Title: Engineering America: U.S. History + Engineering & Architectural Design

Length of Course: Full Year (2 semesters; 3 trimesters; 4 quarters)

Subject Area – Discipline: History/Social Science ("a") -- United States History

UC Honors designation: Honors

CTE Sector: Engineering and Architecture

CTE Pathway: Architectural Design Pathway

Grade/level(s): 11

Pre- or co-requisite: Intro to Engineering Principles (or similar) is recommended

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Course Overview

This course serves to help students make connections between U.S. History and the engineering innovations that helped form our nation. Students will not only use the engineering design process as they attempt to solve the historical challenges presented to them, but they will also look at the Code of Ethics that governs decisions in the world of engineering; they will examine how decisions made by powerful people had an impact on the landscape and forever altered the way things are done in the US. This course seeks to explain the political, social, economic, and technological factors that prompted the need for engineering innovation in US History. Upon completion of the course, students will think and act like historians, understanding that source, contextualizing, and corroborating historical sources are used to analyze and address present day issues. Their understanding will be demonstrated in a culminating project in which small student teams design/build a scale model of a modern "ideal" US city informed by their understanding of history. Upon completion of this course, students will understand the design process, logistical thinking, and relevance of engineering in American life. This course provides a foundation that could serve as an opportunity for further study in engineering as a career.

Course Content:

Recurring Assignment: Engineering Portfolio

**Students generate an online portfolio of written work samples, photographs of artifacts, video evidence of key assignments, and a step-by-step exposition of the culminating project. Assignments and projects are to be linked using a logical navigation sequence and following contemporary (HTML5-compliant) design features to ensure platform-friendly review. The portfolio will be used to assess content knowledge for both US History and the Architectural Design Pathway with a focus on the capacity to demonstrate drafting and design standards including but not limited to scale, accuracy and tolerances, and material selection in relation to products, buildings, and other structures. Each assignment added to the portfolio must include an abstract correlating the end product with its historical basis, e.g. in Unit 1 - Key

Assignment 2, students compose an abstract to explain the origins of the US Constitution and use a chart of the Engineering Design Process to visually complement the abstract.

Unit 1 - Engineering the Dream

In this unit, students examine the documents that were engineered by those who sought to make the New World into a new, free, nation. The Declaration of Independence, the Bill of Rights, and the U.S. Constitution serve as foundational documents that set the stage for the development of the United States as a nation. After exploring the key ideas of the Enlightenment, and the role and function of quad charts as an organizational tool in engineering, students will create a quad-chart for the Declaration of Independence. The use of the quad chart will help the students think critically about the Declaration of Independence by having them summarize and consider the purpose of the content. Just as in engineering, the design has to have all these elements in place before the "product" can be produced, or written in the case of the Declaration of Independence. Next, students will explore the Engineering Design Cycle, and apply the cycle to the problems faced by America as a young nation. Students will then walk through the design cycle and apply it to the Constitution. Lastly, students will explore the role of the Bill of Rights in the government system of the United States. In a short essay, students will compare and contrast the Bill of Rights to a code of ethics for engineers.

Unit 1 - Key Assignments

1: Quad Charts and the Declaration of Independence

Quad charts are technical documents used to briefly describe an invention or innovation through writing and/or illustration where each of the quadrants categorizes information or ideas. After instruction on various types of quad charts used in the field of engineering, students review key Enlightenment philosophies and the events leading up to America's separation from Britain and create a quad chart for The Declaration of Independence. (As an alternative (or extension) students could create a quad chart for a specific, assigned section of the Declaration of Independence and share with the class or in small groups.) The quad chart should ask the students to identify the Declaration or their assigned sections with a picture that represents the main idea of the text they've been assigned; a summary of the section including the Enlightenment ideas found in the passage, its purpose, and its benefit to society as a way of demonstrating how the ideals of the Enlightenment influenced the creation of and concepts in the Declaration of Independence. (Suggestions for quadrant categories: "Objective," "Picture Title," "Benefit/Goals," and "Connections.")

Example quad charts:
http://www.slideshare.net/minwir/project-management-1-16207009 and
http://blogs.mtu.edu/engineering-research/files/2015/10/Quad-Chart-Template-and-Examples.pdf

2: The Engineering Design Cycle and the Constitution

The Engineering Design Cycle is a series of steps that engineers follow to come up with a solution to a problem. In the case of the young American nation, the most

pressing problem was finding an effective government system that upheld the ideas of the Enlightenment espoused in the Declaration of Independence. To model the design cycle process students apply the engineering design cycle to the Articles of Confederation. Then, after exploring (through their text or class lecture) the ways in which the Articles of Confederation failed to meet the desired solutions (in other words, after students research the weaknesses of the Articles of Confederation), students will work in small groups (3-5 students) to apply and create an Engineering Design cycle chart that implements the steps of the design process and demonstrates how the Constitution improved upon and addressed the weaknesses of the Articles of the Confederation. Students share their Design Cycle charts in poster form through a gallery walk. Through this assignment, students demonstrate an understanding of the Articles of Confederation, how the Constitution was designed, and how the design cycle can be applied across disciplines, whether designing a government or a new machine or tool. (As an extension, students can first use the Design Cycle to create their own form of government that addresses the problems of the Articles of Confederation, before they read and analyze the actual Constitution.)

3: The Bill of Rights

In establishing the Bill of Rights to the Constitution, the engineers of our government system were guaranteeing that they would honor the "natural rights" of the citizens. Structural engineers similarly guarantee their work and the public's safety by adhering to a code of ethics. Students will work in small groups of 2-3 to read, compare and contrast the Bill of Rights with an Engineering Code of Ethics from an engineering society, such as those published by the American Society of Civil Engineers found here: http://www.asce.org/uploadedFiles/About_ASCE/Ethics/Content_Pieces/CodeofEthics2006.pdf. Students document their findings in a graphic organizer. Students will use their completed organizer to write an individual essay exploring the role of the Bill of Rights in creating a democratic government and its significance in influencing how the government functions. Likewise, students will explore how a code of ethics influences the work of engineers and create an analysis of how the two are similar and how they are different.

Unit 2 - The Civil War and Reconstruction

This Unit explores the causes of the Civil War and the unexpected consequences of the Reconstruction Era. The students will research the impact of such simple machines as the cotton gin and the McCormick Reaper on the labor force and the economy of pre- and post-Civil War America. Students will use computer aided drafting as they learn documentation standards, processing, and manufacturing of models of machines and their predecessors. The unit will examine the treatment of freed slaves in the post-Reconstruction era under Jim Crow laws and Black Codes as they look at the patent process and the difficulties African Americans had in getting equal access to protection against infringement. In order to further understand patent laws, students will look for ways to improve the patent processes and present their ideas to the class.

Unit 2 - Key Assignments

1: The Cotton Gin

After instruction in and discussion of the sectional differences between the North and the South prior to the Civil War, students read this article https://www.asme.org/engineering-topics/articles/history-of-mechanical-engineering/how-the-cotton-gin-started-the-civil-war (or one similar of the teacher's choosing) on the contribution of the Cotton Gin to the Civil War. Then students research the progression of technology focusing on the evolution of manipulatives, chemical refining, and foundational materials used to develop agrarian tools such as the cotton gin and McCormick Reaper. Students use technical documentation standards (i.e. CAD and associated methodologies used in professional drafting) to draft and communicate the design (orthographically and in planar views), processing (using annotation methods in a "key" to editorialize relevant historical connections), and manufacturing of an agricultural device/machine of their choosing. Students should also fabricate models of the machine and its predecessor using recyclable materials or other scaled manipulatives in order to explore the simplicity of these history altering machines, while also understanding that new technology in chemical refining made the manufacturing of these machines possible (see possible resources for student research below). In a concluding presentation, students will share their model with the class and correlate the impact of the device/machine/invention on the labor force and how the increase in production capacity boosted agricultural output allowing for continued population growth and urban development. For example, a student may research the invention of the reaper and how it became an essential component of the combine / harvester and how such inventions contributed to slavery in the south.
Possible resources:
http://www.ck12.org/book/Engineering%253A-An-Introduction-for-High-School/section/6.5/ ;
http://www.ck12.org/earth-science/Petroleum-Power/rwa/300-Years-of-Fossil-Fuel-Use/

2: African American Inventors in the post-Reconstruction South

As the Civil War ended, slaves were granted their freedom, but just over a decade later many African Americans faced similar living conditions and limits to their freedom with Jim Crow laws and Black Codes. Students will explore the limits placed on African Americans after the end of Reconstruction in class readings, lecture and discussions from their district approved text. Amongst these injustices was the lack of recognition through the patent system for African American inventors, exacerbating the lack of equal rights and keeping African Americans from the benefits of economic and technological developments. Students will research and present to the class an invention or innovation designed by African Americans in the second half of the 1800s and make connections to present day applications of those inventions. In addition, students will research the requirements to apply for and hold a design patent and explore the impartiality (or lack thereof) for minorities in this time period. Students will analyze the patent application process (19th century versus modern-day) and make recommendations for improvement as a part of their presentation. The students should create a multimedia presentation (Prezi or PowerPoint) to share with the class

highlighting their invention, its inventor and their proposed solutions to the patent process in order to demonstrate their understanding of the injustices created by the Black Code and Jim Crow laws.

Unit 3 - Industrial Revolution and Westward Expansion

In Unit 3, students examine how basic discoveries (tools, implements, machines) lead to mechanization and/or automation, ultimately improving productivity and efficiency in manufacturing. Students will research the Captains of Industry to ascertain how these men embraced new technology and took advantage of new materials to build railroads, bridges, and other structures that changed the face of America. Students will discover the necessity of developing new sewage and sanitation technologies, because of the rapid growth brought on by the Industrial Revolution. Students will also explore the relevance of working conditions, labor unions and building codes.

Unit 3 - Key Assignments

1: Captains of Industry and Modeling

After exploring the role of the leaders of the Industrial Age, known as the Captains of Industry, (using their district approved text or the video series the "Men Who Built America" -http://www.history.com/shows/men-who-built-america), students will examine as a case study the construction of the Eads bridge undertaken by Andrew Carnegie and James Eads using new materials (Bessemer steel, concrete etc.) to erect this engineering marvel of the industrial age. Students will begin by reading this article on the engineering accomplishments of the Eads Bridge (http://msc.aisc.org/globalassets/modern-steel/archives/2011/03/2011v03_eads_bridge.pdf). Students will then research the history of metals in early-manufacturing, the introduction of alloys, and the relationship between raw materials and those processed for use in the bridge. Students will apply this knowledge along with drafting skills (measurement, tolerance, drafting standards) in a build activity engineering challenge where students attempt to maximize the effectiveness of a bridge design to support a greater load. Suggested models include cable, truss, or pier bridges. After the bridges are tested, students will write an analysis of why their bridge performed the way it did compared to the strengths and weaknesses of real-life bridge design (e.g. dual-truss design allowing for longer spans between below-deck piers; or, a cable design supporting a span between only two piers) and why such engineering and material advancement were critical for the industrial age.

2: Transcontinental Railroad

After a class discussion and reading in their text on the role of westward expansion, the significance of railroads and the role of immigrant labor for America's industrial growth, students will research and prepare a report detailing the logistical requirements to build the Transcontinental Railroad. The research will enable the students to understand the vast complexity in large scale engineering projects that require a large labor force. Students will calculate the following materials that were required to construct the Transcontinental Railroad from Oakland, California to Promontory Summit, Utah: how many railroad ties; pounds of steel for stakes; weight and volume of ore; and cost of life. Students must plan how many workers are needed to shovel base rock, relocate base rock, hammer in railroad spikes, and move rails.

Additionally, students will include an analysis of labor needs for the job. Students will calculate how many workers it would take to build the Transcontinental Railroad in the time span of 6 years (based on 1863-1869 while identifying the total available work hours limited by weather and daylight). Students will then create "field manager guidelines and suggestions," to be included in their report, for working with the labor force used to build the Transcontinental Railroad. In order to create these guidelines, students research attitudes towards immigrant workers (such as the Chinese and Irish) and create suggestions for "managing" workers in culturally sensitive ways. (Suggested Activity: Akin to the competition between Central Pacific and Union Pacific where the companies raced towards Salt Lake City laying base gravel, railroad ties, and tracks to maximize the bond monies received for total miles of completed track, students compete in a race to move heavy loads from opposing, equidistant endpoints in a simulation activity where teams are awarded for ensuring safe and complete delivery of an undamaged payload.)

3: Urbanization and the Industrial Revolution

Students explore the impact of rapid urbanization during the Industrial Revolution (i.e. unsafe and unsanitary living conditions) through a case study. Students will explore the challenges faced specifically by Chicago. With closer proximity to one another, pollution, and the onslaught of disease, the citizens of Chicago recognized the need for improved waste management, so Chicago built the first underground sewage system. To facilitate this learning, students watch the PBS series (can be found on Netflix) called **How We Got To Now**, episode 1 "Clean." While watching, students should take notes and document the successes, failures, and outcomes as a result of the sewage system. Using the movie and researching primary and secondary sources regarding life in Chicago before, during and after the sewage system was built, student groups will create a presentation on the following: life on the streets of Chicago before the "new" sewage system was built; how population density convoluted the waste management problem; the operational characteristics of the sewage system, including details about its construction and materials used; the success and/or failure of the system. A good resource for finding the trouble with the soil and what happened in winter conditions can be found at: https://books.google.com/books?id=LA8OAAAAYAAJ&pg=PR18&lpg=PR18&dq=what+happened+to+the+sewage+in+Pullman%27s+chicago&source=bl&ots=HETx-h8YWv&sig=vGbURUcKAHWj4HozuRd1O4VyVkk&hl=en&sa=X&ved=0ahUKEwitnPPd6-HNAhVN-2MKHa5XCtwQ6AEIWjAJ#v=onepage&q=what%20happened%20to%20the%20sewage%20in%20Pullman's%20chicago&f=false

Based on applying the construction practices of the time, students evaluate the project's efficacy. Presentation should include a discussion of how this engineering feat changed the world (for example, municipal waste management, health, chlorinated water, infrastructure of cities, attitudes of "can do") along with discussion of the conditions it was in response to. Through this assignment, students will learn the history of the modern city as well as how engineering impacted not only infrastructure but also public health and attitudes. They will use what they learn in this research as they design their culminating project--the ideal modern city.

4: Building Codes, Working Conditions and Unions

Along with unsanitary living conditions, many workers faced unsafe working conditions. In order to gain a better understanding of the types of dangers faced at the time, students will closely examine perhaps the best known industrial accident of the age, the Triangle Shirtwaist Factory fire and its connections to the labor movement/unions. After introducing the events of the fire and the events/conditions that led up to the fire via class discussion or video (like the one found here: https://www.youtube.com/watch?v=hCB4SgXRgKg) students will participate in a class discussion or fishbowl on the ethics of the event/circumstances. Students should reference an Engineering Code of Ethics during their discussion (like the one introduced in Unit 1) to determine if the business owners and/or the building designers had any responsibility for the death of the workers at the Triangle Shirtwaist Factory. Students should then imagine that they were a worker in New York at the time. Based on their discussion, students will write a letter to their local newspaper encouraging or discouraging workers from joining their local union and demanding safer working conditions and building codes. Students should base their reasons in their letter off of the Code of Ethics and their research of the demands of unions at the time.

Unit 4 - Imperialism and WWI

Structural and architectural design is influenced by the society and environment in which it was created. In this unit, students will explore how the innovation and engineering of the Industrial Revolution set the stage for the Imperialism of the late 19th and early 20th century. First, students will read and analyze how innovations of the late 19th and early 20th century made the imperialism of the 1900s possible while creating orthographic drawings to document the technology of the time. Next, students will explore how the challenges of the Spanish American war led to changes in military technology, and they will represent the emerging technology of the time with freehand graphics. Students will then turn their attention to the modern marvel of the Panama Canal and explore its design aspects through a close read of an article that explores the engineering of the canal and fabricate a scaled model focused on the functionality of the lock system (e.g. hydro-electric generators, pumping stations, fluid transfer systems, et cetera).

Unit 4 - Key Assignments

1: *Guns, Germs, and Steel*

Students will explore the way the inventions of the Industrial Age paved the way for and made possible the imperialism of Africa and Asia by Western powers through the creation of a multimedia presentation (such as Prezi or PowerPoint) based on one or more of the following: the book (or TV show) Guns, Germs, and Steel; The Tools of Empire; or, The Influence of Sea Power Upon History. (Students could read a section from one of the books as selected by their teacher.) These books focus on the role technology and engineering advancements played in shaping and creating the environment for the Imperialism of the western world in Africa and Asia. In an oral presentation supported by multimedia (PowerPoint, Prezi, et cetera), students should detail the role three of the technologies played in America's imperialism of Africa and

Asia alongside orthographic drawings of at least three of the technologies (guns, weapons etc) mentioned in the book or section.

2: The Splendid Little War and the Impact of Environment on Design

Structural design is shaped by history and the environment. The Spanish American War demonstrated that while America's Navy was mostly prepared for America's changing role as a major player in the world, America's Army was not. Students explore in a class discussion and lecture how the Spanish American War came to be and how the short conflict changed America's perception of itself and its role in the world. Students then use this information to inform their research into how the Spanish American War influenced the way in which America's Army and Navy were structured and equipped. Students write a report on their findings, using proper citations. In their paper, students should use freehand graphics to visually demonstrate the structural design of 3-4 of the ships or weapons mentioned in their report with notations that explain how the lessons of the Spanish American War influenced the design of the weapon, ship or vehicle.

3: The Panama Canal

The Panama Canal is one of the Seven Wonders of the Modern World and a key component in America's naval superiority in the 20th century. Students will write a newspaper article announcing the Canal's opening as a reporter from 1914. In preparation for their article, students will read in their history text about America's changing attitudes and its role in the world during the age of Imperialism. Students will then explore the structural engineering components of the canal. Students will read and annotate a document on the engineering behind the Panama Canal such as the one found here https://www.aip.org/commentary/panama-canal-engineering-marvel or here http://www.scientificamerican.com/slideshow/panama-canal-the-worlds-greatest-engineering-project. Next, students will construct scaled models of no less than three sequential locks using CAD software. As part of their models, students should articulate how hydroelectric power is used and generated by the canal and how the fluid dynamics lift incredible loads. This technical information as well as their drawings and the historical significance and engineering marvel of the canal should all be included in their newspaper "front page" or article on the opening of the canal.

4: The 14 Points

Students will closely read and annotate The 14 Points as a way of understanding President Woodrow Wilson's goals for America at the end of WWI. Students will create a quad chart summarizing the purpose, the key players/stakeholders, the desired end result (of the treaty) and the measure of success for the treaty based on the 14 points. Once students have created their quad-charts they will analyze the key components (or read key selections from) the Treaty of Versailles in small groups in order to determine if the treaty was a success in light of the goals laid out by President Wilson using the Engineering Design Process. Students will write a short, multi-paragraph summary of their analysis of the treaty and as a group rewrite a section of the treaty in a way that would have better realized Woodrow Wilson's goals as laid out in the 14 points.

Unit 5 - Great Depression and the New Deal

The industrial growth of the late 19th c. led to rapid economic growth in the early 20th c. However, the time period of economic prosperity came crashing down in America's worst economic downturn, The Great Depression. After exploring the causes of the Great Depression students will examine the role of the government in addressing the Great Depression, in large part through major feats of engineering and public works projects.

Unit 5 - Key Assignments

1: The Hoover Dam and Structural Design

The Roaring 20s came to a screeching halt with the Great Depression's emergence. Students will examine in their class text the impact of the Great Depression on individuals and communities and the government's response. One way President Hoover (finally) addressed the suffering of those impacted by the Great Depression was through the building of the Boulder (Hoover) Dam. As a congressperson who is supporting the building of the dam, students will develop a presentation on the benefits of the dam to share before the class as fellow members of Congress. Students are to research the structural design of dams and analyze how efficiently the Hoover Dam was built, comparing material use, cost, time, and labor (http://www.roadsbridges.com/engineering-behind-hoover-dam-and-its-bypass). In addition, students will address the potential benefit to the community of the project in addressing challenges of the Great Depression. The presentation should include compelling arguments justifying building the dam and technical information on the construction of the dam, including visuals such as a quad chart, graphs, and/or drawings.

2: The TVA Science and Technology

President Roosevelt promised a "New Deal" for America and among the most reaching New Deal programs was the TVA or Tennessee Valley Authority. Students read in their history text about the changing role of government and the various New Deal agencies and their critics. Students then investigate the series of dams and hydro-electric (and later nuclear) plants in the Tennessee River Valley that were built as part of the New Deal and that drastically changed the landscape of America. Students will investigate the use of hydro-electric power across the American landscape and how communities exploited these natural resources to continue to build capacity for cities and an expanded labor force. Students will then create a sketch of two facilities built as part of the TVA project. The sketches should include orthographic drawings scaled to the current landscape using Internet-sourced images (e.g. students use Google Maps to generate a scaled drawing based on a GPS-sourced live image of a specific location within the current-day United States or its territories) http://www.21stcenturysciencetech.com/Articles_2011/Summer-2011/Roosevelt_TVA.pdf. Students will then create an impact report on the financial and environmental impact of the two dams or power plants using the data and specifications in their sketches. Based on the details of the dams or power plants the students sketched

and researched students will write a recommendation to Congress on whether or not the proposed facilities should be built and why.

Unit 6 - WWII

The Great Depression was dramatically and swiftly brought to an end by the attack on Pearl Harbor and US entrance into WWII. In addition to studying the events that led up to the attack, students will look at why the attack was so devastating, and why the US was helpless to defend the harbor. The students will see the "Sleeping Giant" wake and in addition to examining innovations and technologies that came out of WWII, students examine the inadequate housing and facilities in U.S. Internment Camps as a means to under the broader injustices of Japanese internment. To further encourage students to imagine all possible scenarios in the design process, students will research 1)the errors in the engineering design process with the use of the Higgins boat and 2) discuss the Code of Ethics wrapped around and through the development and use of the Atom Bomb.

Unit 6 - Key Assignments

1: Pearl Harbor

The disaster still evident today at Pearl Harbor was a result of a variety of presumptions which began with warfare policy and lack of foresight. In this assignment, students will investigate how the following impacted the outcome of the attack: the layout of the harbor (how the fleet was physically docked) or the lack of alternate (courses) for egress; the capacity to rapidly mobilize the resting fleet; minimal land-to-air protection of the neighboring airstrip where the squadron of fighter planes were kept; and, the communication system used to alert and mobilize ground troops. Students will generate a large-scale chart to identify the steps missing from the Engineering Design Process (i.e. lack of forethought) when evaluating the aftermath and present their findings to a military review board.

2: Japanese Internment

Students will turn their attention from the attack to America's response and the internment of Japanese Americans as a result. Students will begin by reading first-hand accounts of the treatment of Japanese-American immigrants including Executive Order 9066; and *A Farewell to Manzanar* by Jeanne Wakatsuki Houston (either in part or in its entirety). While reading *A Farewell to Manzanar*, students will document the references to poor living conditions found in the camps. Students should make note the lack of natural resources accessible by the camp, the weather extremes not addressed by the inadequate designs of the temporary housing (too hot in the summer months, freezing temperature in the winter months) and a lack of proper sanitation systems. (Students can refer back to Unit 3 Assignment 3 to remember the consequences of inadequate sewage/sanitation systems.) By means of comparison, students conduct research on residential construction practices of the 1940s, such as can be found in these two linked resources:
http://www.dot.ca.gov/ser/downloads/cultural/tract_housing_in_ca_1945-1973.pdf
or
https://heritage.utah.gov/history/world-war-ii-post-war-residential-building-types
Using evidence from their text and their research, students will produce a digital

presentation that illustrates the poor construction, the life of the Japanese immigrants, and the personal and material loss they endured.

3: D-Day and Higgins Design

After a class discussion on the significance of D-day and viewing photographs and re-enactments in video (such as the opening scene of *Saving Private Ryan*) students will examine the key transport ship in D-day, the Higgins boat. While the Higgins boat has been attributed to the pivotal success of D-Day by delivering our soldiers directly to the beaches of Normandy, they were well known for one critical design-flaw: soldiers stood behind a great steel wall that provided little protection from the onslaught of firepower aimed directly at those closest to the beach. In teams, students will design a more effective means to deploy soldiers, limited by the materials and technology available in 1944 (e.g. iron, steel alloys, NOT materials like kevlar and carbon fiber). Emphasis should be placed on students identifying online databases where material hardness (e.g. Rockwell hardness standards), malleability, and weight per cubic measure help guide decisions about material selection. Students generate a host of planar and orthographic drawings which are evaluated by the whole group via a gallery walk format. Based on this research, students will write a report to the War Department as a commander planning an amphibious assault during WWII. Students will demonstrate their understanding of the brutality of D-day by explaining from a technical, historical and strategic perspective the need for these improved transport ships.

4: The Atomic Bomb and Ethics in Engineering

As WWII dragged on, president Truman made the controversial decision to use America's new and terrifying weapon, the atomic bomb. As students research the development of the Atomic Bomb, students learn how the German threat impacted its development and influenced Truman's decision to use it. Students, in a Socratic Seminar, consider the proposal to use this unproven technology in warfare. In their discussion, they will address the essential ethical questions to consider before using a technology. Students must identify the theoretical impact to the landscape, and its inhabitants upon detonation (consider researching locations like Battle Mountain, NV). In addition, students must include an environmental impact report focused on the predicted use of (or restriction to) the affected region(s). (The teacher could further this discussion with bridged topics like genetic modification or chemical warfare.) During the Socratic Seminar, students consider the emotional aspect of the decision to use the atomic bomb and reflect on the Engineering Code of Ethics and the role this played in the Manhattan Project.
After noting their takeaways from the Seminar, students write an expository essay in which they extend their understanding of the Engineering Code of Ethics to a current engineering topic with potentially far-reaching effects. (Solar farms that are desecrating the desert; desalinization of ocean water; etc.)

Unit 7 - The Nifty 50s

With the horrors of WWII in their rearview mirror, America sped into the 1950s creating an explosion of culture and consumer products. These innovations brought about a changing perception of the American dream and new engineering challenges. Students will explore how the culture and baby boom of the 1950s led to changing

home designs by creating a digital or physical poster of the changing design elements of homes in the 1950s. Next, students will explore a key aspect of America's love affair with the automobile by analyzing America's blossoming Interstate Highway System. Students will apply their design skills by creating and proposing an improved freeway system in a presentation that meets industry standards.

Unit 7 - Key Assignments

1: Tract Homes and Design Efficiency

As the 1950s began, Americans were ready to forget the problems of the world and work on creating the American dream. Students investigate early tract home developments across the US by reading an article such as the following: http://ushistoryscene.com/article/levittown/. Students research the key design elements shared amongst similar developments built across the country in this time period and create a digital or print comparison of communities at the time. Students reflect on the how the baby boom and post-war attitudes of Americans led to the development of these communities, and hypothesize how the post-war attitudes influenced the design of these homes. Students will include images of developments from multiple states, their analysis on how attitudes impacted design and the relationship between tract home design and modern day community planning in their digital or print comparison (poster board) as a way of exploring the ideals of post WWII America.

2: The Freeway System and the Communist Threat

Though Henry Ford has been attributed with making the automobile affordable to every family, Eisenhower has been attributed with giving those families a road to drive upon. Students will read in their history text of the development of the freeway system, in part because the fear of Communist aggression led government leaders to prepare to mobilize the US military. Students investigate this connection and examine the strengths and weaknesses of each route (see road use reports from NHTSA or the DOT) in relation to the fear of an offshore aggressor and the daily demand for private transportation on these same roadways. Their research should include the Federal Aid Highway Act of 1956, the number of cars on the road from the start to the end of the 1950s, and how the newfound mobility of a nation permeated and affected life in the US. Working as a military contractor, students will present their findings/connections in an industry-style report advising the army on the best route to Florida, or to California in case of an invasion, being sure to justify their decision and explain its superiority over two alternative routes.

Unit 8 - The Cold War

As WWII drew to a close, a new threat to America emerged in the shape of the Communist aggression of the Soviet Union. Throughout much of the 1950s, 60s and beyond America's policies, spending, and engineering expertise were focused on preventing the spread of and defeating the "threat" of the Communist Soviet Union. Students will explore the changing nature of the Cold War by creating a 3D timeline of key cold war events. Next, students will explore the impact of Sputnik on creating change in America's education system or in our space program by applying the Engineering Design Process to the challenges created by Sputnik. The review of the

Engineering Design Process and the acquisition of the skills necessary to build 3-D models will be key in preparing students for their culminating project, engineering an ideal city.

Unit 8 - Key Assignments

1: The Cold War 3-D Timeline

Students will create a timeline of the following Cold War Events using scaled 3-D model components (e.g. a replica of the UN Building in New York City, a replica of the U2 plane, miniature bricks placed upon one another to form a wall-in-progress, et cetera). Facilities with the capacity to implement 3-D printing may use online resource files (e.g. http://www.thingiverse.com/) to generate models where students apply scale to final printed components. In a presentation of the timeline, students will explain the events that lead to each point in history. A teacher -generated rubric will guide the students in their research and presentation.

- Yalta Conference-February 1945
- United Nations is formed- June 1945
- Berlin Blockade and Airlift-June 1948-May 1949
- NATO formed-1949
- Korean War-1950-1953
- U2 Spy Plane Incident- May 1960
- Bay of Pigs Invasion-April 1961
- Berlin Wall Construction Begins-August 1961
- Cuban Missile Crisis-October 1962
- Vietnam War - November 1955 - April 1975

2: Sputnik and the design of Engineering Education

Students will analyze America's math and science education of the 1950s through the lens of the Engineering Design Process in light of the changes made to America's education system as a result of the launch of Sputnik and America's fear of communism. Students will read in their texts or articles such as this one http://news.harvard.edu/gazette/story/2007/10/how-sputnik-changed-u-s-education/ on the influence of Sputnik on America's education system and the fear that Sputnik's launch meant the US was woefully behind the Russians in math and science. In groups of 2-3 they will create a presentation to share with the Department of Education on the validity of changing math and science education at the high school level to include a greater focus on engineering. (Possible extension: Students apply the Engineering Design Process to one of the failed NASA projects leading up to Apollo 13. In this version of the assignment, students continue to build upon drafting techniques by generating technical drawings of the key components responsible for specific failures including but not limited to the latching mechanism of Apollo 1, responsible for the lives of all three astronauts. Students will present their findings to a mock NASA Review Board, where they will address the component failures [annotated in their technical drawings] and defend suggested improvements using visual aids [drawings]).

Unit 9 - Civil Rights

As the Cold War created uncertainty and upheaval overseas, the Civil Rights movement created drastic change domestically. After exploring these changes in a class discussion on key civil rights events and legislation, students will examine how the gains on the civil rights movement changed the designs of public facilities, in particular schools. Building upon their exploration of building standards in Unit 4 (The Industrial Revolution) students will create a report contrasting and analyzing the design and building codes of public facilities of the 1960s and 1970s. In the final project, students examine the ways in which the ubiquity of the television in American homes by 1960 increased the reach and impact of the Civil Rights movement, analyze connections to contemporary social movements and hypothesize new technological modes of communication through engineering innovations that could continue to spur change.

Unit 9 - Key Assignments

1: African Americans fight for legal equality denied since the end of Reconstruction

Students will review the impact of Jim Crow and Black Code laws by reading a teacher selected section of Roll of Thunder, Hear My Cry (consider chapter one). Based on their reading, students form a hypothesis and then research how buildings were designed in the era of segregation. Students create a written report on how integration caused by Brown v Board , the Montgomery Bus Boycott, and other seminal developments of the Civil Rights movement changed building and planning methodologies/requirements/practices (consider the need for "Separate but Equal" bathrooms, classrooms, et cetera). Student's reports should focus on evolving building standards (see local building codes) of the 1960s and 1970s by comparing public facilities (e.g. school buildings, mass-transit stations like a bus depot or an airport, et cetera) and demonstrate how integration impacted design and cost of both public and private projects. In this report, student should also address the effective use of space and how Integration provided an increase in design flexibility.

2: Television, social media and civil rights

In order to examine the role of innovative technology (television) in the advancement of Civil Rights, students investigate a resource such as the following website: Get Up! Stand Up! The Civil Rights Movement and Television
https://www.paleycenter.org/education-class-get-up-stand-up-civil-rights-movement-television/
Students learn that, by 1960, 90% of homes had televisions, which meant 90% of people had access to information and ideas not accessible before. This increased access to information increased the reach and impact of the Civil Rights Movement and its leaders. Students extend their understanding of this impact by making comparisons, through classroom instruction and research, to contemporary social and civil rights movements/issues that have also reached more people through an increase in access to information due to technological innovations. Finally, students apply the applicable skills learned in the context of architectural design to a new engineering context, utilizing the engineering design process to conceptualize and design a communication tool that they imagine would be the next step for

spreading/disseminating information and promoting ideas and/or movements. Students write a spec sheet or quad chart (or similar document) that communicates purpose, audience and design and/or other relevant metrics. (If available, students may go so far as to use a 3D printer to create a model of the design.) Finally, in a presentation or essay, students compare and contrast their new tool and its hypothesized effects to past innovations and their influence, demonstrating an understanding of important moments/leaders in the Civil Rights movement and the ways in which engineering innovations can change lives.

Unit 10 - It's a Great Big Beautiful Tomorrow-engineering the future city

Culminating project:

Culminating Assignment: Students have surveyed American History through the lens of Engineering and learned additional skills related to general engineering practices, design and drafting standards, and the use or application of materials throughout history. In this culminating assignment, student groups (2-3 students max) will gather together the successes and failures witnessed in developing communities over the last 200 years to build an ideal American city of today. In contemporary terms, we refer to this as master planning. Students will research how the need for the following critical areas for master planning are decided upon: public utilities including water, sewage, and power; transportation systems including private and public modes within and beyond the borders; resource management including local public service offices and entities; and, business and commerce all while following local, state and federal laws. The stages of this project will include:

1. Identifying city parameters (i.e. borders, landscape, natural resources, et cetera)
2. Drawing orthographic models of the public utility backbone, the roadways, community services, private residences, public open space, and locations for business and commerce
3. Presenting the initial design to a review panel to "authorize" the project (suggested connection with local public works professionals) and ensure all aspects of a master plan are addressed
4. Construction of a scaled model (stress using recyclable or recycled materials)
5. Presenting the scaled model (annotating the design features in the presentation) to the review panel
6. Generating the projected cost to develop and open the future city
7. Participating in a gallery walk of all models during which student projects are judged based on how effective the design addresses these or any teacher-created criteria:

- open city streets
- areas for sharing culture
- places for innovation/creative thinking
- parks
- what to do with homeless
- Affordable housing
- schools

- senior living
- Hospitals

In their presentations, students should discuss specific failures/successes/moments from history that influenced their designs, and based on those insights, they indicate why their designs improve upon/prevent/create the components required to build an ideal city. Through this assignment, students draw upon history learned throughout the course, and they apply it to the innovative approach and design of their city. A teacher-created rubric will inform students of parameters and expectations.