



**NORTH CAROLINA  
SCIENCE OLYMPIAD**

Storm the Castle  
NC Coach's Clinic  
Science Olympiad 2012  
Presented by Kris Tesh



**Description:** Design, construct, and calibrate a device that uses only the energy of a falling counterweight to launch a projectile as far and accurately as possible.

## So you want to build a catapult...

But that's only part of the challenge. Some teams have competed before and only want to see how the rules (and devices) are different from last year. Others are new coaches who imagine they don't know what to do. In this presentation I'll review:

How to read the rules

How to plan a catapult

Build tips

Competition tips (How to win!)

## How to read the rules:

I've included a copy of the rules where I've marked changes and key rules.

Rules define the event

Each sentence matters

These rules are interpreted. Ask if you aren't sure

Check event Clarifications at [ScienceNC.com](http://ScienceNC.com) and [SoINC.org](http://SoINC.org)

This is a rule from this year's competition.

"3. **CONSTRUCTION:** *The entire device, including the projectiles and counterweights must fit in a 65.0 cm x 65.0 cm x 65.0 cm cube when in the ready-to-fire position. The cube must be square to the floor and launch area.*"

This rule describes the size allowed for the device, giving everyone a well-defined size limit for their device. Some words have specific meanings for our purposes. If something is unclear, ask! Questions will be answered.  
Email me with questions at [kitesh@ncsu.edu](mailto:kitesh@ncsu.edu)

Ready to Launch position: Pull the trigger and it fires. You will want to make counterweights for practice, so you may as well make them competition-sized.

Launch Area: Another rule defines the Launch Area as a 1x1m square the catapult must be completely inside to launch.

## How to Plan your Catapult:

Catapults can be simple or complex. They range from simple see-saws to complex moving levers, to pulley-based systems. All catapults work with energy - exchanging the energy of a moving weight for that of a moving projectile. Here are some basic examples.

I strongly suggest starting simple and working up from there. A simple and reliable catapult will often outscore a wildly inaccurate complex device.

# Build tips

I strongly suggest that new teams build a catapult early. I suggest having one built before the school Christmas Break, and starting tests during that break. You'll need a catapult, a counterweight, some projectiles, a test range, and a test plan.

Start with a plan for your catapult. Plan dimensions, sizes, materials, and so on. I suggest plywood, 2x4 lumber, and generally sturdy construction if you're new. More complex materials include fiberglass, using parts of fishing rods, and so on.

Squarely cut cuts

Square drill holes - Borrow or get a cheap drill press

Ball bearings (Sacrifice a thrift store roller blade)

If you can, use pre-drilled holes and wood glue to assemble wood parts

Practice area:

Level, tall space.

A way to mark impacts - spotters work well

A measuring tape for recording results

Best results come from running it just like the competition

Launch area, target box, etc

After calibration, practice with timer and scoring

Call out "3, 2, 1, FIRE!" to avoid penalty 5.c.iv.

Goals:

Learn performance - X counterweight and Y projectile give Z distance

Practice operation - something will break, be prepared to fix on the fly

Practice aiming

How we make the competition counterweights:

2 4" PVC endcaps, cut a bit shorter, with a short 4" PVC pipe connecting them. Drill holes centered on each endcap, put a 1/4" bolt through them to hold it together, and fill with heavy things. I suggest copper or lead BBs or shot from Wal Mart. Be careful with lead, wash your hands after handling.

As described in the rules, the counterweight has a hook, not a closed loop. Also, the entire counterweight and hook fit inside a 15cm cube.

# Competition Tips (How to Win)

1. Read the rules  
Breaking construction rules gets a team penalized or ranked after most other teams
2. Read the scoring rules  
Scoring tells you how to win:
  - A. Know your catapult's range for the setup given.  
Guessing wrong by 0.5m adds up to about a 1.5 point penalty for that target.
  - B. Make the graphs right.  
The rules give an exact rubric to earn those 12 points. Point this out to your team!
  - C. Be practiced!  
Encourage your team to develop an exact procedure. Trebuchets were military devices, after all...  
Failure to do things in the right order or skipping steps can botch shots and earn penalties.

## Competition

### The day before:

- Check box for all needed materials
- Tools, parts, trigger, 2 copies of graphs
- Check that goggles are packed to go

### Competition day (For your team)

- I suggest breakfast. Impound on time! If you have an event during the walk-in period, you must let it be known
- Pay close attention to the counterweight and projectile masses.
- Be careful to follow the rules that you've been practicing for weeks.
- Ask questions if you have them.
- Good luck!

## Contact me with Questions

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See Also:  
ScienceNC.com  
scioly.org