



A Better Fort for George

**Submitted by: Michelle Booth, Kevin Hill, Laura Melvin, Derek Perdue, Math,
Engineering, ELA/Social Studies, Science
Wicomico County**

Target Grade: 3rd – 5th

Time Required: 3-5 day unit plan

Standards:

Science (NGSS):

- 2-PS1.A. Matter can be described and classified by its observable properties. Different properties are suited to different purposes.
- 3-PS2.B. Types of Interactions: Objects in contact exert forces on each other.
- 3-PS3.C. When objects collide, the contact forces transfer energy so as to change the objects' motions.

ELA (CCSS):

- RI.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Math (CCSS):

- 4. NF.C.6. Use decimal notation for fractions with denominators of 10 and 100. For example, rewrite $62/100$ as 0.62; describe a length as 0.62 meters, locate 0.62 on a number line.
- 2. MD.A.1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

Social Studies (MSC):

- 5. C.1.a. Identify and sequence key events between the French and Indian War and the American Revolution.

Technology (ITEA):

- Standard 8. Students will develop an understanding of the attributes of design.
- Standard 9. Students will develop an understanding of engineering design.



- Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Standard 11. Students will develop abilities to apply the design process.
- Standard 20. Students will develop an understanding of and be able to select and use construction technologies.

Lesson Objectives:

Students will:

- Build a model wall of a fort that could have spared Washington's defeat.
- Collaborating and sharing/accepting ideas in a group setting to solve a problem or accomplish a task.
- Understanding different materials have different properties which make them useful for particular jobs.
- Calculating cost of materials for a project.
- Measuring using the metric system.
- Persevering when accomplishing a goal.
- Reading informational/biographical text.
- Solving problems in which there are multiple solutions.

Central Focus:

Students are challenged to build a model wall of a fort that could have spared Washington this defeat. Students may choose from a variety of materials from which to construct their wall, which will be tested using modeled musket and cannon fire. Student materials come at a cost as identified by a budget sheet, and each team will need to build the strongest yet most economical wall possible. The wall should measure a minimum of 30cm across and 15cm high. Forts will be scored based on the dollar amount spent as well as a damage scale score determined when testing.

Background Information:

On July 3, 1754, under British command, Major George Washington and his men fought the French army at Fort Necessity in Pennsylvania in one of the first battles of the French and Indian War. Sadly, Washington and his troops were defeated that day and he had to surrender. This was Washington's only defeat in the French and Indian War. But what if they had a better fort? What if Fort Necessity had been stronger and withstood the French forces?

The information and lessons provided are designed to set the context and build a foundation of knowledge in order for students to complete the engineering design challenge, which is the culminating activity. As all classes and classrooms are different, it is at the teachers' discretion as to how and when these lessons are implemented. Also, these lessons should NOT be the only method of implementing this unit/design challenge. Teachers can and should make any changes, additions, extensions, etc. necessary to meet the needs of their classroom. The context for this unit can be set



through either ELA (biographies, non-fiction text, etc.) or Social Studies (historical figures, Presidents Day, French and Indian War, etc.), and using Science and Math to build the knowledge base in materials and measurement in order for the students to complete the design challenge. The ELA/Social Studies portions provide the “why,” and the Science/Math portions provide the “how.”

This unit incorporates skills and lessons from English Language Arts and Social Studies through the use of non-fiction informational biographical text about George Washington and the French and Indian War. Students will also need to communicate and share ideas, draw diagrams, and present their finished project to the class. Math and Science content knowledge are utilized in the measurement, construction, and testing of their engineering project. Real world connections can be made through using the engineering design process to solve problems in any engineering capacity as well as the practice of testing and selecting appropriate materials from a construction and economic standpoint.

Students should come into this activity with some knowledge of:

- George Washington
- Forces
- Measurement
- Decimals
- Money
- Collaboration
- Some engineering design experience

Materials

Science

Lab sheets, marshmallows, dried beans, marbles, index cards 3X5 and 5X8, Masking Tape, Popsicle Sticks, Craft Sticks, Sugar Cubes, Frosting, styrofoam trays, triple beam balance scales, calculators, rulers, graduated cylinders, rulers .

Math

Dimes, pennies, meter stick, index card, metric worksheet, blank wall # line, sticky notes with tenths, and hundredths labeled to be placed on the number line.

Instruction

	Description
Engagement	ELA or Social Studies (Appendices A and B): <ul style="list-style-type: none"> • Read informational text and answer questions about George Washington (Appendix A). • Background on French and Indian War, Fort Necessity, and Washington’s role in the



	<p>War. (Appendix B)</p> <p>Explain to students that they will need to design and build a model fort wall to help George Washington fight the French at the Battle of Fort Necessity during the French and Indian War.</p>
Exploration	<p>Review the Engineering Design Process (Appendix C)</p> <p>Math (Appendix D):</p> <ul style="list-style-type: none">• Measurement to the nearest centimeter.• Decimal notation for fractions with denominators of 10 and 100. <p>Science (Appendix E):</p> <ul style="list-style-type: none">• Allow students to observe, handle, and test each of the building materials.• Review forces as they pertain to load bearing structures as well as energy transfer when objects collide.
Explanation	<p>Engineering Design (Appendix F):</p> <p>Review the conditions and parameters of the project as well as review the Engineering Design Process, the budget sheet, testing criteria, and scoring the forts effectiveness.</p> <p>Teams of 3 to 4 students will work together, share ideas, draw a diagram, select materials, and fill out a budget sheet.</p>
Elaboration / Extension	<p>Students will build their structures according to their design plans, and then present their ideas to the class.</p>
Evaluation	<p>Students will test their forts by hurling projectiles at the model wall and assessing the damage, then calculating their total fort score by adding the cost of their fort to the damage score.</p> <p>Students will write a reflection journal on their design, testing, and any improvements to their design (Appendix G).</p>

Essential Questions:

- What if George Washington were able to build a better fort in one of the first battles of the French and Indian War? Would he have had to surrender?
- How can we determine what materials we should use to help Washington build a better fort?

Day 1: Engagement

Introduction/Set Context (ELA/Social Studies):



Overview:

Students will read two informational texts, the first about George Washington, and the second about the Battle for Fort Necessity. These texts will help provide the context for the engineering design project “A Better Fort for George.”

Essential Questions:

What if George Washington were able to build a better fort in one of the first battles of the French and Indian War? Would he have had to surrender?

Step 1. Prior to teaching about George Washington, have students turn and talk about what they know about George Washington. We then began a KWL chart together.

Step 2. Once we complete the K and W of the KWL chart, students read the article about George Washington with a partner. As the students read the article with their partner, they will track their thoughts and discussed together before we came back together as a whole group to answer the following questions: What was surprising? What was interesting? What did you learn? Were any of your questions answered?

Step 3. Students then work together to complete the comprehension questions, which we then checked and corrected together. Read the second article in a similar fashion the following two days.

Day 2 and 3: Exploration

Introduction to design challenge and build knowledge:

Explain the engineering challenge, and review the Engineering Design Process

Overview:

In this lesson students will learn how fractions and decimals are related, how to label decimals on a number line and write metric measurements in decimal form. They will use this knowledge as a civil engineer in the challenge-Based Problem “A Better Fort for George”.

Essential question:

- How are decimals and fractions written using decimal notation?
- How are decimal numbers and fractions related?
- How does the metric system of measurement show decimals?
- How can I represent decimals on a number line?

I. Introduction

Mary is at the Candy Store. She sees that some of the candy prices are written as decimals and some of them are written as fractions of a dollar. Mary is confused because she believes that decimals and fractions are not related. Do you agree with Mary? Explain.



Have students discuss this within their groups and then as a class.

Possible Guiding Questions:

1. How do you think fractions and decimals could be related?
2. What do you know about what fractions represent? Could you relate this to decimals?
3. What can you tell me about what makes up a dollar?
4. If Mary sees a candy that costs $\frac{9}{10}$ of a dollar, how do you think we could represent how much this candy costs with money? Show with your coins.
(Number line)
5. Do you think decimals could be represented as fractions?
6. How can we use our knowledge of money to help us relate this decimal to this fraction number line?
(how does money relate to fractions)
7. how many pennies are in a dollar?
8. What fraction of a dollar would one penny represent?
9. How many dimes are in one dollar?
10. What fraction of a dollar would one dime represent?
11. If you had all pennies (all dimes) to make one dollar, how could you represent this as a fraction?
(where would each amount of money be located on the number line?)
12. label the dime and penny on the number line.

II. Lesson

1. Have students look at the Meter stick.
 - a. What is it? How is it related to the number line (slide 4)
 - b. How many fractional parts is it broken into?
 - c. Each tick is 1 cm. How many cm make up 1 meter?
 - d. How would you write that as a fraction? Have students support their reason for numerator and denominators.
 - e. Have students close their eyes and put their finger anywhere on the meter stick. What decimal is represented by the tick their finger landed on?
2. Use the meter stick to measure the length of the index card. How many cm is it? How will we represent it as a fraction of a meter? How will you represent it as a decimal?
3. Next measure the width of the index card. How many cm is it? How will we represent it as a fraction of a meter? How will you represent it as a decimal?
4. Have students work in pairs to measure items around the room in meters and record information on the worksheet.



III. Closure

1. How are decimals and fractions related?
2. How can we use decimals to record measurement in metric units?
3. Pass out sticky notes with fractions and decimals between 0-1. One to each student. Have them place the fraction or decimal correctly on the wall number line.

Science

Overview

This 5E Science lesson is one of the learning experiences in a STEM unit plan designed for President's day. Its intention is to familiarize students with the observable properties of the materials so that they can make informed and reasonable decisions about which ones are best suited for completing their engineering activity, which is based on constructing a durable fort wall for George Washington at the historic battle of Fort Necessity.

Engage: Students will watch the following youtube video:

<https://www.youtube.com/watch?v=OuQOmOBayBA> Before viewing the teacher will warn students that they are viewing a non-violent demonstration of the power of ballistic walls to withstand the force of modern weaponry. Students who do not wish to view gunfire may opt out.

- Teacher will explain that some engineers employed by military, police, and security forces work to design building materials that can withstand the tremendous forces that are delivered from modern weapons. In order to protect human life from attack, scientists and engineers must investigate and measure the physical properties of a variety of substances to determine what can best be used to design weapon-proof shelters.
- Teacher reminds students that in this unit's final engineering activity, students will be required to design a model fort wall that can withstand a projectile attack from marshmallows, dried beans, and marshmallows. They will need to investigate the properties of the projectiles as well as the properties of the building materials that can be used for the fortress wall.

Explore:

- Students will be placed into groups and given lab sheets (see sample below) for the investigation of materials.
- Students will use science tools to observe, record, and contemplate the potential use and power of the materials.
- Teacher will facilitate the student investigation by clarifying questions, guiding inquiry, and maintaining order.

Explain:

- Teacher will work with students to analyze and communicate their understanding of the materials properties through discussion. After students from each group have had time to share their reasoning about the materials dangers and uses, teacher will



guide questions and discussions appropriately to cover any important properties that have been overlooked.

- During this time the teacher is to reinforce and activate student's prior knowledge about the properties of matter.

Extend:

- During this time the teacher can pass out calculators to the students and have them follow along with a brief lesson on force.
- Teacher will remind students that forces are pushes or pulls.
- Teacher will ask students whether the projectile will be pushing or pulling on their fortress walls. A brief discussion may be required to clear up misconceptions.
- Teacher will explain to students that the amount of force each projectile has can be easily calculated if the projectile's speed and mass are known.
- Teacher will say that for the purposes of this activity all projectiles will have an estimated speed of 5 meters per second. Teacher can remind students that speed is equal to the distance an object travels over time. Teacher can then do a demonstration of a projectile launch so that students have a real-world example of what 5 meters per second looks like.
- Teacher will introduce the idea that force can be easily calculated by multiplying the mass of an object by its speed. Force (momentum) = mass X speed (velocity)
- Teacher will then have students calculate the force for their different projectiles based on the assumed speed of 5 meters per second multiplied by their mass.
- Students will share their answers in a teacher led discussion and the class will conclude which projectile will exert the most force on the fortress wall.

Differentiation

For this lesson, students will have the opportunity to check work they complete with other students and the teacher. The for that they build can be of their choosing which allows them to express themselves creatively.

Assessment

Formative:

- Students will be assessed through observation by the teacher throughout this lesson.
- Students will be evaluated based on their lab sheets, discussions, and conclusions.
- Students will finally be encouraged to begin the process of creating a shopping list and thinking about their budgets for material selection in the fortress wall.

George Washington

George Washington was born on February 22, 1732 in Westmoreland County, Virginia, although he grew up near Fredericksburg. In his childhood and adolescence, he studied math and surveying. When he was 16, he went to live with his brother Lawrence in Mount Vernon.

George was scarred with Smallpox before the age of 20, but inherited his brother's land (including Mt. Vernon) when he died in 1752.

Washington's military career began in 1753, when he was sent into Ohio country. In 1754, he battled the French and was forced to surrender Fort Necessity (near present-day Pittsburgh, Pennsylvania). He continued as an officer in Ohio country, and served under the British general Edward Braddock when their army was ambushed by the French in 1755. Once again, Washington tasted defeat after their surrender of Fort Duquesne to French forces. Washington helped take Fort Duquesne back in 1758.

Washington was married to Martha Custis in 1759. Washington managed the family and estate until he took command of the Virginia troops just before the American Revolution. He was made commander of the Continental Army on June 15, 1775.

Washington proved himself an excellent leader, and won several decisive battles during the Revolution. As an advocate of a federal government, Washington became chairman of the Constitutional Convention and helped in getting the Constitution ratified. In 1789, he was inaugurated as America's first president.

Washington was re-elected in 1792, but refused a third term. On December 14, 1799, seventeen days before the new century, Washington died of acute laryngitis.

1.) When was George Washington born?

- A. After February 24
- B. Before February 20
- C. After February 26
- D. Before February 23

2.) George Washington couldn't be scarred with smallpox at which age?

- A. 16
- B. 17
- C. 19
- D. 21

3.) In which of the following years was George Washington successful in battle?

- A. 1750
- B. 1753
- C. 1758
- D. 1755

4.) George Washington married Martha _____.

6.) What does the noun 'advocate' mean as written in the following sentence:

As an advocate of a federal government, Washington became chairman of the Constitutional Convention and helped in getting the Constitution ratified.

- A. Opponent
- B. Supporter
- C. Creator
- D. Player

7.) Which of the following was George Washington not involved in?

- A. Surrender of Fort Duquesne
- B. Constitutional Convention
- C. Revolutionary War
- D. Boston Tea Party

8.) George Washington became Chairman of the _____.

- A. Constitutional Convention
- B. American Revolution
- C. Virginia
- D. French forces

5.) What happened first?

- A. George Washington inherited his brother's land.
- B. Washington's military career began.
- C. Washington was married.
- D. He went to live with Lawrence.

9.) What happened last?

- A. Washington was inaugurated as 1st president.
- B. Washington refused a third term.
- C. 1794.
- D. The new century.

10.) What happened last?

- A. Washington was an excellent leader.
- B. Washington won several decisive battles during the American Revolution.
- C. Washington died after the new century.
- D. Washington died before the new century.

11.) What was the site of Washington's first battle against the French?

- A. Fort Knox
- B. Fort Necessity
- C. Fort Duquesne
- D. Fort Sumter

The Battle of Fort Necessity

Rivals in North America

Rival claims between the French and the English to the vast territory along the Ohio River between the Appalachian Mountains and the Mississippi approached a climax about 1750. The Ohio Company (organized in 1748 by a group of prominent Englishmen and Virginians who saw the economic and financial potential of the area) had obtained a large grant of 200,000 acres in the upper Ohio River Valley. From its post at Wills Creek, now Cumberland, Maryland, the Company planned additional settlements and started to open an 80-mile wagon road to the Monongahela River.

Meanwhile, the French, who considered the Ohio a vital link between New France (Canada) and Louisiana, advanced southward and westward, from Fort Niagara on Lake Ontario, driving out English traders and claiming the Ohio River Valley for France. In 1753, Governor Robert Dinwiddie of Virginia learned the French had built Fort Presque Isle near Lake Erie and Fort Le Boeuf in that part of the Ohio country claimed by Virginia. He sent an eight-man expedition under George Washington to warn the French to withdraw.

Washington the Emissary

Washington made the journey as a British emissary in midwinter of 1753-54. He was 21 years old. French officers politely told Washington they were not obliged to obey his summons, and they were going to stay. Washington returned to Virginia and informed Governor Robert Dinwiddie that the French refused to leave.

The Fort Necessity Campaign

In January 1754, even before he learned of the French refusal to abandon the Ohio Valley, Governor Dinwiddie sent a small force of Virginia soldiers to build a fort at the forks of the Ohio, where Pittsburgh now stands. The stockade was barely finished when a French force drove off the Virginians and built a larger fort on the site. The French called it Fort Duquesne in honor of the Marquis de Duquesne, the new governor of New France.

In early April, George Washington, newly commissioned lieutenant colonel, started westward from Alexandria with part of a regiment of Virginia frontiersmen to build a road to Redstone Creek, present day Brownsville, Pennsylvania, on the Monongahela. He was then to help defend the English fort on the Ohio.

When Washington reached Wills Creek, he learned the fort was in French hands. He resolved to push on to Redstone Creek and await further instructions. By the end of May, his force was well beyond Wills Creek when the commander of the expedition, Col. Joshua Fry, arrived there with the rest of the Virginia

Regiment.

"The volley fired by a young Virginian in the backwoods of America set the world on fire."

Horace Walpole

"I fortunately escaped without any wound, for the right wing, where I stood, was exposed to and received all the enemy's fire, and it was the part where the man was killed, and the rest wounded. I heard the bullets whistle, and, believe me there is something charming in the sound."

A cursive signature of George Washington, written in black ink. The signature is fluid and elegant, with the first letters of 'G' and 'W' being particularly prominent and stylized.

A few days after the incident, this is how George Washington described his first experience under fire. The shots at Jumonville Glen were the first in the Fort Necessity campaign, ultimately leading the world to war. But the story of Jumonville Glen has the intrigue of a mystery thriller and contains controversy and unanswered questions.

Washington Arrives at the Great Meadows

By late May of 1754, Washington had reached a large natural clearing known as the Great Meadows. He made this his base camp. Grass there could provide food for his animals, and water was readily available.

Soon after he arrived, he received word that a party of French soldiers was camped in a ravine not far from his position. On the stormy night of May 27th, 1754, Washington and about 40 men began an all-night march to confront the French and learn their intentions. They travelled through woods so dark the men sometimes spent nearly half an hour just trying to find the trail.

The Skirmish

About dawn, Washington met with a friendly Seneca chief, Half King, and made plans to contact the French Camp. As the French commander had not posted sentries, Washington and his men easily surrounded the unsuspecting French.

A shot was fired, no one really knows by whom, and soon the peaceful glen was filled with the crash of

musketry and the sulphurous smell of powder. The skirmish lasted about 15 minutes. When it was over, 13 Frenchmen were dead and 21 captured. One escaped and made his way back to Fort Duquesne at the forks of the Ohio. Washington's casualties were one man killed and two or three wounded.

Diplomats or Spies?

Controversy surrounds the events that took place at Jumonville Glen, named after Ensign Joseph Coulon de Jumonville. He was the leader of the French detachment, and was killed there.

Soon after the smoke had cleared, French survivors claimed they had been attacked without cause by Washington. They claimed they were on the same sort of mission Washington himself had been on the winter before. That explained, they said, why they had been so easily surprised and why they had not posted sentries. Washington asked why, if the French were on a diplomatic mission, they were hidden in a ravine, off the trail, and in the area for perhaps a couple of days without approaching him.

Washington sent his prisoners to Williamsburg while he returned to the Great Meadows.

After the skirmish with Jumonville's forces, Washington feared "we might be attacked by considerable forces."

He undertook to fortify his position at the Great Meadows. During the last two days of May and the first three days of June, he built a circular palisaded fort, which he called Fort Necessity.

He learned that Joshua Fry died at Wills Creek on May 31. Washington assumed command of the regiment and was promoted to colonel.

The rest of the Virginia regiment arrived at the Great Meadows on June 9, along with supplies and nine small cannon called swivel guns. Washington's command now totaled 293 officers and men. He was reinforced several days later by about 100 men of Capt. James Mackay's Independent Company of regular British troops from South Carolina. Washington's attempts to retain his Indian allies were not successful.

While the South Carolinians remained at the Great Meadows, Washington and his Virginians spent most of June opening a road from Fort Necessity to Gist's Plantation, a frontier settlement in the direction of the forks of the Ohio. Reports that a large force of French and Indians was advancing from Fort Duquesne, however, caused him to withdraw his men to the Great Meadows, where they arrived July 1.

The next day, they strengthened Fort Necessity by improving the trenches outside the stockade. On the morning of July 3, a force of about 600 French and 100 Indians approached the fort. After the French took up positions in the woods, Washington withdrew his men to the entrenchments. Rain fell throughout the day, flooding the marshy ground. Both sides suffered casualties, but the British losses were greater than French and Indian losses.

The fighting continued sporadically until about 8 p.m. Then Capt. Louis Coulon de Villiers, commander of the French force and brother of Jumonville, requested a truce to discuss the surrender of Washington's

command.

Near midnight, after several hours of negotiation, the terms were reduced to writing. Washington and Mackay signed the multi-part document. The British were allowed to withdraw with the honors of war, retaining their baggage and weapons, but having to surrender their swivel guns. Washington surrendered his command to the French.

One clause stated that Washington was guilty of the assassination of a French officer, Jumonville. He denied this. He said the translation he had been given was not "assassination", but "death of" or "killing." In any event, the French used this propaganda to great advantage in efforts to discredit the English.

The British troops left Fort Necessity for Wills Creek on the morning of July 4. From there they marched back to Virginia. The French burned Fort Necessity and afterwards returned to Fort Duquesne.

The following year Washington joined another British expedition to the Forks of the Ohio under the command of General Edward Braddock.

After George Washington's defeat at Fort Necessity, his British force retreated to Wills Creek (present day Cumberland, Maryland).

THE MARCH TO THE FORKS

After appeals from colonial governors, the British decided to take matters more seriously and sent Major General Braddock to North America with two regiments of infantry. Braddock, a career soldier, had risen through the ranks. After 45 years of military service he became commander-in-chief of all British forces in North America. The British plan for 1755 was to simultaneously attack many French forts in North America. Braddock would lead the expedition against Fort Duquesne personally. That spring, he disembarked his army at Alexandria, Virginia. After adding colonial troops and a few Indians to his force, Braddock had about 2,400 men. George Washington joined the campaign as a volunteer aide to the General.

BRADDOCK ROAD

The army assembled at Wills Creek. Braddock decided to follow the road Washington had blazed over the mountains on his way to Fort Necessity the previous year. Because the trail was inadequate for the army's large wagons and artillery, it was widened to 12 feet, but only at great effort and expenditure of time. The force seemed to move at a snail's pace. Finally the army was split in two with Braddock moving ahead with the bulk of the men and a few pieces of artillery. The remainder would follow under the command of Colonel Dunbar

In early July, the advance group was approaching the Forks of the Ohio. On July 9, they made a second crossing of the Monongahela River. From that point it was a short march to Fort Duquesne.

THE BATTLE OF THE MONONGAHELA

Soon after the river crossing, the woods in front of the British column exploded with musket fire and the whooping of Indians and their French allies as they collided head-on with the British. Advance British units fell back upon the main body, while the rear units continued advancing, adding to the confusion. Disorganization and fear seized the British. In the smoke of the battle, fighting an unseen enemy, and with many British officers killed early on, discipline all but ended.

The Battle lasted three hours. Finally, as Braddock was carried from the field severely wounded, the surviving British fled. British losses had been horrendous: more than 900 casualties out of 1,400 men engaged. They were completely beaten by a force they could not see in a wilderness where they did not want to be. Their retreat to the safety of Dunbar's camp was hasty and disorganized. Washington reported "The shocking Scenes which presented themselves in this Nights March are not to be described. The dead, the dying, the groans, lamentations, and crys ... of the wounded for help were enough to pierce a heart of adamant".

THE GENERAL IS BURIED

On July 13 The British camped about one mile west of the Great Meadows, site of Fort Necessity, and in the evening Braddock died. Washington officiated at the ceremony the next day. The general was buried in the road his men had built. The army then marched over the grave to obliterate any traces of it and continued to eastern Pennsylvania.

One can only imagine what went through the general's mind after the battle. He commanded what some considered an invincible army. They were not ambushed, but rather surprised, and discipline broke down. The rout was a disgrace. Doctors later reported that the general had died more from anxiety than from his wounds.

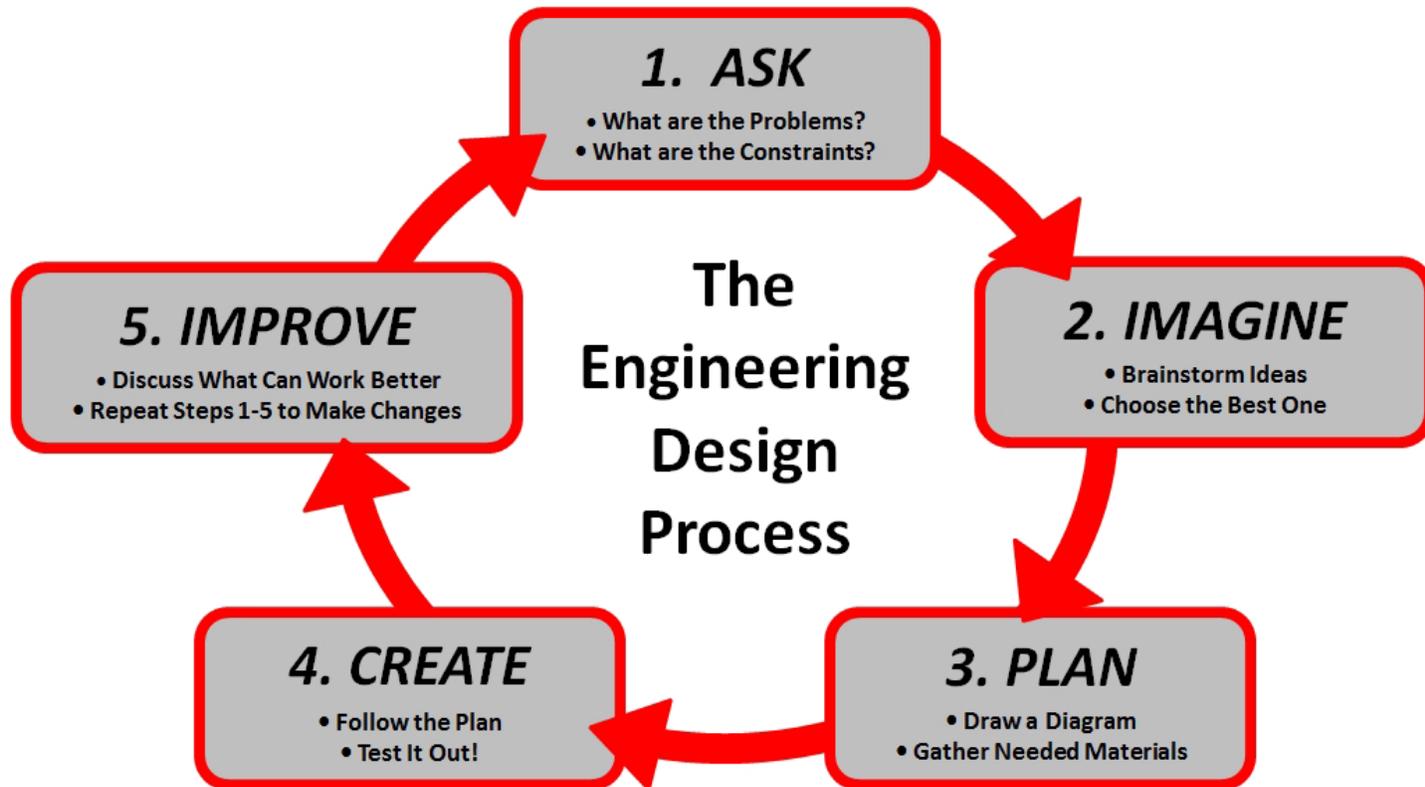
Washington later wrote "...Thus died a man, whose good and bad qualities were intimately blended. He was brave even to a fault and in regular Service would have done honor to his profession. His attachments were warm, his enmities were strong, and having no disguise about him, both appeared in full force."

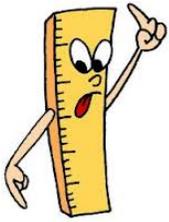
The French used this British retreat to their advantage, and soon French-inspired Indian attacks occurred throughout the frontier. Terrorized settlers streamed eastward and the war spread. In the ensuing decade, however, France lost all her colonies in North America and the British Empire was expanding around the globe. The removal of external threats to colonist and the increased cost of governing the British Empire helped set the stage for the American Revolution.



<http://www.nps.gov/fone/prelude.htm>

The Engineering Design Process





Metric Masters!

$$\frac{53}{100} = 0.53$$

Name _____

Date _____

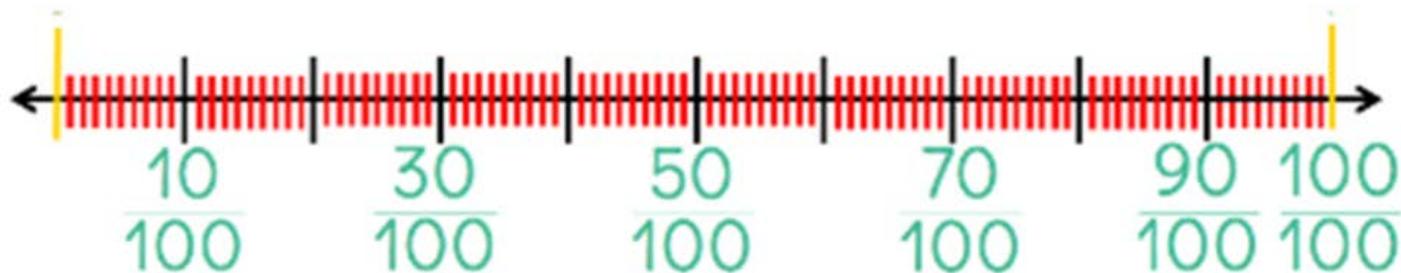
Directions:

Measure the items below in meters. Record the results as a fraction and as a decimal.

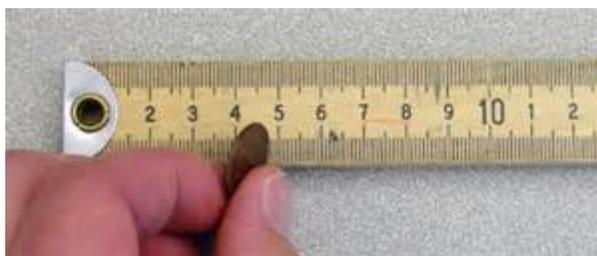
Item	Fraction	Decimal
Length of your desk		
Height of your desk		
Height of the door		
Length of the light switch		
Length of a dry erase marker		

Length of your shoe		
Your choice: _____		
Your choice: _____		

Number line



Number line on a meter stick



Properties of Materials Investigation

Directions: In the projectile and fort wall materials tables below complete the following steps:

Step 1 – Use the triple beam balance scale to determine the mass of each projectile and fort material.

Step 2 – Describe the observable properties of each projectile

Step 3 – Use the measurements and observations to conclude which projectile poses the greatest threat to your structure. Remember all projectiles will be moving at a similar speed, but their masses and physical properties are different.

Projectile Table

	Mass	Relevant Observable properties (flexibility, hardness, texture, etc.)	Draw conclusions to rate the projectiles danger on a scale of 1-5 with 5 being the most dangerous
Marshmallow			
Dried Beans			
Marbles			

In the space provided write at least two well-constructed questions about the materials and their properties. Also write one question you might have about how motion and speed might play a role in the force that each projectile delivers to the fortress wall.

Fort Wall Materials Table

	Mass	Relevant Observable properties (flexibility, hardness, texture, etc.)	Draw Conclusions to rate the Fort Wall Materials on a usefulness scale of 1-5 with 5 being the most useful
Index Card 3X5			
Index Card 5x8			
Popsicle Stick			
Craft Stick			
Sugar Cube			

Engineering Design

A Better Fort for George



On July 3, 1754, under British command, Major George Washington and his men fought the French army at Fort Necessity in Pennsylvania in one of the first battles of the French and Indian War. Sadly, Washington and his troops were defeated that day and he had to surrender. This was Washington's only defeat as a general.

But what if they had a better fort? What if Fort Necessity had been stronger and withstood the French forces?

Your challenge is to build a model wall of a fort that could have spared Washington this defeat. You may use any of the materials below, and your wall will be tested using modeled musket and cannon fire. Your materials come at a cost, so please try to build the sturdiest and least expensive wall possible. The wall should measure a minimum of 12 inches across and 6 inches high. You will fire upon the fort wall and rate the damage accordingly using a scale score. A total fort score will be calculated by totaling your cost and damage score.

Materials: You may use any combination of materials for your fort wall.

<u>Item</u>	<u>Cost per Item</u>	<u>Amount Used</u>	<u>Total Cost</u>
Index card 3" x 5"	\$0.25		
Index Card 5" x 8"	\$0.50		
Masking Tape (per inch)	\$0.25		
Popsicle Stick	\$1.00		
Craft Stick	\$2.00		
Sugar cube	\$0.20		
Frosting (per teaspoon)	\$0.20		
Total Cost			

Test Your Fort Wall



Testing Your Fort Wall: You will “fire” each of the materials 5 times on your fort wall by flicking the projectile using either a spoon or craft stick (not included in your cost). At the end of 5 shots, you will assess the damage and give it a score based on the scale below.

Damage Scale:

0 = No damage at all

1 = Minor/small damage

2 = Moderate damage but still standing and fully functional

3 = Significant damage; large pieces missing but some structure still in place

4 = Heavy damage; only small part of wall may be in tact

5 = Total collapse; entire fort wall has been destroyed

<u>Projectile</u>	<u>Damage Score after 5 shots</u>
Marshmallow	
Dried Pea/Bean	
Marble	
Total Damage Score*	

*Once you reach a score of 5 (total collapse), then any remaining projectiles will receive a score of 5 to figure into your final Total Damage Score. For example, if the wall collapses when using the dried pea/bean, then that receives a score of 5 and the marble will receive a score of 5 counting toward your Total Damage Score.

Rating Your Fort Wall:

To calculate how efficient and effective your fort wall is, add your Total Cost to your Total Damage Score. For example, if a fort wall costs \$6.75 to construct and received a Total Damage Score of 8, then the total score for the fort would be 14.75.

_____ + _____ = _____

Total Cost

Total Damage

Fort Score

Do you think General George Washington and his troops would have won the Battle of Fort Necessity if you would have constructed the walls?

What changes might you make if you had to redesign and rebuild your wall?

Artifacts

Decimals and the Metric System Pictures

