CANNON WARS

The Siege of Toulon

You are a French gunner in the Revolutionary army who will besiege the city of Toulon and take it back from the British! You must design a magnetic cannon to attack a British fortress and help claim the city for the French Revolutionaries.

You will have **2 minutes** to do as much damage to the British fortress as possible. The front of your cannon will be placed **3 meters** from the wall of the fortress. You will earn **5 points** for each block of wall you knock down and **10 points** for each British sentry you knock over. The team that does the most damage to the fortress (and gets the most points) will win and receive a Cannon of Honour.

Siege of Toulon, undated print.
Library of Congress, Washington, D.C. (Digital File Number: cph 3a26681)

Forces Final Project

This is your final project and assessment on Forces. You will be working on the project over the next 4 weeks. <u>From October 28th - November 13th</u> you will be building, testing and explaining your cannon. <u>The week of November 16th</u> will be "Seige Day" where we will test your final design.

You may work with a partner of your own choosing, <u>but you must complete your own project report</u>. **There are <u>many parts </u>to this assignment so make sure to read this carefully and refer back to it often.** This report is a scientific report. This means that it should be complete, organized and professional.

Please work in THIS document when creating your report. Please delete these first two instruction pages and any other instructions before you turn your report in.

There are three sections in the final report: Iterative Design, Claim-Evidence-Reasoning, and Results & Analysis. Your reports are due **no later than Monday, November 23rd at 4:00pm.**

Engineering Requirements

Firing Mechanism - Think of all the forces we've studied this year and use these forces in your firing mechanism. You are free to design anything you want as long as it is NOT an explosive.

Ammunition - The cannonballs will be marbels. This is the only ammunition that you can use. On siege day will have an "unlimited" supply of marbels.

Cannon Reinforcement - You will also need to design and build the reinforcement or housing for the cannon. You will build the cannon from supplies provided in the lab (wood, rubber, foil, etc.). You can NOT purchase a pre-built cannon. You MUST make this from scratch. If there are supplies from home you want to use you must first get approval from Ms. S.

This is your design criteria. This mean your cannon must do each of the following:

1. **Increase Force**. The greater the force of the cannon the easier it will be to knock down the fortress wall. Is there a way to design the cannon to increase the force of the cannonball?

2. **Increase Accuracy**.   The front of your cannon will be placed 3 meters from the fortress wall. How can you build your cannon so that you can accurately hit targets on the wall?

3. **Increase Efficiency**. You only have 2 minutes to do as much damage as possible. Can you build your cannon to make reloading easier and your cannon more efficient?

You must build at least **3 prototypes** before your final design. Remember you final design can be any one of your prototypes.

Iterative Design

Your Name:

Your Partner's Name:

<mark>Plan 1</mark> - *A well labeled sketch of what you think you are going to build.*

<mark>Prototype 1</mark> - *An annotated photo of your first build.*

<mark>Test 1</mark> - *Test your prototype and answer the questions below.*

1. What was successful about your prototype?

2. What failed?

<mark>Evaluate 1</mark> - *Answer the questions below to analyze your test.*

1. How would you change your design?

2. Why are you changing your design?

<mark>Plan 2</mark> - *This is a well labeled sketch of what you are going to build AND answer the questions below.*

1. How does this design increase the force?

2. How does this design increase accuracy?

3. How is this design more efficient?

Prototype 2 - *This is an annotated photo of your second build.*

Test 2 - *Test your prototype and answer the questions below.*

1. What was successful about your prototype?

2. What failed?

Evaluate 2 - *Answer the questions below to analyze your test.*

1. How would you change your design?

2. Why are you changing your design?

Plan 3 - *This is a well labeled sketch of what you are going to build AND answer the questions below.*

1. How does this design increase the force?

2. How does this design increase accuracy?

3. How is this design more efficient?

Prototype 3 - *This is an annotated photo of your third build.*

Test 3 - *Test your prototype and answer the questions below.*

1. What was successful about your prototype?

2. What failed?

Evaluate 3 - *Answer the questions below to analyze your test.*

1. How would you change your design?

2. Why are you changing your design?

Implement - *Annotated photo of your final build and answer to the questions below.*

1. How do you expect your cannon to do on Siege Day?

2. Why do you think this?

Claim-Evidence-Reasoning

Once your design is complete, you need to write a Claim-Evidence-Reasoning to answer the question, "**Why does the cannonball fire from the cannon?**" Remember while you are working on this with your partner, <u>you are submitting your own final report and your CER should be in your *own* words</u>.

Claim - This should be a one to two sentence summary of <u>why the cannonball fires.</u>

Evidence

Draw a force system diagram showing all the forces in the cannon <u>the moment before the cannonball fires.</u>

Draw a free body diagram that shows the <u>forces acting on the cannonball when it is firing</u>.

Using the force probes, find the force of your cannonball. You should take at least 5 readings. Put these readings in a table below and **use the average as your final reading**.

Reading	Force of cannonball
1	
2	
3	
4	
5	
Average	

Find the mass of your cannonball and record it here.

Use Newton's 2nd Law to calculate the acceleration of cannonball. Please show your work.

Reasoning - Using the Scientific Principles explain <u>why the cannonball fires</u>. *You should have at least 3 paragraphs.*

Results & Analysis

After you have wreaked havoc on the fortress you must record a few final pieces of data and write a final analysis of how your cannon did.

Before and after photos of the Siege
Take a photo of the British fortress before the siege starts and then take another photo after the siege. Include both of these photos here. Make sure to label the photos "before siege" and "after siege".

Total number of points awarded
You will earn **5 points** for each block of wall you knock down and **10 points** for each British sentry you knock over. Record the number of points you earned here.

Cannon Analysis
After the siege write answers to the following questions in complete sentences.

1. Did your cannon perform as expected?

2. Why or why didn't your cannon perform as expected?

3. What in your design worked well?

4. What in your design failed?

5. If you could start over what would you change?

6. Why would you make these changes?

Cannon Wars Evaluation

Component	Points
Iterative Design	*50 points total*
Plan, Prototype, Test & Evaluate 1	15
Plan, Prototype, Test & Evaluate 2	15
Plan, Prototype, Test & Evaluate 3	15
Implement	5
Claim-Evidence-Reasoning	*50 points total*
Claim	5
Force System Diagram	10
Free Body Diagram	10
Mass, force and acceleration	10
Reasoning	15
Results & Analysis	*20 points total*
Before & After photos	4
Points awarded	1
Cannon Analysis	15
Total Number of Points	**120**