Trebuchets - **Project**: Build a working Trebuchet and make a movie about it.
Tentatively DUE May 18.

This project is worth approximately 15%-20% of your 4th 9-weeks grade.

Requirements: The Trebuchet must be able to launch a water balloon up to 10, 15, and 20 meters at a target. Your trebuchet must be able to vary the distance it fires. It is to be a maximum of **0.9 m wide by 1 m long by 1.1 m tall (not counting arm),** with a maximum **1.2 m** length of arm. You should used marked free weights. Weight of projectile = a water balloon filled with 0.3 liter of water = 0.3 kg of water. **A maximum of 5 people per group.**

You need to provide the water balloons on launch day.

YOU MUST HAVE A REMOTE TRIGGER ON YOUR TREBUCHET!!!! - You will need a pin that keeps the trebuchet from launching and at least 6 feet of rope or string attached to pull the pin. If you have no remote trigger then you will not be allowed to launch and will not receive any points for the trebuchet.

As you build the trebuchet you need to document the progress, i.e. take pictures, movies, notes. You will test your device and plot distance (on LoggerPro) thrown versus weight used. You will need to make a way to vary the weight used in your trebuchet. You will need to test it multiple times at each of the weight used. Your trebuchet must make it through all testing, so build it well. Grades will be based upon having a working trebuchet, a diagram of design **before** you begin, data gathered about the trebuchet and graphs to help predict what weights to use for what distance, the lab measuring how far your trebuchet will throw a water balloon, and how close you come to the target during the final test, but most of your grade will come from your lab report.

You must take part in the building process and have proof (pictures) that you helped.

No using trebuchets built for other classes or clubs.

Due dates - April 09, 23, May 7, 18, 20, 21

April 09 - Must show evidence of research, have a design drawn out, and evidence of having materials purchased.

April 23 - Must show evidence of work on trebuchet. (Pictures and movies)

May 7 - Must show evidence (pictures and movies) of a working trebuchet and data from multiple trials. Trebuchet video showing at least a 10-meter launch.

May 18 - Trebuchet due, must have video of a 10-meter, 15-meter, and 20-meter launch, graphs and data ready on this day. You will need to record video of your launches and take pictures during the testing day.

May 20 - Retesting if your Trebuchet did not perform as well as you would have liked then you can retest it after school today. You can earn a max of 90% of the overall grade.

May 21 - Movie and Reflection Questions Due.

Your grade will be comprised from meeting the due dates, having a working trebuchet, having data and a graph about your trebuchet that you used to hit your target, how efficient your trebuchet is, answering the Reflection Questions, and filling out an evaluation about the project.

0% = Your group fails to clean up the testing area or you fail to take home your trebuchet on testing day.

-10% if your trebuchet does not meet the size requirements in 1 of the dimensions.
-20% if your trebuchet does not meet the size requirements in 2 of the dimensions.
-30% if your trebuchet does not meet the size requirements in 3 of the dimensions.

0% = Throwing the water balloons at anyone or anything! Only water balloons launched by trebuchet are allowed.

Efficiency (Z) is measured by the distance the projectile travels divided by the amount of weight needed to launch it. The farther it goes with less weight used the more efficient the trebuchet is. Efficiency grade is compared to the other trebuchets built. Top efficiency will get a quarter of the points towards your overall score for the project. All other trebuchets will be compared to the most efficient trebuchet. For instance, if the top trebuchet went 20 meters with 10 lbs of weight it would have an Z-value of
$Z = \frac{20m}{1lbs} * 100 = 200\frac{m}{lbs}$, if your efficiency is $120\frac{m}{lbs}$ then you would get $\frac{\left(120\frac{m}{lbs}\right)}{\left(200\frac{m}{lbs}\right)} = 60\%$ of points available.

You will get up to a _____ if you have a:

100% = Working Trebuchet that launches a water balloon up to 20 meters, meets the size requirements, answered the Reflection Questions, recorded data about trebuchet weight used vs distance travelled and plotted in LoggerPro. A working trebuchet that you have video proof launches 10, 15, and 20 meters. Proof means you and your teammates are in the video and you show the distances marked out. Also, your trebuchet must be able to show it can fire a **water balloon** the different distances. The build process has been well documented with pictures and movies of the build process. You have to meet all deadlines, You also have to followed all of the rules. **YOU CLEANED UP THE TESTING AREA AND TOOK YOUR TREBUCHET HOME BY THE END OF THE TESTING DAY.**

90% = Working Trebuchet that launches a water balloon up to 15 meters, meets the size requirements, answered the Reflection Questions, recorded data about trebuchet weight used vs distance travelled and plotted in LoggerPro. A working trebuchet that you have video proof launches 10, 15, and 20 meters. Proof means you and your teammates are in the video and you show the distances marked out. Also, your trebuchet must be able to show it can fire a **water balloon** the different distances. The build process has been well documented with pictures and movies of the build process. You have to meet all deadlines, You also have to followed all of the rules. **YOU CLEANED UP THE TESTING AREA AND TOOK YOUR TREBUCHET HOME BY THE END OF THE TESTING DAY.**

80% = Working Trebuchet that launches a water balloon up to 10 meters, meets the size requirements, answered the Reflection Questions, recorded data about trebuchet weight used vs distance travelled and plotted in LoggerPro. A working trebuchet that you have video proof launches 10 meters. Proof means you and your teammates are in the video and you show the distances marked out. Also, your trebuchet must be able to show it can fire a **water balloon** the different distances. The build process has been well documented with pictures and movies of the build process. You have to meet all deadlines, You also

have to followed all of the rules. **YOU CLEANED UP THE TESTING AREA AND TOOK YOUR TREBUCHET HOME BY THE END OF THE TESTING DAY.**

75% = Working Trebuchet that launches a water balloon up to 5 meters, meets the size requirements, answered the Reflection Questions, recorded data about trebuchet weight used vs distance travelled and plotted in LoggerPro. A working trebuchet that you have video proof launches 5, and 10 meters. Proof means you and your teammates are in the video and you show the distances marked out. Also, your trebuchet must be able to show it can fire a **water balloon** the different distances. The build process has been well documented with pictures and movies of the build process. You have to meet all deadlines, You also have to followed all of the rules. **YOU CLEANED UP THE TESTING AREA AND TOOK YOUR TREBUCHET HOME BY THE END OF THE TESTING DAY.**

70% = Working Trebuchet that launches a water balloon forward, meets the size requirements, answered the Reflection Questions, recorded data about trebuchet weight used vs distance travelled and plotted in LoggerPro. A working trebuchet that you have video proof launches 5 meters. Proof means you and your teammates are in the video and you show the distances marked out. Also, your trebuchet must be able to show it can fire a **water balloon** the different distances. The build process has been well documented with pictures and movies of the build process. You have to meet all deadlines, You also have to followed all of the rules. **YOU CLEANED UP THE TESTING AREA AND TOOK YOUR TREBUCHET HOME BY THE END OF THE TESTING DAY.**

On test day:

You will get a maximum of 4 attempts to launch a water balloon (time permitting).

Extra credit: (Maximum of 20% extra credit)

- Up to 10% If you have a drone and can record video of entire the launch day for all groups.
- Up to 10% You make a creative movie that involves your trebuchet (Think Monty Python and the Holy Grail)
- Up to 5% If you have creative attire on to match your trebuchet, i.e. costumes are encouraged (school appropriate)!
- 5% Hitting target with water balloon launched from trebuchet or
- 2% Splashing target with water from water balloon launched from trebuchet.

Trebuchet Lab Report should include the following pages:

- A video introducing the project and team, along with written descriptions.
- Written and visual instructions on how to build with pictures of the build, (A movie explaining the step by step process.)
- Movies of test launches, Data & graphs
- Results / Conclusions / How to improve
- Credits - Citing where you got your information
- How was work divided among group members, who did what.

** If your trebuchet fails or you are unhappy with the performance on test day you may rebuild it, filming videos/taking pictures of the rebuild process and videos of the rebuilt trebuchet working, launching 10, 15, and 20 meters multiple times. The video of the rebuild and a working trebuchet will need to be submitted before school is over on May 21. You may receive a maximum grade of 90% on the rebuild if all requirements are met.

Trebuchets can be placed into four different categories:

1. the swinging counterweight,
2. the fixed counterweight on a fixed frame,
3. the fixed counterweight on a floating frame, and
4. the floating arm (FAT) trebuchets.
5. King Arthur Trebuchet
6. Merlin
7. and many many more

PLEASE NOTE: Do not expect Mr. Kalash, Mr. Thomas, or Mr. Womack to help you. Any materials you try to get from them would need to be replaced. If you have taken their classes and know how to use equipment, they MAY choose to help, but you should not expect them to do so.