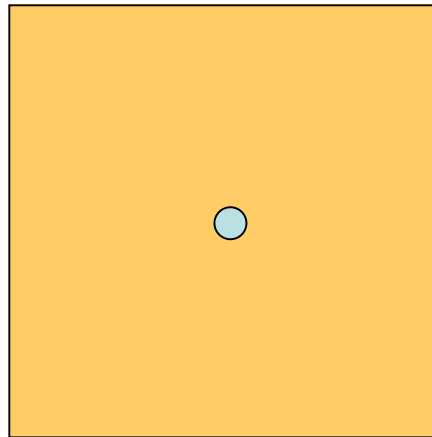
Target Placement

- 2 targets; center between 2m and 8m/10m from front of launch area, in 0.5 m steps, at height of up to 1m (Div B) / 2m (Div C) above ground in 0.01m steps (near target)

NEW

NEW

0 - 1 m (Div B)

0 - 2 m (DiV C)

2 - 8 m (Div B)

2 - 10 m Div C)

New in 2010: Bucket

NEW   NEW

- By request only; otherwise not present
- Bucket size ~1 to ~5 gallon
- Placed on the ground between 2 & 8 (B) / 10 (C) m from front of launch area and up to 2 m to the left/right of the center line
- Teams can attempt a bucket shot if the first shot at a target hits target

Competition

- 10 minutes maximum
- 2 shots on each target
- **Winner** is the team with the *lowest* final score (just like golf!)
- **Final score** = *lower* score from target 1 + *lower* score from target 2 + graph score + penalties **- bucket score**

NEW

Target Scores

- Score = distance (in mm) between center of target and center of first projectile impact

- If you miss the near target, then the score is 800

- For the far target, there is no upper limit, but the distance is recorded in mm

- *Prediction: If you miss one target twice, you will not place in the top 10. Guaranteed!!!*

Graph Score

- Start with 400 points
- Select up to 4 graphs (on graph paper or computer drawn) and have them judged
- *I will pick 1 of the 4* graphs and judge it, then multiply the points for this graph by 4 (or number of graphs turned in, if less than 4)

NEW

- Each graph can lower score by 100 points
  - Up to 20 points for complete data table
  - Up to 20 point for drawing
  - Up to 20 points if drawing matches data
  - Up to 40 points for proper labels (title, team name, x & y axis variables, increments with units)
- Best graph score: 0

NEW # Bucket Score **NEW**

- (remember: you can only attempt the bucket shot, if you hit either target on first try)

- Hit the bucket on the fly: 50 points

- Hit the bucket on the fly, with the ball remaining in the bucket: 100 points

Penalties

- 100 points each for
  - Team member does not wear safety glasses ("**rated ANSI Z87+**")
  - Any team member body part is in target or launch area during launch
  - Any part of device is outside of launch area during launch
  - Launch without warning

Tiers

- First tier: teams that have device **NEW** meeting all specs.

- Second tier: teams that don't

- All teams in the first tier will be ranked ahead of all teams in the second tier.

Example 1: four shots hit targets

- Four shots miss by $(475, 598)_{near}$ and $(195, 217)_{far}$ mm

- One team member did not wear classes

- Graph score was 180

- Final score = 475 + 195 + 100 + 180 = 950

Example 2: one lucky hit on far target, all others miss

- Four shots miss by $(800, 800)_{near}$ and $(55, 2705)_{far}$ mm

- No penalties

- Graph score was 0 (perfect drawings!)

- Final score = 800 + 55 + 0 + 0 = 855

Example 3

- Near target hit on first try: 76 mm
- Bucket shot yielded a hit, but ball came out: -50 points
- Far target hit on first try: 22 mm
- Bucket shot resulted in ball staying in bucket: -100 points
- Perfect graphs, no penalties
- Score: 76 - 50 + 22 - 100 + 0 + 0 =-52

Tiebreakers

1. Sum of near and far target scores

2. Closest shot overall

3. Non-scored shot at far target

4. Non-scored shot at near target

What will it take to win / get a medal?

- 2009 in Div. B: (no bucket shots)
  - First place score: 61
  - Second place score: 63
  - Third place: 105
  - …
  - Sixth place: 181
- Prediction: In 2010 we should see *negative* scores from the winners!