NAME

Standard
STEM-FET
1,4,5,8,9

FET 4.1
Trebuchet

You are going to create a trebuchet and launch projectiles with it.

Background

A trebuchet is a siege weapon used primarily in the middle ages. It uses a lever and a counterweight to gain mechanical advantage to launch a projectile. You are going to build your own trebuchet from materials you "purchase" from RebelTech Hardware. Other than the criteria/constraints below, the design is very much up to you.

Design Notebook

- You will record everything you do in your design notebook. You may create it by hand, in Word, or both.
- It should contain a section for each phase of the design process. The information in the notebook must be organized and placed into the appropriate sections.
- The notebook text must in your words – no copy/paste, no word-for-word retyping.
- Drawings must be drawn by you from scratch, either electronically or by hand. You may use drawings or plans from the web, but you must redraw them.
- Notebook contents:
  - Project name and team members' names.
  - Description of the project.
  - Detailed description and history of a trebuchet – what it is, what it was used for, who used it and when, etc.
  - Definition and description of the mechanical advantage of a lever and how to calculate it.
  - All criteria and constraints.
  - Simple sketches of 3 possible designs. Should include all parts and the overall dimensions (L/W/H) of the assembled trebuchet (you don't need dimensions of each individual part on these).
  - Evidence of discussion related to the 3 designs, including advantages and disadvantages of each one.
  - Identification of the design you pick (can be one of the 3 or a combination), reasons why you chose it, and reasons why you didn't choose the others.
  - DETAILED drawings of your chosen design. You should at least include separate drawings of: 1) the side view of the trebuchet; 2) the top view of the trebuchet; 3) the trigger mechanism; 4) the sling. Include all parts, the dimensions of all parts, and the overall dimension. These should be neat, professional-looking, and detailed enough that another team could look at your drawings and build it.
  - Detailed calculation of the mechanical advantage of your designed trebuchet's throwing arm.
  - DETAILED step-by-step instructions on how to build your trebuchet. You can do this as you build it.
  - A test plan that includes a description of each test you do, your expected results, and the actual results.
  - Description of any changes you had to make to your trebuchet during or after testing.
  - Results of your final official testing, including distance and accuracy measurements and any adjustments you make between launches.

Construction Criteria and Constraints

- Finished length, height, and width must each be no more than 24".
- It can only use a counterweight to provide the force required for firing.
- Counterweight and all components related to it must weigh no more than 4kg.
- Trebuchet must have a trigger mechanism. It should allow the trebuchet to remain in a ready-for-firing state without human intervention. It must also allow the trebuchet to be fired from at least 3 feet away to the side.
- All materials MUST be directly purchased from RebelTech Hardware, except those that are used to construct the sling, trigger, and counterweight.
- You must provide or find the material for the sling, trigger, and counterweight.
- Plywood cannot be used for the main fulcrum supports or the lever arm, but it can be used for bracing.
- Tape may be used, but NOT AS PRIMARY SUPPORT OR STRUCTURE. You must provide tape if you want to use it.

Performance Criteria

- It must launch a tennis ball.
- It should be accurate within +/-15% (this means it would be able to be aimed and fired at a target).

Project Restrictions

- All projectile launchings will be done outside. You may test fire your trebuchet in class provided that it does not have any projectile in it. You can only test in the designated testing area in the classroom, and only one team may test at one time. We will schedule a day to work outside so you can work on your slings and test fire your trebuchet.

- No trading of materials purchased at RebelTech Hardware. All materials you purchase will be tracked.

RebelTech Hardware Store

- Just like real life, materials at RebelTech Hardware cost money. To help you purchase these, you have been given store credit. All of these are listed in the table below.
- To purchase materials, you must first present a drawing that shows the exact dimensions and placement of the materials to be purchased. You must also have enough credit with which to purchase the materials.
- When your purchase is approved, your materials will be numbered (where possible) and your purchase will be recorded.

Item (dimensions may vary slightly)	**Price**	**Team Limits**
Short Beam (2cm x 4cm x 30cm)	$10	8
Long Beam (2cm x 4cm x 40cm)	$20	2
Extra Long Beam (2cm x 4cm x 60cm)	$50	1
Plywood (30cm x 60cm x 1.25cm OSB)	$20	2
Pivot shaft	$20	1
String	$.25/in	none
Screw eyes	$1 each	none
Screws/glue	free	none
Your Team's Store Credit	$225	

Schedule (may be adjusted due to school activities, weather, etc.)

Research, Design, and calculations	3/16 – 3/22
Initial Construction	3/23 – 3/25
1st outside testing day for initial tests	4/5
Adjustments, additional build, wrap-up	4/5 – 4/6
2nd outside testing day for final official tests	4/7

Grading and Possible Penalties

- You will be given 3 separate grades for this project: 1) the design notebook; 2) the finished trebuchet; 3) productivity and work ethic. See the rubric below for grading criteria and scoring. Print any electronic parts of your notebook, staple everything, and turn it in. Place the trebuchet in the designated area (you'll be told where this is).
- You are expected to be productive and safe at all times. To help ensure this, there are certain penalties that will be given if these expectations are not met. These are individual penalties, but will be applied to everyone involved in the action. Other penalties such as parent calls, administrator contacts, and write-ups may also be added to these.
    - Doing other things instead of working on the project (games, phones, etc.) (-5 points per instance)
    - Incorrectly using tools and equipment (-5 points per instance)
    - Using any unauthorized tools and materials (-5 points per instance)
    - Any activity that causes disruption or negatively affects other students (-5 points per instance)
    - Indoor test-firing outside of designated area (-20 points per instance)
    - Launching a projectile of any kind indoors (-50 points and removal from project)
    - Any activity that negatively affects anyone's safety (-50 points and removal from project)

Design notebook – print, assemble, staple, and turn in	**100**
– Contains all required information in sufficient detail	80
– Organized, contains required sections, information in proper sections	20
– Penalties – plagiarism, drawings not from scratch (-10 pts each instance, drawing, or section)	?
Finished Trebuchet	**100**
– Meets construction criteria and constraints	80
– Meets performance criteria	20
– Penalties – improper use of materials, exceeding limits (-10 pts each instance or part)	?
Productivity and Work Ethic	**100**
– Scoresheet results (you will be told about this later)	?
– Penalties – violations of expected behaviors (see list above)	?