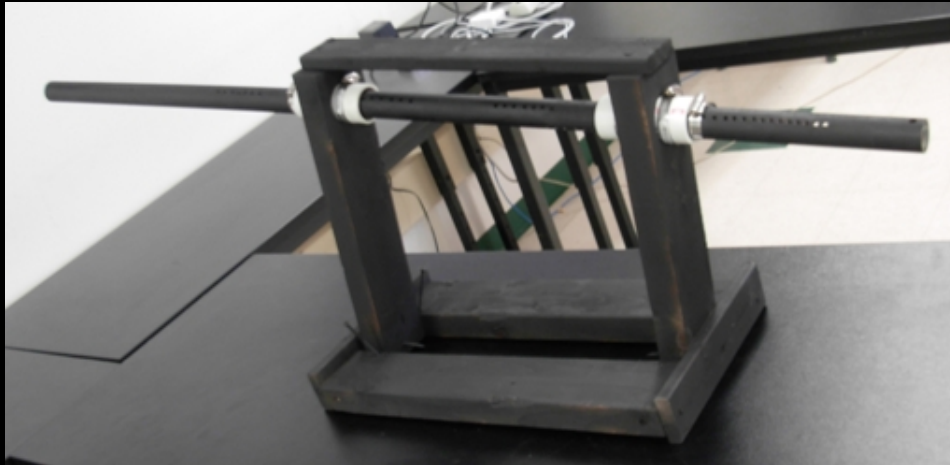
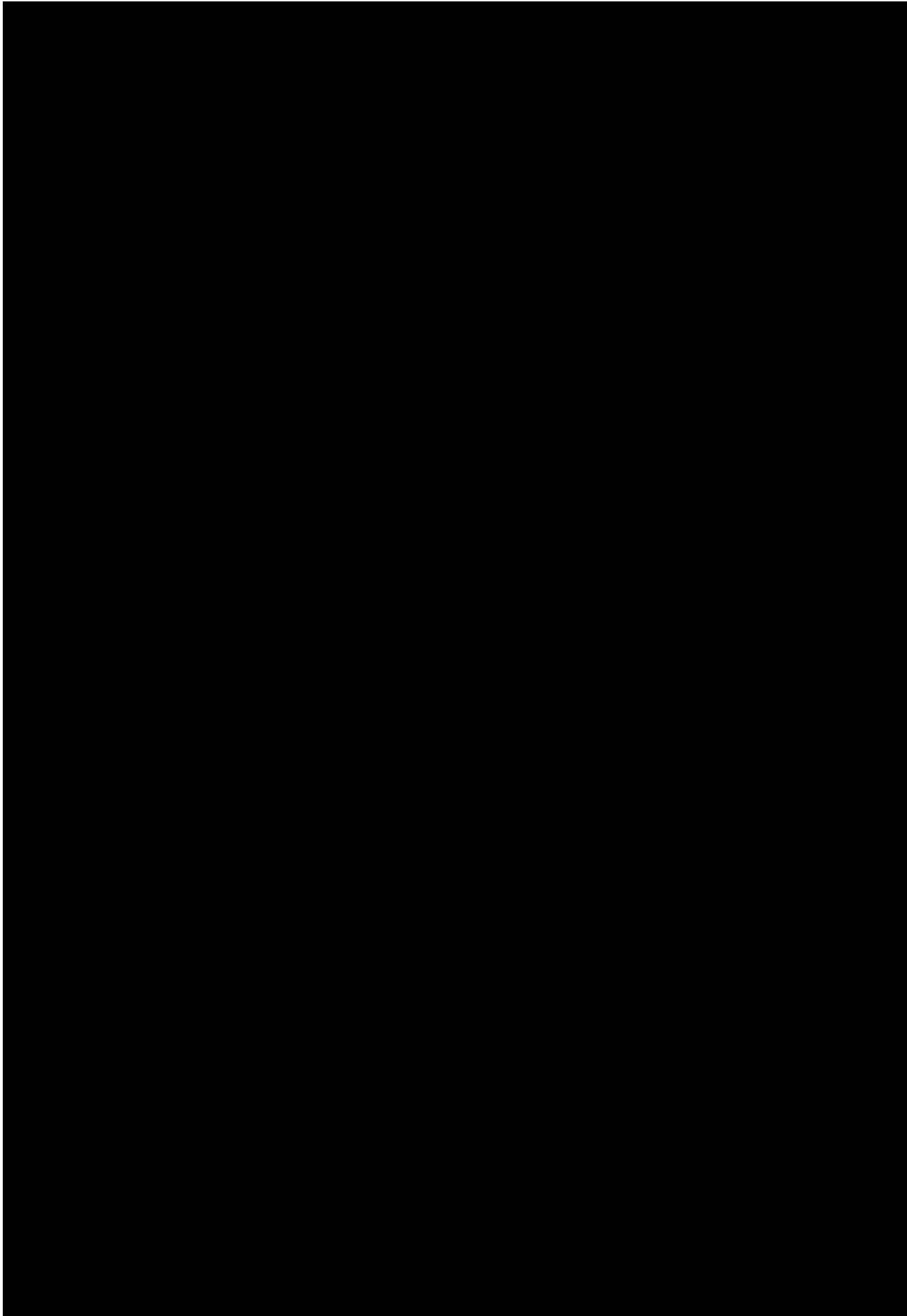


# M272 Ballista

## User's Manual:

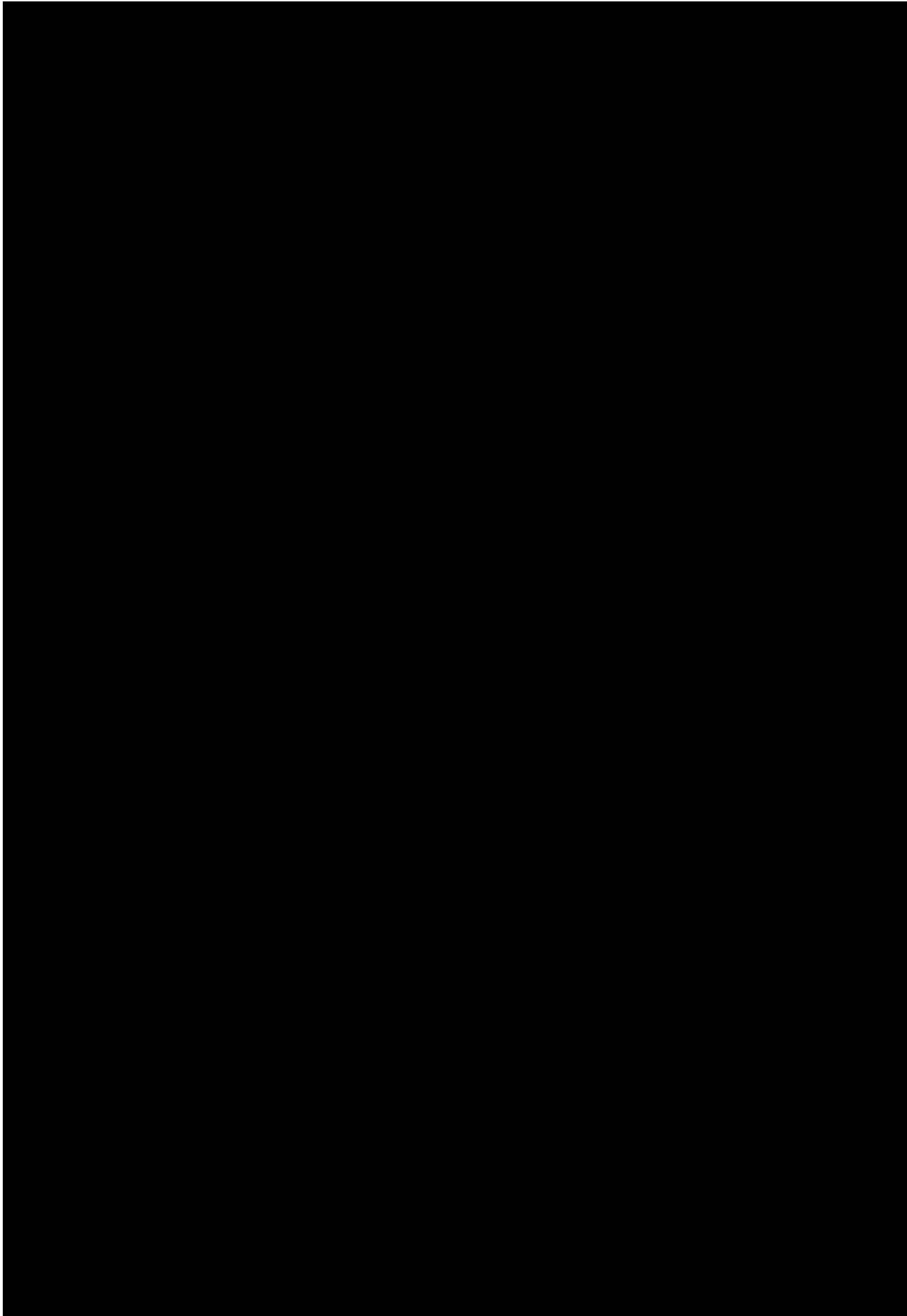


Provided By:  
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# Ballista/Catapult Background:

Science of Catapult

For grading purposes only: this is also the history paper that was part of the assignment but it was placed here to be turned in

The catapult was created back in ancient times and has been used on many occasions throughout time since its creation. The Chinese, Greeks, and Romans have used various types throughout history. Europe adopted such an idea during the Medieval times while dealing with the French. They have been used on the field, in castles, and over tall walls in battle.

Some types of catapults used during the Medieval times include the Ballista, Mangonel, and the Trebuchet. The design of the M272 is most like that of the ballista. The Mangonel was best in distance, the trebuchet in height, and the ballista in accuracy. The Mangonel and the Trebuchet were thrown/launched in an overhead manner, whereas the Ballista had a straight trajectory like that of a rifle. The ballista used a tension driven barrel driven by such things as springs or bows.

Although most catapults were extremely large in size and most times not mobile, the M272 is sturdy, durable, and yet easy to transport. For example here is a picture of a real life-size ballista:



<http://www.turbosquid.com/FullPreview/Index.cfm/ID/237617>

<http://www.middle-ages.org.uk/catapults.htm>

# Quick Start Guide:

## General launching instructions:

- Read *all* instructions before making any attempts.
- Make sure the slot on the back end of the barrel is directed up.
- Use "loading device" (Exxon White Screwdriver) to compress spring so that it's top meets the correct launch distance hole.
- The "locking device" (Smaller silver screwdriver) will likely have to be used to pull the spring back far enough to insert the "loading device" close enough to the top of the spring to pull it back far enough
- Insert "locking device," in front of the entire spring, into the hole that corresponds with the distance wanted
- Remove "loading device" and drop projectile into the barrel of the cannon
- While holding the cannon stationary quickly and in a straight manner remove the "locking device" to release the spring and launch the ball

## Specific advice for the distances:

### 2 Meter Shot:

- Set cannon base so that the front of it is approximately 0 meters away from the starting line.
- Locking hole: fifth set of perpendicular holes up from the bottom (also marked on barrel with a "2")
- This hole has given short results, so if possible, try to angle the 1/8" "locking device" in the 5/32" holes so to compress the spring as much as possible from that hole.

### 4 Meter Shot:

- Set cannon base so that the front of it is approximately 1 meter away from the starting line.
- Adjust that distance as attempts are made and error seen to ensure accuracy.
- Locking hole: third set of perpendicular holes up from the bottom (also marked on barrel with a "4")

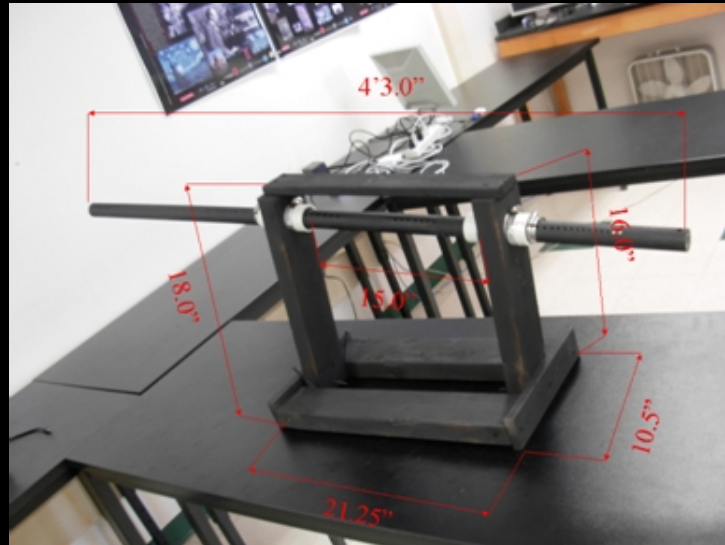
### 6 Meter Shot:

- Set cannon base so that the front of it is approximately 0 meters away from the starting line.
- Adjust distance from starting line as attempts are made to ensure accuracy.
- Locking hole: second set of perpendicular holes up from the bottom (also marked on barrel with a "6")

# System Overview:

Size, Shape, Composition, Quality of Parts, Sketch, Specification/Capabilities, Min/Max, Accuracy

## Dimensions:



PVC Barrel ID: 1.00" ; OD: 1.25"  
Inner Sleeve ID: 1.25" ; OD: 1.50"  
Outer Sleeve ID: 1.50" ; OD: 1.75"  
5/32" air holes throughout pipe  
1/8" holes and pins for firing  
Spring: 7/8"x4"x0.080" w/ 24.80lbs work load

Projectile: 1.00" or 2.542cm  
Minimum Distance ~ 1.0m  
Maximum Distance ~ 8.5m

With front of base located at the starting line the launcher is accurate up to ~8.5m without triggering system and ~6.0m with the triggering holes

The base of this catapult is made of treated 2"x4" lumber which coarse 4" Phillips deck screws. Needless to say its stability and sturdiness is exceptional. The parts, and mechanisms are quality hardened steel, PVC, and wood, so they are durable as well. But the human body is not as durable so **BE CAREFUL!!!!** with this device.

# Tooling:

## Loading Device:

1/8" phillips end of the white Extron screwdriver:



- This tool will be used to compress and align the spring

## Locking Device/Pin:

1/8" silver Phillips screwdriver:



- This tool will be used to lock the spring in place (trigger mechanism)

## Spring and Piston:

7/8"x4"x0.080" spring with 24.80lbs work load attached to a steel piston with a 1/4" dowel pin and hole in piston to fasten to the inner diameter of the barrel:



# Operating Instructions:

Step By Step Firing/Capabilities, Firing Tips, Launching Graph

## General Information:

- Read *all* instructions before making any attempts.
- Make sure the slot on the back end of the barrel is directed up.
- Use "loading device" (Exxon white screwdriver) to compress spring so that it's top meets the correct launch distance hole.
- The "locking device" (smaller silver screwdriver) will likely have to be used to pull the spring back far enough to insert the "loading device" close enough to the top of the spring to pull it back far enough
- Insert "locking device," in front of the entire spring, into the hole mostly perpendicular to the slot that corresponds with the distance wanted
- Remove "loading device" and drop projectile into the barrel of the cannon
- While holding the cannon stationary quickly remove the "locking device" to release the spring and launch the ball

## 2 Meter Shot:

- Set cannon base so that the front of it is approximately 0 meters away from the starting line.
- Locking hole: fifth set of perpendicular holes up from the bottom (also marked on barrel with a "2")
- This hole has given short results, so if possible, try to angle the 1/8" "locking device" in the 5/32" holes so to compress the spring as much as possible from that hole.

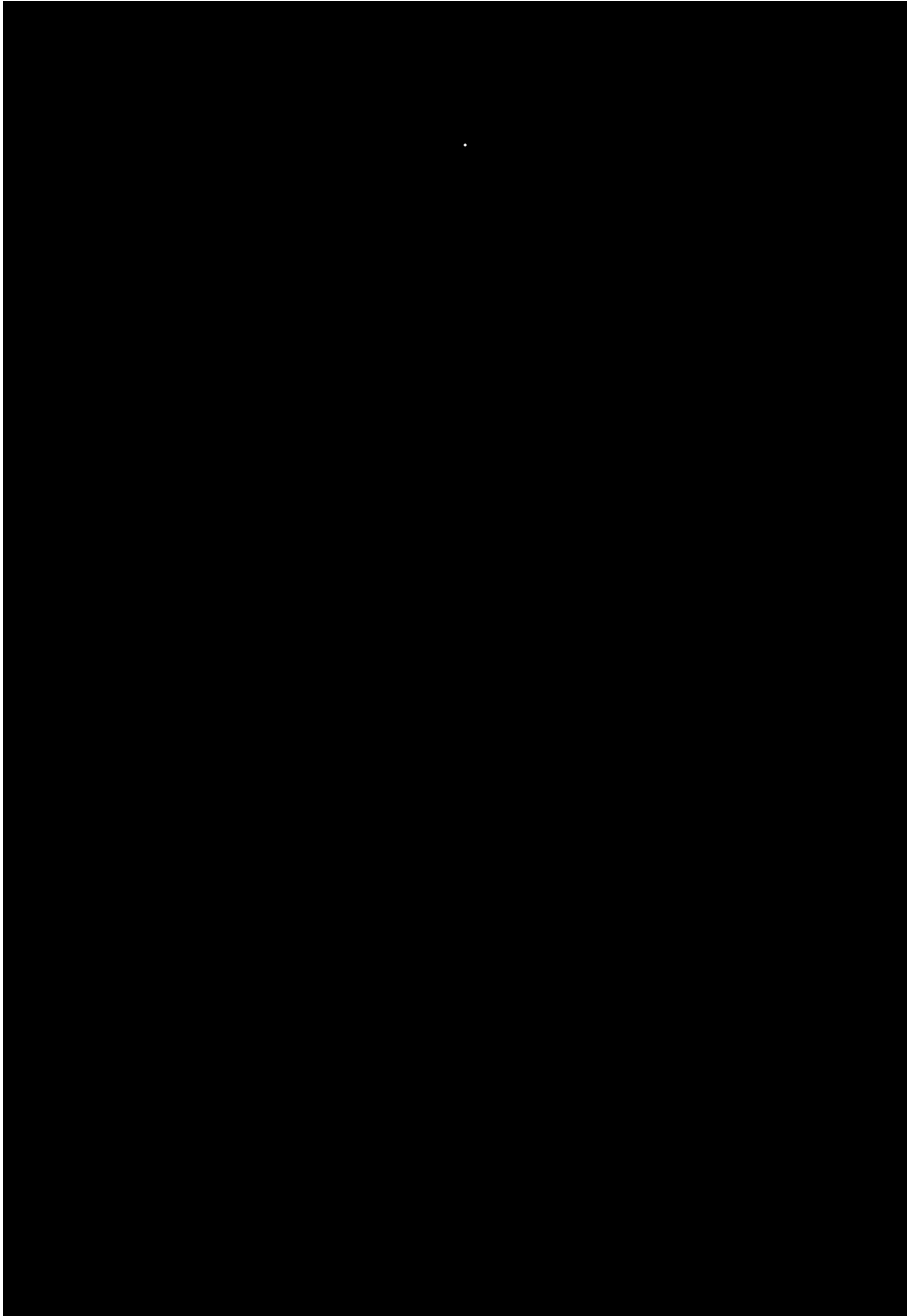
## 4 Meter Shot:

- Set cannon base so that the front of it is approximately 1 meter away from the starting line.
- Adjust that distance as attempts are made and error seen to ensure accuracy.
- Locking hole: third set of perpendicular holes up from the bottom (also marked on barrel with a "4")

## 6 Meter Shot:

- Set cannon base so that the front of it is approximately 0 meters away from the starting line.
- Adjust distance from starting line as attempts are made to ensure accuracy.
- Locking hole: second set of perpendicular holes up from the bottom (also marked on barrel with a "6")





# Common Mistakes/Precautions/Notes:



Figure 1: Freshman Trial

- Make sure the piston in the back stays in place and do not remove the dowel pin
- If spring shoots out, as expected for the longer two distances, drop it back into the barrel broken/burnt welded side first for alignment to be correct and accurate and tilt cannon upwards so it slides to the bottom of the barrel



- Make sure sleeves are in place so that the pipe doesn't come out of line:



Figure 2,3,4: Sleeves are placed between the white piping sleeve and black barrel and if they slip out make sure the slide back in as shown in figure 4 to ensure accuracy

- A large amount of force will be necessary to compress the spring for the 4 and 6 meter launch
- Make sure to only load ball *after* the spring is compressed and safely locked in place with the holding mechanism to avoid misfires, which counts as an attempt
- This is a very user controlled launcher, so a sort of mental usage is recommended; if the launcher is shooting too far, move it back, adjust/recalibrate it, etc.
- Aim pole with the common sense of windage (left/right) and elevation (make sure warp of barrel follows in the downward direction for best results, even though it only slightly affects the distance)
- Ensure that the locking pin is put through both perpendicular holes in order for spring to align straight with the piston and barrel
- Measure from the front of the base and not the front of the barrel
- Make sure the slot on the back end of the barrel is directed up.

# Credits:

Thanks, Resources, Similar Product Comparisons, Repair/Re-Calibration, Warranty

## Special Thanks:

- **Smith**
  - Assistance, expertise, equipment, instruction, testing area/material
- **Sicher**
  - Equipment, class-time, expertise, opinions/thoughts, materials, testing area
- **Billet Industries**
  - Equipment, machinery, material, expertise
- **Father**
  - Equipment, driving, materials

## Materials:

- ACE Hardware
- Home Depot
- Billet Industries
- Home
- Smith/Sicher



### Catapult Price List

Qty:	Item:	Individual Price:	Totaled Price:	Where Achieved:
1	1"x5' PVC pipe	\$2.99	\$2.99	ACE Hardware
4	PVC Sleeves	\$0.25	\$1.00	Home
1	1 1/8"dia x 4" stock 1018 steel	\$3.00	\$3.00	Billet Industries
4	2" pipe clamp	\$1.30	\$5.20	Home Depot
2	1.5" pipe clamp	\$1.15	\$2.30	Home Depot
1	2"x4"	\$5.00	\$5.00	Home
1	flat black paint	\$0.99	\$0.99	Home Depot
0.25	7/8x4/0.080" 24.80lb spring	\$3.98	\$1.00	Home Depot
0.1	Coarse 4" deck screws	\$3.46	\$0.35	Home Depot
Total Price:			\$21.82	

## **Warranty/Disclaimer:**

We as a group will not be held responsible for any damage, miscalculations, breakage, and/or pain. Keep in mind that over time materials do wear and replacement may be necessary but that's normal. After thorough testing from our own group and by an outside party (freshman) we have proved this to be a safe and accurate device. After reading all of this users manual the operator should have no problem with the operation of this device. As this is a powerful and dangerous apparatus:

**BE CAREFULL!!**