Scrambler

This guide is based on the 2022-2023 *Draft Rules*. Please follow the 2022-2023 official rules manual for the most up-to-date rules. No content from here may be interpreted as an extension of the rules.

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Design Process

Introduction and Goals

Many aspects of your Scrambler design must be considered when designing your device. First, let’s outline the goal:

Teams design, build, and test a mechanical device, which uses the energy from a falling mass to transport an egg along a straight track as quickly as possible and stop as close to the center of a Terminal Barrier (TB) without breaking the egg.

Essentially, you must construct 1) a vehicle and 2) a “launcher”. The launcher, which has the 1.50 kg mass on it, propels the vehicle towards the wall to stop as close as possible to it, without going past it—going too far will obviously break the egg.

All energy to propel the vehicle must come from gravitational potential energy (GPE) of the mass. This means that you can convert the GPE to elastic potential energy (a rubber band), for instance.

Your final score is the better of the two run scores, plus any final score penalties. The run score is as such:
Run Score = (Vehicle Distance, in cm) + (Run Time, in sec * 2) + Run Penalties

For example, if your vehicle’s run time was 7.27 seconds and the vehicle distance was 67.6 cm, your final score would be (67.6) + (7.27 * 2) = 82.14.

Scrambler, as well as all other vehicle events, are all about **testing, testing, testing**. Any device can perform well, as long as the vehicle is semi-consistent. Figure out ways to make your device consistent, and collect tons of data for each target distance!

Scoring

There’s two scores to minimize here: your time score and distance score. Your **Time Score** is 2 points per second of run time, which is defined as the time the vehicle takes to travel between the 0.25 m and 7.25 m timing lines. The faster your vehicle is, the lower your Time Score is.

Your **Distance Score** is 1 point per centimeter of vehicle distance away from the center of the terminal barrier (TB). It is trivial to understand that the closer you are to the center of the terminal barrier, the lower, and thus better, your score will be.

Your **Run Score** is the sum of these two scores. A poor Distance Score paired with a good time score, or vice versa, is not enough to do well—as such, aim for both a fast vehicle and consistent one.

Optimization of Distance and Time

Due to the incorporation of both the distance score and time score into your final run score, it is important to try to balance the two. A very fast vehicle will obtain a good time score, but the vehicle is likely to skid and be less accurate than a very slow moving one. However, a very slow moving vehicle's time score will obviously be poor, but will be much more accurate than a fast moving one.

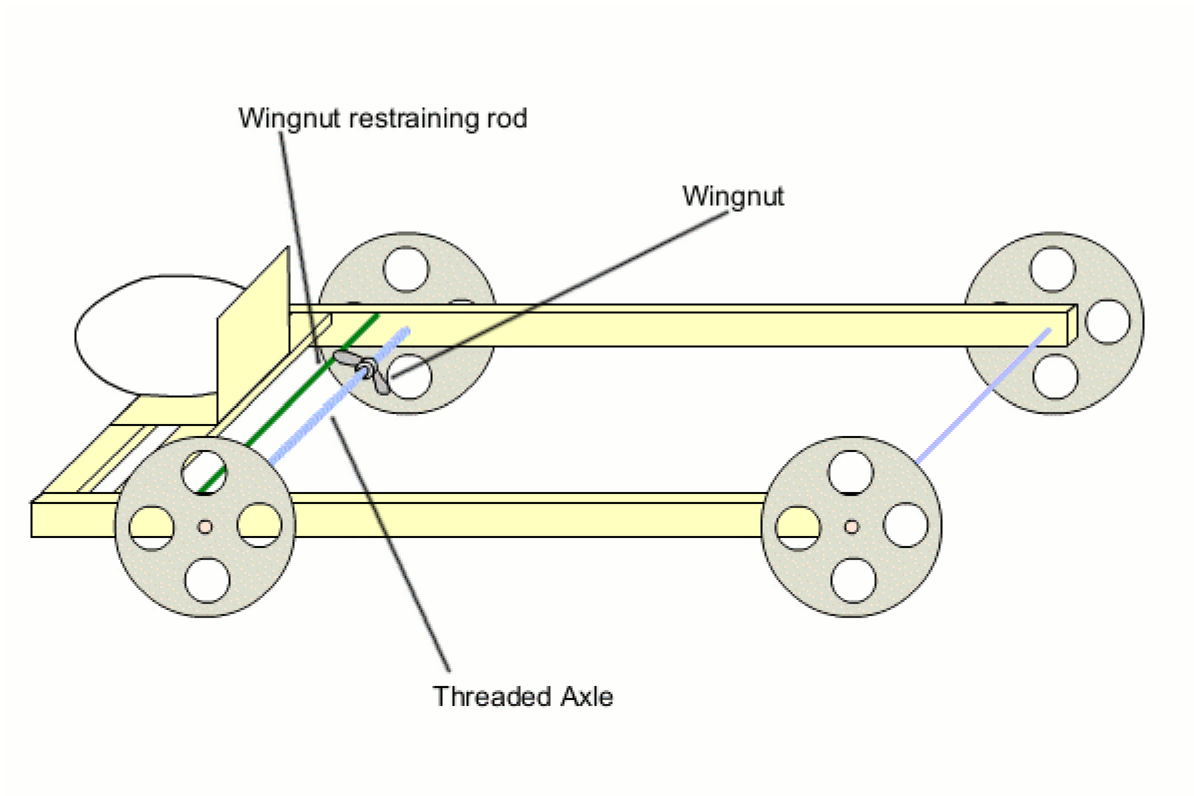
As such, one may find that they may not need all 1.50 kg of mass that is allowed. If your vehicle is too fast, simply decrease the mass; if the vehicle is too slow, increase it.

Construction

When constructing your launcher and vehicle, aim to have a sturdy structure that can, at very minimum, withstand some bumps and rough handling when traveling to competitions. In many devices, the launcher may be constructed out of a harder wood or wooden boards; occasionally, a metal frame is used. Similarly, the vehicle is commonly constructed out of wood or metal as well—however, some teams may choose to design and 3D print their chassis out of PLA or ABS plastic.

One aspect of the device that many competitors overlook are the dimensions of the device. More specifically, the device may only be 75.0 cm wide, 75.0 cm long, and 50.0 cm high, when flat. This doesn't mean to build it to exactly those dimensions! A 49.5 cm tall device performs nearly just as well as a 50.0 cm tall one does—but if a single nail pokes out of the top, or your device is just slightly uneven, then it may be over these dimensions. As such, design your device to fit in a slightly smaller box—perhaps 74 x 74 x 49, so that you are confident that it won't be over the given dimensions.

Construction: Braking System



Typically, vehicle braking systems use a threaded rod braking system (see animation: https://scioly.org/wiki/index.php/File:SC-brake2.gif). In this example, as the vehicle moves forwards, the wingnut winds and travels to the right side of the vehicle. When the wingnut contacts the end, the vehicle stops.

By adjusting how many rotations of the vehicle you do when winding the vehicle before the run, you can adjust the distance the vehicle travels to high precision.

Other Resources

- Scioly.org Wiki: https://scioly.org/wiki/index.php/Scrambler
- SOINC Scrambler Page: https://www.soinc.org/scrambler-c

- Scioly.org 2017 Forums Thread: https://scioly.org/forums/viewforum.php?f=248
- Jason and Allen Chang’s Event Guide: https://docs.google.com/document/d/19f9g3ItmCxKyCCqTj8cC1T1kfpqS7GdiJrGq3J64NSM/edit#heading=h.4cl0j4gt07qy
    - The guide contains some information regarding Gravity Vehicle, the 2020-2022 division C vehicle event.
- BEARSO 2020 Vehicle Design Writeup: https://drive.google.com/file/d/1OuvXxjwSdu3jBigeXeUfd3aMR_zOLf6j/view
    - The guide contains information regarding Gravity Vehicle, the 2020-2022 division C vehicle event.