



# Balloon Race, 2007

Science Olympiad Coaches Clinic

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**Balloon Race**

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**DESCRIPTION:** Students will attach a weight to helium-filled Mylar balloons and "race" them to a predetermined level.

The objectives are to:

1. demonstrate skillful use of a balance;
2. demonstrate an understanding of density;  
and
3. make careful measurements and use good construction techniques.

**Step 1:** Zero out the balance you are given

**Step 2:** Verify the mass of the provided weight

**Step 3:** Attach the balloon to the provided weight using the paper clip and remass the weight

**Step 4:** The difference between the answer to #2 and the answer to #3 is the lifting power of the balloon

**Step 5:** Place the balloon and weight aside and mass the material provided

**Step 6:** Determine the area of the material provided in  $\text{cm}^2$ .

**Step 7:** Divide the answer to number 5 by the answer to number 6. This is the area density of the material in  $\text{g}/\text{cm}^2$

**Step 8:** Determine how heavy you want the weight you create to be (i.e.: if the balloon has a lifting force of 7.2 g, you could decide to use a percentage of the lifting force, or you could decide to create a weight that was within .1 g of the lifting force, etc.)

**Step 9:** Divide the answer to Step 8 by the answer to Step 7 - this gives you the area of the weight you want to create in  $\text{cm}^2$

**Step 10:** Determine the length and width of the material you need to create a weight with the area you want. Cut out a piece of the material that will have this area.

**Step 11:** Provide the official with your balloon-string-paperclip device and the weight you created to determine the first run time of your device.

**Step 12:** Based on the results of your first run, determine the mass of a second weight that will give you better results. For example, if your balloon did not reach the finish line on the first run, then you need to create a weight that is lighter for the second run. If the balloon reached the finish line, then you want to create a heavier weight to attempt to achieve a longer run the second time.

**Step 13:** Divide the answer to Step 12 by the answer to Step 7 - this gives you the area of the weight you want to create in  $\text{cm}^2$

**Step 14:** Determine the length and width of the material you need to create this second weight with the area you want. Cut out a piece of the material that will have this area (if you have enough material left after the first run, use what is left; otherwise, request a second piece of material from the event supervisor).

**Step 15:** Provide the official with your balloon-string-paperclip device and the weight you created to determine the second run time of your device.

# Scoring

1. 50% of the score is based on the students' calculations and construction of the weight. The more precise they are, the more points they get. The team with the highest score on this part receives 50 points, and the other teams receive points based on how close they came to this top score.

Example: top scoring team receives a score of 48 raw points. Their score is 50. If another team has a raw score of 45, they would get  $45/48 * 50$  or 46.875 points

## Scoring - Part 2

The actual “race” counts for the other 50 points. Here, the team with the slowest time of the competition receives 50 points, and the other teams receive points based on how close they came to the slowest time.

Example: Team with the slowest time has a balloon that takes 35.7 seconds to reach the finish line. They receive 50 points. Another team has a balloon that takes 20 seconds to reach the finish line. Their score for this part of the competition is  $20/35.7 * 50$  or 28.01

## Scoring - Part 3

Final score for each run is the combination of the points from the calculations/construction and the score from the “race”. Each team receives the higher of the scores from their two runs. The team with the highest score wins.

# Rules Changes From Last Year

1. Maximum times are based this year on how high the finish line is. For rooms with finish lines up to 10 feet, the maximum time is 60 seconds. For rooms with finish lines between 10 feet and 15 feet, the maximum time is 90 seconds. And for rooms with finish lines over 15 feet, the maximum time allowed is 120 seconds. Students should practice to insure that, while getting the slowest rise possible, they reach these finish lines in the time allotted.
2. Balloons that fail to reach the finish line in the allotted time will be given an ascent time score of 0. That is the only penalty this year for failing to reach the finish line - there is no longer a second tier for those balloons.

# Rules Changes From Last Year

1. Each team will be allowed two (2) runs this year. They will have 15 minutes to make their measurements, perform their calculations, and create the weight for their first run. After the first run, they will have an additional 5 minutes to create a second weight for a second run. This second run is designed to allow students to react to variations within the room that they couldn't measure, and weren't aware of until they completed their first run. It is not designed to allow students to make all new measurements, searching for a mistake that gave them the results of their first run - the math is simple enough that they shouldn't have to repeat it a second time. They must make the second weight from the material that remains after they create their first weight (if they don't have enough left, they can request additional material from the event supervisor). They **MAY NOT** alter the first weight for the second run.

# Tips, Tricks, and Things To Watch Out For

1. Remember that the rules state that you CANNOT mass the weight after you have constructed it. In some cases, the balance may be taken away before you start to cut out your weight. The emphasis here is on good construction habits. If you did your calculations correctly and constructed carefully, the weight you create should be very close to the weight you wanted. At the National competition, you get points based on how close you came to creating the weight you wanted.
2. In deciding what cuts to make to create your weight, remember that every measurement and every cut creates a possible error. If you can create your weight with one measurement and one cut, you cut down on possible errors.

# Tips, Tricks, and Things To Watch Out For

1. Emphasize that the students need to zero out the balance, and make sure that it is recording in grams if it is an electronic balance. Students need to practice with electronic balances to learn how to determine masses with them.
2. While practicing, students should learn to recognize the correct size for answers. The most common mistakes usually involve using the incorrect numbers for the dividend and divisor, and students should know they made a mistake when they look at the answer they received.
3. The first measurement/construction time is 15 minutes. They need to pay attention to the time announcements, and determine when they need to begin cutting so they are done when time runs out. The second time period is only 5 minutes, and they need to be even more aware of the time here.

# Tips, Tricks, and Things To Watch Out For

1. There are two important changes in the rules this year: each team gets to launch their balloon twice (with a different weight each time) and the only penalty for failing to reach the finish line is a run time score of zero (there is no longer a second tier for balloons failing to reach the finish line). Students should use these two changes to allow them to make at least one run where they “go for broke”, trying to get the absolute slowest rise possible. If this attempt results in a weight the balloon cannot raise to the finish line, they still have a second run, where they can play it “safe”. Whether they make their first or their second run the “safe” run is a part of the team’s strategy.
2. While they have 15 minutes to make measurements and calculations and create the weight for their first run, they only have 5 minutes to make their second weight.

# Tips, Tricks, and Things To Watch Out For

1. Both members of the team should practice making the calculations, measurements, and cuts.
2. Students should use as wide a variety of materials as they can to practice with. The rules state that the material must have a uniform density (that leaves out corrugated cardboard) and they imply that the material must be easily cut with scissors. Any material that has a uniform density and can be cut with scissors could be used.
3. Nothing in the rules indicates that the material supplied will be rectangular in shape. While circles and trapezoids would be hard for the supervisor to provide (since they all have to be the same size), triangles are possible.

# Tips, Tricks, and Things To Watch Out For

1. Teams should experiment with different shapes for their weights (including cutting them out in a shape other than a rectangle and folding them)
2. Teams should also experiment with the position of the weight when the balloon takes off - do they want it flat on the floor, perpendicular to the floor, or something in-between.
3. Students should take changes in the room as the balloon rises into account - the higher the finish line from the floor, the more these changes will impact the flight of the balloon.

# Tips, Tricks, and Things To Watch Out For

1. At the competition: Tell the event supervisor or one of the proctors IMMEDIATELY if there is a problem. Problems can be fixed if the people in charge are made aware of them - its difficult (if not impossible) to determine if there was a problem if the first time the Supervisor hears about it is an hour after the team competed when they file an appeal.
2. Pay careful attention to the instructions the event supervisor gives. No matter how carefully the rules are worded, each supervisor will have his/her own interpretation, and their interpretation is the one that counts.

# Tips, Tricks, and Things To Watch Out For

1. All students will be required to remain in the room until every team has competed. Once the door is shut at the start of the hour it will not be opened again until all teams are finished, so students should plan on remaining in the room for the entire 50 minutes.
2. Teams will have a maximum of 15 minutes to do all calculations and create the weight they want to use for their first run. They will then have an additional 5 minutes to create a second weight for their second run. The reason for the second run is to allow students to compensate for conditions in the room that they could not measure, and can't discover until they complete their first run.

# Tips, Tricks, and Things To Watch Out For

Practice, Practice, Practice. Find different locations, with different ceiling heights, rooms facing the sun and rooms away from the sun, large mylar balloons and small ones, long strings and short ones, small paper clips and giant paper clips. If you concentrate on carefully working out the calculations and doing the construction, then the race will take care of itself (all teams will have the same conditions). One thing you should check every time you practice is how close is the actual weight you created (in mass) to the weight you wanted to create? The rules include the possibility of using any of three different types of balances - your team should practice with all three.

Good luck and have fun!

# Questions and Clarifications

All questions about the rules should be submitted to the official Rules Clarifications page at:

<http://www.soinc.org/events/correct.htm>

Students and coaches should view this page periodically to find out what clarifications have been posted. Its always a good idea to print this page and take several copies with the team to competitions in case there is a dispute about a rule - attaching a copy of the specific rule clarification that pertains to an appeal will help to settle it in your favor.