Unit 3: Essential Infrastructure Designs: Water Systems

Content Area: **Technology**
Course(s): **Engineering**
Time Period: **Week 15**
Length: **5 Weeks**
Status: **Published**

Unit Overview

In this unit, the class will explore the water distribution systems that we use everyday from an engineering perspective.

Students will work collaboratively within a simulated/virtual world to recreate a water distribution system that conquers geographical challenges and includes a dam, aqueduct, and water pipelines.

Standards

TECH.8.1.8	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.
TECH.8.1.8.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.8.A.1	Demonstrate knowledge of a real world problem using digital tools.
TECH.8.1.8.A.3	Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
TECH.8.1.8.A.CS1	Understand and use technology systems.
TECH.8.1.8.A.CS2	Select and use applications effectively and productively.
TECH.8.1.8.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.8.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.8.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.
TECH.8.1.8.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.8.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.8.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.8.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.8.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.

TECH.8.1.8.F.CS1	Identify and define authentic problems and significant questions for investigation.
TECH.8.1.8.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.8.F.CS4	Use multiple processes and diverse perspectives to explore alternative.
TECH.8.2.8	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.
TECH.8.2.8.A	The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live.
TECH.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.
TECH.8.2.8.A.3	Investigate a malfunction in any part of a system and identify its impacts.
TECH.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.
TECH.8.2.8.A.CS1	The characteristics and scope of technology.
TECH.8.2.8.C.4	Identify the steps in the design process that would be used to solve a designated problem.
TECH.8.2.8.C.5a	Explain the interdependence of a subsystem that operates as part of a system.
TECH.8.2.8.C.5b	Create a technical sketch of a product with materials and measurements labeled.
TECH.8.2.8.C.CS2	The application of engineering design.
TECH.8.2.8.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.8.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.
TECH.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.
TECH.8.2.8.D.CS1	Apply the design process.

Essential Questions

- What is the source of the water we use in our daily lives?
- How is water transferred to our homes?
- How does proper water filtration keep us healthy?

Application of Knowledge: Students will know that...

- A dam is an engineered structure designed to create reservoirs and control water flow to population areas
- Dams are used for water supply, irrigation, flood control, and the generation of hydroelectric power
- Local water treatment centers treat and prepare the water we use
- Regardless of where water comes from (Reservoir, lake, or well) it is raw water and not yet ready for human consumption
- The water distribution network is composed of a water main, water service lines, and a water tower

located on high ground

Application of Skills: Students will be able to...

- Build a dam, reservoir, and aqueduct distribution system, along with a water treatment facility, to provide clean water to their simulated/virtual city
- Define: dam (arch, earth, rock fill), reservoir, aqueduct, hydroelectric power, anoxia, desalination, filtration, potable water, raw water
- Explain how an algae bloom occurs
- Locate the water supply shut off valve in their home

Assessments

- City of the Future Design Rubric and Scoresheet
- Student Presentations
- Information from this unit will be included on a locally developed, end of course benchmark assessment that may take the form of a test, performance based project, or other summative assessment.

Suggested Activities

Watch excerpts from: PBS: Building Big Series on DVD - Dams

Objective: Changing the course of rivers has changed the course of history. Award-winning author-illustrator--and captivating storyteller--David Macaulay (The Way Things Work) goes to extremes to bring you an unprecedented look at the power of dams. You'll meet the courageous and ambitious builders, relive the deadly disasters, and discover the little-known personal triumphs and tragedies behind the greatest dams ever built.

The Dam Challenge
Objective: Dams don't last forever. Hot and cold weather makes them crack. Water erodes their foundations. They create environmental problems. Eventually, every dam must be repaired, removed, or replaced. Students act as a consulting dam engineer to advise the dam owners whether their dams must be repaired, taken down, or simply left alone. Like all dam engineers, they must weigh the pros and cons before making their final decisions. http://www.pbs.org/wgbh/buildingbig/dam/challenge/index.html

Shapes Lab

Objective: Students will learn how the shape of a structure affects how strong it is by applying different loads. http://www.pbs.org/wgbh/buildingbig/lab/shapes.html

Build a Water Filtration System

Objective: Students will design and build a water filtration device, test the device, make observations, and collect data and collaborate as they analyze results and attempt to identify the best filter media to use. Based on their analysis and on study of other filtration devices, they will make modifications to their model and repeat the process in an effort to produce the most effective filtration apparatus possible. Compare individual results and communicate their results to the larger community.
https://www.nasa.gov/offices/education/programs/national/summer/education_resources/engineering_grades7-9/E_water-filtration.html#.V6C125MrKi4

Brainpop Video: Dams

Objective: How can we hold up water? Use a dam! In this BrainPOP movie on dams, Tim and Moby teach you why these massive devices are so useful. Starting in ancient Egypt and Iraq, Tim and Moby explain how dams have irrigated dry farmland, and how they can be used to generate electricity and control flooding. You'll learn the meaning of terms like reservoir, aqueduct, hydroelectricity, turbine, and fish ladder. And you'll also how dams are built, and how they can be harmful to the environment. Oh, and if you've ever wondered what dams have to do with the water we drink, watch this movie to find out!
https://www.brainpop.com/technology/energytechnology/dams/

Brainpop Dams Activity

Objective: After viewing the Brainpop video on Dams, students will identify the main parts of a dam by labeling a diagram. In addition, students will decide what purpose a dam will serve in different stated scenarios.
https://www.brainpop.com/technology/energytechnology/dams/activity/

Activities to Differentiate Instruction

Differentiation for special education:

- General modifications may include:
    - Modifications & accommodations as listed in the student's IEP
    - Assign a peer to help keep student on task
    - Modified or reduced assignments
    - Reduce length of assignment for different mode of delivery
    - Increase one-to-one time
    - Prioritize tasks
    - Think in concrete terms and provide hands-on-tasks
    - Position student near helping peer or have quick access to teacher
    - Anticipate where needs will be

Content specific modifications may include:

- Provide written instructions and Minecraft building guidelines
- Students will benefit from established routines and seating, and peer-to-peer teamwork that encourage a cooperative learning environment
- Students who have completed the current project can investigate online Minecraft tutorials for additional creative solutions

- Students may work at their own pace
- Reduce/increase assignment requirements

Differentiation for ELL's:

- General modifications may include:
    - Strategy groups
    - Teacher conferences
    - Graphic organizers
    - Modification plan
    - Collaboration with ELL Teacher
- Content specific vocabulary important for ELL students to understand include: dam, aqueduct, water, pipes, algae, water tower, reservoir, flood

Differentiation to extend learning for gifted students:

- Activities to encourage additional exploration of engineering concepts:
    - Select a famous dam/reservoir system and study its engineering design and re-create it in your virtual city.
    - Study the Panama Canal and re-create this engineering marvel in your virtual world
    - Graphic Organizer: Pros and Cons of Dams (https://www.brainpop.com/technology/energytechnology/dams/activity/#=graphicOrganizer)

Integrated/Cross-Disciplinary Instruction

Social Studies - Explore real life dams (Hoover, Aswan, Grand Coulee) and create models of water delivery infrastructure systems.

Math - practice ratio and proportion; geometry and measurement associated with building and design

Science - find out how forces affect structures like dams and reservoirs

Engineering - Design and build a model of an arch dam, buttress dam, or embankment dam

Resources

- **DVD** - *David Macaulay: Building Big Dams, PBS*
- **DVD** - *Panama Canal, PBS*
- **DVD** - *Everyday Engineering: Understanding the Marvels of Daily Life*, Professor Stephen Ressler, The Great Course

- **Course Guidebook** - *Everyday Engineering: Understanding the Marvels of Daily Life,* Professor Stephen Ressler, The Great Courses
- **Brainpop Video: Dams**
- https://www.brainpop.com/technology/energytechnology/dams/
- *The Spotter's Guide to Urban Engineering: Infrastructure and Technology in the Modern Landscape*, Claire Barratt & Ian Whitelaw, 2011
- http://www.pbs.org/wgbh/buildingbig/
- http://www.pbs.org/wgbh/buildingbig/dam/challenge/index.html
- http://www.pbs.org/wgbh/buildingbig/lab/shapes.html

21st Century Skills

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.