Unit 4: Essential Infrastructure Designs: Power Sources

Content Area: **Technology**
Course(s): **Engineering**
Time Period: **Week 16**
Length: **5 Weeks**
Status: **Published**

Unit Overview

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

Students will work collaboratively within a simulated/virtual world to recreate an electrical distribution system (grid) using Minecraft Redstone that includes different power sources (hydropower, wind power, and solar power), a network of power plants, substations, and transmission lines.

Standards

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.1	Demonstrate knowledge of a real world problem using digital tools.
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	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
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.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.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
TECH.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.
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.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.

TECH.8.1.8.E.CS4	Process data and report results.
TECH.8.1.8.F.CS1	Identify and define authentic problems and significant questions for investigation.
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.A.CS2	The core concepts of technology.
TECH.8.2.8.B.5	Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries and societies.
TECH.8.2.8.B.CS2	The effects of technology on the environment.
TECH.8.2.8.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.8.C.1	Explain how different teams/groups can contribute to the overall design of a product.
TECH.8.2.8.C.2	Explain the need for optimization in a design process.
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.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.
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.CS1	The attributes of design.
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.5	Explain the impact of resource selection and the production process in the development of a common or technological product or system.
TECH.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.
TECH.8.2.8.D.CS1	Apply the design process.

Essential Questions

- Where does electricity come from?
- How is electricity delivered to my home?
- What is meant by "renewable energy resources'?
- How will a city of the future incorporate sustainable energy resources?

Application of Knowledge: Students will know that...

- Alternative energy sources will fuel cities of the future.
- Electricity can be moved across vast distances using a system of transformers, conductors, feeders, substations, and transmission towers before being delivered to commercial and residential structures.

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

- Build power plants and using Redstone in Minecraft, create an electrical "grid" to deliver power to your city.
- Define: grid, conductor, feeder, substation, transformer, renewable energy
- Provide their city of the future with alternative/renewable energy sources such as solar and wind power.
- Use Minecraft Redstone properties to construct an electical grid to provide power to their city.

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

Electricity

Objective: Bill Nye the Science Guy teaches about the greatest inventions including electricity

https://www.youtube.com/watch?v=gixkpsrxk4Y

http://starmaterials.com/VideoGuide/BN/BNP/Electricity/index.htm (video worksheet)

Brainpop Video: Electricity

Objective: Why can you get a shock when you touch a doorknob or take off a sweater? It's static electricity! In this BrainPOP movie, Tim and Moby introduce you to different types of electricity. You'll find out how the different kinds, ranging from lightning to electrical currents, are alike and different. Discover the three parts of an electrical circuit and how magnetic fields are created. Plus, find out about how a light bulb receives energy to light up and about the important role magnets play in creating electricity. It's all so shocking!

https://www.brainpop.com/science/energy/electricity/

Energy-efficient Practices

Objective: Student will learn ways in which to save on electricity in their homes

https://www.brainpop.com/science/energy/electricity/fyi/#tab=1

Brainpop Video: Energy Sources

Objective: We can't use our feet to power our cars like in The Flintstones. So, how do cars move around? It's energy! In this BrainPOP movie, Tim and Moby introduce you to energy sources and basic methods of energy production. You'll learn where energy comes from, how motion is converted into electricity, and how we use generators to create energy. Discover how water and wind can create mechanical energy and how the sun and earth help us do everything from heat our homes to get work done. Find out how fossil fuels generate energy, and the problems that overusing them can bring.

https://www.brainpop.com/science/energy/energysources/

Renewable energy sources

Objective: As a follow up to the video, students will learn how tidal power, ocean thermal energy, deep lake water cooling and blue energy are providing energy alternatives to traditional sources.

https://www.brainpop.com/science/energy/energysources/fyi/#tab=3

Graphic Organizer

Objective: Choose four energy sources and show the steps they go through to create electricity.

https://www.brainpop.com/science/energy/energysources/activity/#=graphicOrganizer

Brainpop Video: Forms of Energy

Objective: Does nervous energy count as energy? In this BrainPOP movie, Tim and Moby introduce you to the different forms of energy. You'll learn the difference between these types, like potential energy and kinetic

energy, plus how one form of energy can transform into another. Discover what kind of energy is stored in food and helps you walk and run. Find out what forms of energy we get from the sun, batteries, and power plants, as well as which types airplanes, wind, moving water, and sound waves all have.

https://www.brainpop.com/science/energy/formsofenergy/

Brainpop Video: Solar Energy

Objective: The sun has some serious rays! So do we turn them into electricity? In the BrainPOP movie, Tim and Moby explain all about solar energy! You'll learn about the pros and cons of solar power as compared to fossil fuels, and also some of the different ways in which solar power is used today — and how it might be used in the future. You'll also find out about photovoltaic (solar) cells, those dark-paneled devices you see on things like calculators, rooftops, and satellites.

https://www.brainpop.com/science/energy/solarenergy/

Activity

Objective: Using Google Earth or other online satellite imagery, locate a power transmission line in your neighborhood or region and trace it back to the nearest power plant. From the satellite image, can you identify what type of power plant it is?

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: energy, electricity, grid, solar, wind

Differentiation to extend learning for gifted students:

- **Activities to encourage additional exploration of engineering concepts:**
  - Students with **Redstone experience** can prepare a presentation in which they demonstrate how to use Redstone to create electrical current in the Minecraft world.
  - **What does it take to be an electrical engineer?** (https://www.brainpop.com/science/energy/electricity/fyi/#tab=3)
  - **Research geothermal energy** (https://www.brainpop.com/science/energy/energysources/fyi/#tab=1)
  - **Research solar powered cars** (https://www.brainpop.com/science/energy/solarenergy/fyi/#tab=3)

Integrated/Cross-Disciplinary Instruction

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

Science - study how electricity is produced and delivered to your home

Engineering - Design and build a model of an electrical grid, including power plants, substations, and a wired transmission system

Resources

- DVD - *Everyday Engineering: Understanding the Marvels of Daily Life*, Professor Stephen Ressler, The Great Courses
- Course Guidebook - *Everyday Engineering: Understanding the Marvels of Daily Life*, Professor Stephen Ressler, The Great Courses

- *The Spotter's Guide to Urban Engineering: Infrastructure and Technology in the Modern Landscape*, Claire Barratt & Ian Whitelaw, 2011
- *Minecraft Redstone Handbook*, Mojang, 2015
- *Minecraft Construction Handbook*, Mojang, 2014

21st Century Skills

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.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.