Readington Township Public Schools

Innovation & Design Grade 7

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OVERVIEW

This unit will provide students with a powerful understanding of the tradition of Roman architecture, and its influence on architecture in America and around the world. Students will be using a sketch-based 3D-modeling program called *Google Sketch-Up.* It offers a suite of powerful drawing tools that will allow students to design columns and arches before drawing formal architecture such as temples, amphitheaters, and basilicas or utilitarian buildings such as bridges and aqueducts. Students will then take on the role of an architect as they design their own buildings and then develop a digital 3-D model of it. When students finish designing their model, they can save and print it, or share them with others by posting them to the 3-D Warehouse, where it can be seen on a real map in *Google Earth.*

STUDENT OUTCOMES (Linked to the New Jersey Student Learning Standards)

NJSLS- Science-Engineering Design

MS.ETS1.A: Defining and Delimiting Engineering Problems
MS.ETS1.B: Developing Possible Solutions
MS.ETS1.C: Optimizing the Design Solution

NJSLS -Technology

Standard

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Strand

A. Technology Operations and Concepts: ***Students demonstrate a sound understanding of technology concepts, systems and operations.***

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results
8.1.8.A.5 Create a database query, sort and create a report and describe the process, an explain the report results.

C. Communication and Collaboration: ***Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.***

8.1.8.C.1 Collaborate to develop and publish work that provides perspectives on a global problem for discussions with learners from other countries.

D. Digital Citizenship: ***Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.***

8.1.8.D.1 Understand and model appropriate online behaviors related to cyber safety, cyber bullying, cyber security, and cyber ethics including appropriate use of social media.
8.1.8.D.2 Demonstrate the application of appropriate citations to digital content.
8.1.8.D.3 Demonstrate an understanding of fair use and Creative Commons to intellectual property.
8.1.8.D.4 Assess the credibility and accuracy of digital content.
8.1.8.D.5 Understand appropriate uses for social media and the negative consequences of misuse.

E: Research and Information Fluency: ***Students apply digital tools to gather, evaluate, and use information.***

8.1.8.E.1 Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem.

F: Critical thinking, problem solving, and decision making: ***Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.***

8.1.8.F.1 Explore a local issue, by using digital tools to collect and analyze data to identify a solution and make an informed decision.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Strand

A. The Nature of Technology: Creativity and Innovation *Technology systems impact every aspect of the world in which we live.*

8.2.8.A.1 Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e. telephone for communication smart phone for mobility needs).

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.

8.2.8.A.3 Investigate a malfunction in any part of a system and identify its impacts.

8.2.8.A.4 Redesign an existing product that impacts the environment to lessen its impact(s) on the environment.

8.2.8.A.5 Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.

B. Technology and Society: *Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.*

8.2.8.B.1 Evaluate the history and impact of sustainability on the development of a designed product or system over time and present results to peers.

8.2.8.B.2 Identify the desired and undesired consequences from the use of a product or system.

8.2.8.B.3 Research and analyze the ethical issues of a product or system on the environment and report findings for review by peers and /or experts.

8.2.8.B.4 Research examples of how humans can devise technologies to reduce the negative consequences of other technologies and present your findings.

8.2.8.B.5 Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries and societies.

8.2.8.B.6 Compare and contrast the different types of intellectual property including copyrights, patents and trademarks.

8.2.8.B.7 Analyze the historical impact of waste and demonstrate how a product is upcycled, reused or remanufactured into a new product.

C. Design: *The design process is a systematic approach to solving problems.*

8.2.8.C.1 Explain how different teams/groups can contribute to the overall design of a product.

8.2.8.C.2 Explain the need for optimization in a design process.

8.2.8.C.3 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.

8.2.8.C.5 Explain the interdependence of a subsystem that operates as part of a system.
Create a technical sketch of a product with materials and measurements labeled.

8.2.8.C.6 Collaborate to examine a malfunctioning system and identify the step-by-step process used to troubleshoot, evaluate and test options to repair the product, presenting the better solution.

8.2.8.C.7 Collaborate with peers and experts in the field to research and develop a product using the design process, data analysis and trends, and maintain a design log with annotated sketches to record the developmental cycle.

8.2.8.C.8 Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.

D. Abilities for a Technological World: *The designed world is the product of a design process that provides the means to convert resources into products and systems.*

8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.

8.2.8.D.2 Identify the design constraints and trade-offs involved in designing a prototype
(e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook.

8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

8.2.8.D.4 Research and publish the steps for using and maintaining a product or system and incorporate diagrams or images throughout to enhance user comprehension.

8.2.8.D.5 Explain the impact of resource selection and the production process in the development of a common or technological product or system.

8.2.8.D.6 Identify and explain how the resources and processes used in the production of a current technological product can be modified to have a more positive impact on the environment.

E. Computational Thinking: Programming: ***Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.***

8.2.8.E.1	Identify ways computers are used that have had an impact across the range of human activity and within different careers where they are used.
8.2.8.E.2	Demonstrate an understanding of the relationship between hardware and software.
8.2.8.E.3	Develop an algorithm to solve an assigned problem using a specified set of commands and use peer review to critique the solution.
8.2.8.E.4	Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

RATIONAL

Unit 1 Earthquake Towers

Engineers have been trying to understand the effects of earthquakes on structures for years. Such as how and why they cause such tremendous damage to structures. Working together, scientist and engineers are looking for ways to construct buildings that will withstand earthquakes. Like engineers, students will design and build a model structure out of balsa wood that will withstand the stress of a simulated earthquake. The activity is to simulate a 20-story, 200-foot high building. They will be testing their towers using a Programmable Earthquake Tremor Table. Students will analyze the effects of various loads and observe the forces that will shake their structure until it collapses.

Unit 2 Siege Machines

Siege engines were built as an ancient invention to bring an enemy to its breaking point, but in the modern world, they brought a great deal of delight. Catapults and trebuchets were once used to destroy castle walls, ruin enemy lines, or to throw projectiles inside a castle from an enemy ship. Today, these devices are loved for ingenuity in science and math. These big guns of siege warfare are built for entertainment, but they also do a tremendous job of enhancing math, history, physics, engineering, and problem-solving to young minds. Students will design, build, test, and modify scaled down versions of this powerful machine; meanwhile following pre-established criteria and constraints.

ENDURING UNDERSTANDINGS

Students will:

- Select and use applications effectively and productively.
- Apply existing knowledge to generate new ideas, products, or processes.
- Communicate information and ideas to multiple audiences using a variety of media and formats.
- Contribute to project teams to produce original works or solve problems.
- Advocate and practice safe, legal, and responsible use of information and technology.
- Plan and manage activities to develop a solution or complete a project.
- The relationships among technologies and the connections between technology and other fields of study.
- The influence of technology on history.
- The application of engineering design.
- The role of troubleshooting, research and development, invention and innovation and experimentation in problem-solving.
- Apply the design process.

ESSENTIAL QUESTIONS

Unit 1 Earthquake Towers

What factors cause tremendous damage to structures during earthquakes?
What is a frequency, and how are objects of various heights affected by different frequencies?
When building an earthquake resistant structure, what components of a design are essential?

Unit 2 Siege Machines

What was a siege machine and how do they work?
What were some types of siege machines?
Why were siege machines valuable to use during Ancient times?
What purpose does building these powerful machines serve today?

STRATEGIES

- Groups Discussions
- Teacher Presentation
- Student Projects
- Interactive SMARTBoard Lessons
- Tutorials
- Online Practice using lesson specific websites
- Multimedia Presentations

EVALUATION

Assessments may include but are not limited to:

- Teacher Observations
- Class Participations
- Class Discussions
- Class Assignments
- Homework Assignments
- Student Notebooks
- Student Projects

REQUIRED RESOURCES

Computer with internet connection

SCOPE AND SEQUENCE

Unit 1 Earthquake Towers (20 days)

- Structures Lab PBS Webquest on forces, loads, materials, and shapes. (1 day)
- Introduction and notes on earthquakes and seismic waves. (½ day)
- Seismic waves lab/ activity. (1 day)
- Earthquake Engineering lab (1 day)
- Observe Harmonic Highrise and draw concept sketches. (1 day)
- From groups and create a 1 story prototype of a proposed design (2 days)
- Add live load, then test and evaluate and prototype (1 day)
- Draw 5 story working drawing with a 1 to 1 scale on graph paper. (2 days)
- Use timber tester and measure balsa wood. (1 day)
- Measure, mark, cut, glue and pin columns and bracing of towers first 2 sides. (3-4 days)
- Stand up and glue floor plates of the first 2 sides of the tower (2 days)
- Measure, mark, cut, glue and pin columns and bracing of towers 3rd and 4th side. (3-4 days)
- Create a presentation on design and add mass plates to tower (1 day)
- Test and evaluate the structure. (1 day)

Unit 2 Siege Machines (14 days)

- Introduction and notes on simple machines, levers and siege machines. (1 day)
- Introduction to Physics Illustrator. (1 day)
- Build a trebuchet in Physics Illustrator. (1 day)
- Compare and contrast trebuchets to tension powered catapults. (½ day)
- Assemble and glue a tension powered catapult. (1 ½ days)
- Testing tension powered catapult experiment. (1 day)
- Compare and contrast tension to torsion powered catapults. (½ day)
- Build, test and evaluate torsion powered catapult. (2 days)
- Modify catapult for Ultimate Catapult Challenge. (2 days)
- Complete Catapult Challenge (accuracy to a random target, longest throw, and battle) (1 ½ days)
- Review and Summary (1 day)
- Assessment (1 day)