On Target

Grades: Grades 2-5
Team Size: 1 - 3 competitors
Duration: 30 minutes
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Summary Description

Each team builds exactly 6 missiles, utilizing precision straws as the missile body. Missiles are constructed during the time of the event, using only materials provided by WESO. Missiles are launched indoors at a fixed target, with each participant on a team getting an opportunity to launch. The accuracy of the missile (distance from target) on a team's three best launches is used to determine the team score, with the shortest total distance from target being considered the winner.

Concepts Covered

- Factors affecting flight of the missiles (weight, thrust, launch angle, fin placement and design).
- The principles of operation of a simple balance.
- Consistency in build and launch – What parameters result in a more robust design?
- Understanding of launch/flight curves (distance versus launch angle and thrust).
- Understanding of the forces acting on the missile in flight (4th and 5th grade only).
- Ability to make adjustments on the fly to zero in "On Target".
- Ability to work as a team.

Rules/Competition Format

1. Competitors will report to the On Target area by their assigned time. At the start of their competition, procedures for the competition will be reviewed and the teams released to a build area where there will be tables with materials for missile construction.

2. Straws, index cards, tape, and clay will be available to the students for missile construction. Participants may only use materials supplied by WESO. The build tables will additionally be equipped with, scissors, ruler, measuring spoons and plastic knives for cutting the clay or leveling it into a measuring spoon. Teams may bring their own measuring spoon to the competition. (This is recommended, as it enables your teams to practice with the same spoon they will compete with. Probably only the 1/4 teaspoon or smaller measure is useful).

3. If an item supplied to the team at the build table is unsatisfactory for any reason (i.e., straw is bent or deformed or otherwise damaged during the build process, is not their favorite color, was cut to the wrong length, etc) teams may request additional materials.

4. Participants may not bring any instructions, templates or tools (other than a measuring spoon, their launcher, and their balance) into the event. All materials are provided (including pencils and note paper). There will be plenty of index cards available, which may be used for notes or calculations, as well as to make any tools necessary to support the building and launching effort. Other provided building materials may be used as well for creating any tools that might be useful to assist with the launch.

5. A balance scale will be available in the building area, should the participants wish to determine if certain measures of materials (or entire missile assemblies) have the same weight. A standalone brass launch tube (the part the straw fits over on the launcher) will also be available in the build area should the participants want to test the fit of their missiles prior to leaving the build area.

6. Students must build all their missiles before leaving the construction area and going to the launch lane. No major modifications may be made to the missiles once the students are away from the construction area.

7. Missiles must be between 10 cm and 25 cm in length, measured from the tip of the nose cone, to the base of the straw (or the bottom of a fin, if it extends beyond the straw). Fins are not required. Students MUST build 6 missiles.

8. When teams have completed their missile construction, they are assigned to one of the launch lanes. All lanes (for each grade) will have the same launch pad to target distance. Each team will launch all of their missiles from the same launch lane before leaving the area. Other schools may be using adjacent launch lanes at the same time.

9. A Pitsco Straw Rocket launcher is used. http://shop.pitsco.com/store/detail.aspx?ID=2547&bhcp=1. (Note: New launchers will be provided to schools (one per school) in 2022). Participants may use the WESO launcher, or may bring in the Pitsco Straw Rocket launcher their school has been using for practices, provided it is not modified in any way.

10. Participants may adjust the launch angle, launch force, and missile position. Launch force is governed by dropping a weighted rod. The participants must just release the weighted rod, not push it down. Launches will be observed and any launch in which the participant is determined to have pushed or thrown the weighted rod down (which could generate more launch force, but also damage the launcher) will be disqualified (given a distance score of 10000 cm). Participants are responsible for ensuring the launch angle is what they wish it to be and that the missile placement (governed by an

o-ring “stop” placement along the launch tube) are what they wish them to be prior to launch.

11. Participants are given an OK to launch signal. This will indicate volunteers have cleared the target area and are ready to spot the missile landing. Launches made without the OK signal will count towards the 6 launches and may receive a score equal to the distance between the launcher and the target.

12. A launch is defined as the missile coming off the launcher once it has been placed. If a team drops the rod and the missile does not come off the launch tube, the team will be able to make adjustments necessary for a successful launch.

13. The point of measurement is the portion of the missile that is closest to the target after the missile has come to a rest on the floor. Each landing site is measured prior to the next launch. If the missile comes apart in flight, the point of measurement will be to the largest piece as determined by the judges.

14. The target will be a 2.54 cm diameter mark on the floor.

15. For a launch to qualify, the missile must travel a horizontal distance of at least 4 meters through the air. A missile that does not meet this criteria will receive a score of 999 cm for that launch.

16. Any missile with any part extending into the ring will get an “on target” score (0 cm). The score for any other missile will be the distance in centimeters from the center of the target to the point of measurement as defined in rule 13.

17. Judges will provide feedback to the participants after each launch in the form of two numbers and two arrows. The first number will indicate how much (in cm) too far or too short the missile landed from the target, and the arrow will indicate too far (up arrow), or too short (down arrow). Similarly, the second number will indicate how many cm to the left or right of the target the missile landed, and the arrow will indicate left (left arrow), or right (right arrow). Participants are expected to adjust their subsequent launches in response to this feedback to improve their next launch.

18. Participants may make adjustments to their launch parameters, or remaining missiles, after each flight. Coaching from the sidelines as to what adjustments are needed will not be allowed, and may result in the forfeiture of a missile launch opportunity.

19. Participants must have an equal number of turns to launch. If a team has 3 participants, each will launch twice. If a team has 2 participants, each will launch 3 times. Participants may divide the missile construction workload any way they desire.

20. It is the responsibility of the participants to ensure that their previous missile firing did not move the launcher before they fire the next round, and to make any corrections if the launcher did move or otherwise requires adjustment. The launcher base can be adjusted as necessary to aim it, but the base should never extend outside the rectangular tape border that defines the launch pad. The area of the launch pad is about twice the width by twice the length of the launcher base.

21. The center of the target will lie on a line that is extended perpendicularly from the center of the front of the launcher. The target will be between 7 and 14 meters from the launcher. The approximate distance of the target from the launcher will be announced no later than three weeks prior to the Olympiad. This value will be announced as a range of plus or minus one half meter. No exact distance will **ever** be provided. The actual target distance may be different for different grades.

22. 4th and 5th grade teams will also take a brief (5 multiple choice or short answer) quiz worth 10 points. Each quiz point will generate a bonus of a 2 cm reduction in the team's total distance from the target in their best three launches.

23. There is a soft limit of 30 minutes for students to complete their launches. Supervisors may help keep teams on task during this time. Time has not been an issue for teams in On Target in the past.

Scoring

A team's score is the sum of the distances from the target of their best three launches (in centimeters). For example, if a team's six missile launches produced distances of 91 cm, 57 cm, 21cm, 11cm, 2cm and 35cm, the third, fourth and fifth launches are used. The team's score is then:
21cm + 11cm + 2cm = 34 cm Total Launch Score

If a 4th or 5th grade team then answered 4 of 5 questions correctly, they would then reduce that score by 8 cm, resulting in a Total Net score of 26 cm. Using this metric, a net negative score is possible for grades 4 and 5.

Teams will be ranked according to Total Launch score (grades 2 and 3) and Total Net score (grades 4 and 5), with lower scores producing better rankings.

Tie Break Criteria

In the event of a tie, the team with the most consistent grouping of launches (maximum distance – minimum distance) will win the tiebreaker. As a first tiebreaker, only the top three launches will be considered (giving a tie break of 19 in the above example). If a further tie

breaker is needed, all of the team's launches will be considered (giving a tie break score of 89 in the above example).

Materials Distributed by WESO

Straw Rocket Launcher
http://www.pitsco.com/Straw_Rocket_Launcher
Distributed in 2022

Balance Arm Scale
Distributed in 2023 and 2024

Precision Straws
http://www.pitsco.com/Precision_Straws
Supplies provided in 2026, if requested

Clay
Crayola Modeling Clay. Also available in crafts sections of many stores locally.
http://www.amazon.com/gp/product/B011Q25T6K/
Supplies provided in 2026, if requested

Index cards
Oxford Ruled 3x5 cards
http://www.amazon.com/dp/B00006IFCX/ref=twister_B00WECRPGY?_encoding=UTF8&psc=1
Supplies provided in 2026, if requested

Additional Materials useful for practices

Measuring tape
Scotch Tape (magic tape, 0.5" wide)
Measuring spoons
Scissors
Ruler
Plastic knife (for cutting/shaping clay)

Materials to be brought to competition

Pitsco Straw Rocket launcher.
One will be available if schools choose not to bring their own, however, due to variations in the launcher, it is recommended students compete using the launcher with which they practiced.
Measuring spoon for clay. (Optional)
No notes or other materials are permitted.
****No cell phones or smart watches are allowed in event rooms. Participants who bring those items will be asked to leave them with the event supervisor for the duration of the event. Participants observed using them during the event will be disqualified.**

Additional Resources/References

Check wesoscience.org for additional references posted after the Coaches workshop.
Coaches Workshop slides
Pitsco Straw Rocket Teacher's guide
Pitsco Straw Rocket User's guide
Pitsco Straw Rocket STEM Activity Guide

Resources volunteered from Previous coaches (pdf on WESO event page)
On Target Lesson/Practice Schedule Guide
Physics Notes for On Target

Event Questions

Please go to http://wesoscience.org/events/ for information on how to submit questions about this event to the supervisors.

Example Question

Keesha launches a rocket with a drop height of 20 and the rocket travels 12 meters. She retrieves the rocket, and launches it again under the same conditions except she changes the drop height to 40. Approximately how far should she expect her rocket to go?

a). 6 meters
b). 12 meters
c). 18 meters
d). 24 meters