

Testing your Trebuchet!

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A trebuchet graphing activity

The trebuchet was a fearsome weapon in Medieval Times. When firing a trebuchet accuracy was very important, and there were a few variables in determining the distance the projectile would travel.

Can you guess what they are? Have a look at your trebuchet.

Well if you can't, then here they are:

1. The weight of the projectile
2. The shape of the projectile
3. The length of the counterweight from the fulcrum (the position of the fulcrum)
4. The **weight** of the counterweight
5. The length of the swing arm
6. The length of the sling
7. The angle of the releasing pin on the swing arm.
8. If the trebuchet has wheels or not.
9. Wind and elevation also were factors in hurling projectiles.

Wow, that seems like too many things for one Siege engineer to think about!

Well, they didn't adjust all of these potential variables. In fact they only adjusted a few, mostly the weight of the counterweight, the length of the sling and the weight of the ball. They wouldn't really change the weight of the ball too much since it had to be heavy enough to do damage to a castle.

For accuracy they also had to turn the trebuchet to one side or the other, but that's a different story.

The question is, what effect do different weight projectiles have on the distance they travel, and, is the increase in distance as the ball gets lighter (or heavier) linear (a straight line), or does it change in an arc, if you were to graph the results.

Use the worksheet to write up what you do.

Test how the weight of the ball affects the distance.

First, on your worksheet, make a prediction – a hypothesis - about what you think will happen as the weight of your projectile changes.

1. Take the plasticene and roll it into three small balls, each one a little larger than the other. If you have a scale you can weigh them – one ball two grams, the next one four grams, the next one six grams and so on (and more if you have time!).
2. Start with the smallest ball. Put some tape on the floor so you can place the trebuchet in the same place each time. Roll out a tape measure in front of the trebuchet, and fire off your plasticene. The lightest will go pretty far and fast so you may have to practice your skills in seeing where it lands. You may also have to go outside to do this.
3. Measure where it **lands**, not where it rolls to, in case the floor is uneven (plus the plasticene dents when it hits the ground, so it doesn't roll evenly). If your tape measure isn't long enough, then get a rough idea where the ball lands, measure out to that point and put down the tape measure there, adding in the distance to what you measure on the tape.
4. Take ten shots and record each distance on the table.
5. Use the next larger ball and do the same thing. Ditto with another heavier ball.

Remember that in medieval times the attackers had to use a heavy projectile, or it wouldn't do any damage to the castle walls, but if they were too close (if the stones were very heavy) then they could be hit with arrows from the castle!

Once you have recorded ten shots of each weight then add up all the distances and divide by the number of shots you made (ten). This will give you an **average** distance for each weight. Then with these numbers you can make a graph.

Plot your graph with two axis. Along the bottom could be the distance the ball traveled, and along the side would be the weight of the ball.

You need to start at zero and make sure your distances between the marks are equal!

Now comes the fun part, draw a line between the marks you made and see what shape the line is. Is it straight, curved? Can you extend the line in the same direction, what might it look like?

Well now that you have an idea about how far the ball goes by changing the size (weight of the ball), now you can **try adjusting the length of the sling**.

In another experiment you might slowly add weight to the counterweight box, recording the results as you go.

You have different types of balls in your kit. Find a few others (nothing hard!) and do an experiment with them, comparing the distance and the way they fly through the air (you can even roll up a piece of paper).

Make a prediction about which will go farther, and fire away! You might predict that the lighter the ball the farther it will go, this may be so for some balls, but for all? What other factors affect the distance of a projectile?

This is an open ended activity leading to some interesting results!

You can easily buy Styrofoam balls of different sizes, - that would make an interesting experiment!

What about firing off projectiles that are the same weight, but different shapes?

How about taking the wheels off (or taping them so they don't move) and test what happens!

You must be careful not to use hard items that may hurt someone if it hits them – soft or light things only!

Ye Olde Trebuchet Worksheet

This will really impress the lord of the castle!

Use the back side to write your test results and make a graph.

Description of your experiment (what are you trying to test?)

Hypothesis (what do you think will happen).

Method (how did you do the experiment?)

Results (well, what happened?)

Helpful tools for testing your siege engine! A table for results and a graph to plot them!

Record your results.

Variable _____

WEIGHT	WEIGHT	WEIGHT	WEIGHT

Effect of changing the weight of the projectile on a trebuchet

Weight
of
ball
—

Distance in _____