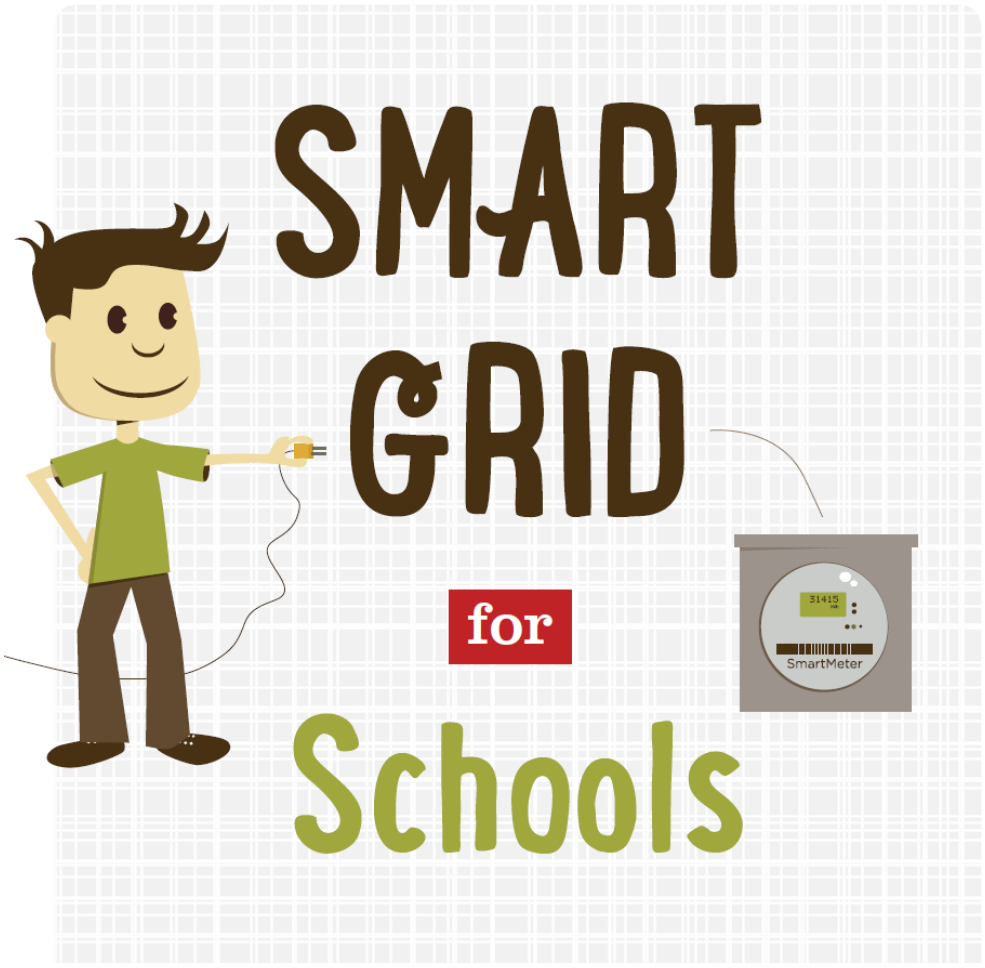

Hands-On Grid Construction

Academic Content

CENTER FOR MATHEMATICS, SCIENCE, AND TECHNOLOGY
Illinois State University

ISEIF

Standards:

The Smart Grid for Schools program can be used to address several educational standards in Science (NGSS), Mathematics (CCSS.Math), Social Studies (SS), and English Language Arts (CCSS.ELA). Many of these standards are addressed within the curriculum while others can be addressed by implementing optional enhancements.

Grade Level	Discipline and Standard	Where and how the standard is addressed
Kindergarten	NGSS.K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.	Students turn the crank on the generator fast and slow, noting the speed of the motor and/or brightness of the bulb. They compare the speed to how quickly they get tired or out of breath. They see the correlation between input and output.
Kindergarten	CCSS.Math.K.MD.3. Classify objects and count the number of objects in each category. Classify objects into given categories; count the numbers of objects in each category and short the categories by count. (Limit category counts to be less than or equal to 10.)	Classify and count various models in the grid system. Count LED lights. Count springs. Count number of customers on each grid line, etc. Classify them by building type, pole type (single or double), etc.
Kindergarten	CCSS.Math.K.CC.1-7. Know number names and the count sequence, Count to tell the number of objects, and Compare numbers.	Make a list of items in the set and allow students to write in the number of each. Compare their list to the inventory list in the box.
First	NGSS.1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.	Students will get excited when the light on the front porch of the house lights up. Use this opportunity to ask them about how lights make it possible to see things. Also, on page 15 (TE) the invention of the light bulb is addressed. Discuss how this changed society.
First	SS.H.1.3. Create and use a chronological sequence of events.	This activity is presented in chronological order. As a class draw a timeline of the development of the electrical grid. You may wish to insert other significant and age-appropriate events such as the invention of
First	CCSS.ELA.RL.1.1. Ask and answer questions about key details in a text.	There are several opportunities throughout the experience where students are asked questions about key details in the text. Their responses can be written and submitted to the teacher.
First	1.OA.1 and 2 Represent and solve problems involving addition and subtraction.	Students can count houses or other components and add or subtract to determine the number of household with or without power in the event of a broken wire or damaged transformer.
K-1	CC.ELA.RI.K.1. With prompting and support, ask and answer questions about key details in a text.	The text provides specific details on the historical development of the electrical grid. Students are asked to address these facts in the discussion sections throughout the experience.
Second	2.MD 1-4 Measure and estimate lengths in standard units.	Measure the length of the grid line from power plant to furthest customer (house). Measure the distance between poles. Calculate how many more poles would be needed to go further distances.

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Second	NGSS.2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.	When students are learning to strip the wires on page 18 (TE) they can be asked about materials. The coating on the outside is a plastic insulator whereas the inner core of the wire is a metal conductor. Ask them what other materials are probably conductors or insulators used in the construction of this set of models.
K-2	SS.IS.2.K-2. Explore facts from various sources that can be used to answer the developed questions.	Throughout the experience students are required to stop and reflect on their work, addressing questions about what they are learning. Answers will come from their reading and experiences.
K-2	SS.IS.1.K-2. Create questions to help guide inquiry about a topic with guidance from adults and/or peers.	Students will be very interested in this activity. Encourage their questions about energy and why it is important to modern society. Also, students may wish to discuss environmental impacts.
K-2	SS.IS.5.K-2. Ask and answer questions about arguments and explanations.	Throughout this experience students are asked to do unusual and unfamiliar tasks. They will discuss within their groups what to do and how best to do it. Encourage their discussions.
Third	NGSS.3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	On page 35 (TE) the Smart Grid Monitor is used to locate a problem caused by a storm. This is a good opportunity to discuss with students the wild fires started in California by downed power lines. How will the Smart Grid reduce the chance of fires?
Third	CCSS.ELA.W.3.7. Conduct short research projects that build knowledge about a topic.	This experience can be used as an introduction to a number of research topics including history, technology, society, environment, economics, etc.
Third	CCSS.ELA.SL.3.2. Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.	Students are required to read these instructions and follow them to successfully complete the tasks. They can be asked to read aloud to their team-mates. They will naturally find the main ideas as they seek to build their grid.
Third	SS.H.3.5. Explain probable causes and effects of events and developments in U.S. history.	This activity is presented in chronological order. Draw a timeline of the development of the electrical grid, inserting significant events and developments in U.S. history. Discuss cause and effect.
Third	3.OA 1-4 Represent and solve problems involving multiplication and division.	Calculate how many poles will be needed to extend the grid a given distance given the spacing between them. Measure in rather large units so that the numbers stay relatively small.
Third	3.NF.1 Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size 1/b.	Count lights and determine the fraction of lights in the entire grid that go out when any given wire is disconnected, fuse is blown, or switch turned off.

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Fourth	CCSS.ELA.W.4.2. Write informative/ explanatory texts to examine a topic and convey ideas and information clearly.	The discussion questions could be assigned as written responses in complete sentences. They could also be assigned reports on an energy-related topic requiring research. Another option is for them to write and illustrate instructions for how they made their grid.
Fourth	CCSS.ELA.RI.4.5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	These instructions are written in a Learning Cycle format. Students could be assigned to review and critique these instructions.
Fourth	CCSS.ELA.W.4.7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.	Many students will be very interested in this project and will want to learn more. Some may even consider a career in the electrical energy field because of this exposure. Facilitate independent research.
Fourth	CCSS.ELA.W.4.8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	Require entries into a journal concerning the students experience with the Smart Grid for Schools system. Encourage them to organize this information into a digital slide show to be presented to parents and/or school board members.
Fourth	4. OA 2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.1	Work fluidly with watts, volts, and amps. Watts is a measure of power. Volts is a measure of pressure, and Amps is a measure of volume. Watts= Volts x Amps Most outlets in a house are 120 volts. Watts or Amps are often printed on tags on electrical devices. Most fuses in a home are set to turn off at either 10 amps or 15 amps, depending on the size of the wire.
Fourth	NGSS.4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	Ask students how the electrical energy is getting from the power plant to the customers. What do customers use electricity to do? Most of these models change electricity into light. The factory changes it to motion. What changes occur in their homes?
Fourth	NGSS.4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	On page 25 (TE) students are asked to select the best power plant. This provides the opportunity to discuss energy sources and their impact on the environment and economy.

Grade Level	Discipline and Standard	Where and how the standard is addressed
G3-5	NGSS.3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	When completed with this activity, propose that students design and build a model of the electrical grid of the future using all renewable energy sources. Provide them criteria and constraints such as power requirements and location restrictions.

Grades 4-8

Grade Level	Discipline and Standard	Where and how the standard is addressed
Fourth	CCSS.ELA.W.4.2. Write informative/ explanatory texts to examine a topic and convey ideas and information clearly.	The discussion questions could be assigned as written responses in complete sentences. They could also be assigned reports on an energy-related topic requiring research. Another option is for them to write and illustrate instructions for how they made their grid. Pg 46
Fourth	CCSS.ELA.RI.4.5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.	These instructions are written in a Learning Cycle format. Students could be assigned to review and critique these instructions. Pg 47
Fourth	CCSS.ELA.W.4.7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.	Many students will be very interested in this project and will want to learn more. Some may even consider a career in the electrical energy field because of this exposure. Facilitate independent research. Pg 16
Fourth	CCSS.ELA.W.4.8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	Require entries into a journal concerning the students experience with the Smart Grid for Schools system. Encourage them to organize this information into a digital slide show to be presented to parents and/or school board members. Pg 47
Fourth	NGSS.4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	Ask students how the electrical energy is getting from the power plant to the customers. What do customers use electricity to do? Most of these models change electricity into light. The factory changes it to motion. What changes occur in their homes? Pg 28
Fourth	NGSS.4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	Electrical energy is converted to light or motion in these models. Encourage students to experiment with other circuits and devices. Do not connect other devices to this set since it is not designed to handle additional loads. Pg 22
Fourth	NGSS.4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	On page 24 (TE) students are asked to select the best power plant. This provides the opportunity to discuss energy sources and their impact on the environment and economy. Pg 29
Fourth	CCSS.ELA.RI.4.1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.	Note that Edison did not invent the light bulb. Edison made the bulb possible by inventing the system that made it available to lots of people. Pg 28

Grade Level	Discipline and Standard	Where and how the standard is addressed
Fourth	4. OA 2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.1	Work fluidly with watts, volts, and amps. Watts is a measure of power. Volts is a measure of pressure, and Amps is a measure of volume. Watts= Volts x Amps Most outlets in a house are 120 volts. Watts or Amps are often printed on tags on electrical devices. Most fuses in a home are set to turn off at either 10 amps or 15 amps, depending on the size of the wire. Pg 34
Fourth but also appropriate for grades 5-8	CCSS.MATH.CONTENT.4.NBT.B.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm. CCSS.MATH.CONTENT.4.NBT.B.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. CCSS.MATH.CONTENT.4.NBT.B.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. Similar standards can be found in grades 5-8.	Calculate the power output of students in the class. See ***Your Horsepower*** on page 10. Work = Force x Distance (going up, not horizontal) Power = Work / Time 1 horsepower = 550 pounds lifted 1 foot in 1 second 1 horsepower = 745 watts. Pg 10
Fifth	CCSS.ELA.RI.5.8. Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).	Review this document to identify key points and how those points are supported with evidence (references). Encourage additional research on energy-related topics to develop well-informed opinions and clear action steps. Pg 13
Fifth	CCSS.ELA.W.5.8. Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.	Throughout the activity students are learning from experience and from the information presented in the curriculum. A written summary of the experience can be assigned. Pg 47
Fifth	CCSS.MATH.CONTENT.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.	Measure distances between the customers and the power plant in various units and convert using a scale to real-life distances. For example, how far is your school from the nearest power plant? Are others further? Represent those distances on your model grid. Pg 31

Grade Level	Discipline and Standard	Where and how the standard is addressed
Fifth	SS.IS.5.3-5. Develop claims using evidence from multiple sources to answer essential questions.	A series of questions are presented in each of the "Discussion" sections of the curriculum. Student responses should be based on evidence. Also, several questions are included at the end of the activity prompting further research. Pg 44
Fifth	SS.IS.8.3-5. Use listening, consensus building, and voting procedures to decide on and take action in their classroom and school.	Now that students are somewhat familiar with the electrical energy and the distribution grid, ask them to identify (and possibly implement) actions that could be taken at their school to decrease energy use. To be successful, groups of students must listen to each other and reach consensus on what they are to do while designing and building their electrical grid. A culminating activity addresses energy conservation in their classroom and school which will require research, presentations, and voting. Pg 46
Fifth	CCSS.MATH.CONTENT.5.NF.A.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.	Calculate total resistance in a circuit. See ***STEM of Energy*** on pages 44 and 45.
Fifth	CCSS.MATH.CONTENT.5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.	Electricity is measured in Watts. Most often, however, it is seen as kilowatts (kW) or megawatts (MW). 1 MW = 1000 kW 1 kW = 1000 watts Research the power output of wind turbines, solar, coal, natural gas, and nuclear power plants converting data to a common unit. Pg 24
G3-5	NGSS. 3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specific criterial for success and constraints on materials, time, or cost. NGSS.3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. NGSS.3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	When completed with this activity, propose that students design and build a model of the electrical grid of the future using all renewable energy sources. Provide them criteria and constraints such as power requirements and location restrictions. Test their designs to find failure points and aspects in need of improvement. Pg 47

Grade Level	Discipline and Standard	Where and how the standard is addressed
Sixth	CCSS.MATH.CONTENT.6.NS.A.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.	Each switch will control a fraction of the entire grid. As grid lines are combined, each switch will control a fraction of a fraction, providing opportunity to work fluidly with fractions. Pg 35
Sixth	CCSS.MATH.CONTENT.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.MATH.CONTENT.6.SP.B.5 Summarize numerical data sets in relation to their context,	Research types of power plants and determine changes necessary to reach Illinois energy goal of 25% renewable energy by 2025. Pg 29
Seventh	CCSS.MATH.CONTENT.7.RP.A.3 Use proportional relationships to solve multi-step ratio and percent problems.	Compare output of various power plants as percents and ratios. For example, how many wind turbines or solar farms will be necessary to generate the power of one nuclear plant? Pg 29
Seventh	CCSS.MATH.CONTENT.7.SP.A.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. CCSS.MATH.CONTENT.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.MATH.CONTENT.7.SP.B.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. CCSS.MATH.CONTENT.7.SP.B.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.	Use a survey to gather data about energy use, conservation techniques, attitudes about various power plants, or other energy-related topics. Compare by grade level at the school or with adults. Pg 25

Grade Level	Discipline and Standard	Where and how the standard is addressed
Eighth	CCSS.MATH.CONTENT.8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.	Use Ohms Law to compare the relationship between resistance, voltage, and current. See ***STEM of Energy*** on pages 44 and 45.
Eighth	CCSS.MATH.CONTENT.8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1	Complete various calculations of Ohms Law and graph the results. See ***STEM of Energy*** on pages 44 and 45.
Middle School	NGSS MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. NGSS MS-PS4-3 Integrate qualitative scientific and technical information to support the claims that digitized signals are a more reliable way to encode and transmit information than analog signals.	Now that students have some experience with electricity, encourage them to make a telegraph system. They can set up "telegraph offices" at various places in the classroom. A telegraph is a digital system, consisting of either "on" or "off" signals. Pg 47
Middle School	NGSS MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Research the role of electrical power plants in producing pollution. Compare natural gas, coal, nuclear, and renewable sources including not only their operation, but also their construction, maintenance, and dismantling. Pg 47
Middle School	MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Assign that groups of students develop a system to generate and distribute electricity in a manner that minimizes harmful impacts. Pg 47

Grades 8-12

The Smart Grid for Schools program can be used to address several educational standards in Science (NGSS), Mathematics (CCSS.Math), Social Studies (SS), and English Language Arts (CCSS.ELA). Many of these standards are addressed within the curriculum while others can be addressed by implementing optional enhancements. For example, there are sections inserted for students to calculate their horsepower output and to work with Ohm's Law to determine resistance and current flow in a circuit. These activities are optional, but address important Mathematics concepts.

Grade Level	Discipline and Standard	Where and how the standard is addressed
Eighth	CCSS.MATH.CONTENT.8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.	Use Ohms Law to compare the relationship between resistance, voltage, and current. See ***Your Horsepower*** and ***STEM of Energy*** . Pgs 12 and 48
Eighth	CCSS.MATH.CONTENT.8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1	Complete various calculations of Ohms Law and graph the results. See ***Your Horsepower*** and ***STEM of Energy*** . Pgs 12 and 48
Eighth	Writing Standard 7.Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.	Assign a research paper on electrical generation including economic and environmental impacts as appropriate for the grade level. Pg 49
Middle School	NGSS MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. NGSS MS-PS4-3 Integrate qualitative scientific and technical information to support the claims that digitized signals are a more reliable way to encode and transmit information than analog signals.	Now that students have some experience with electricity, encourage them to make a telegraph system. They can set up "telegraph offices" at various places in the classroom. A telegraph is a digital system, consisting of either "on" or "off" signals. Pg 49
Middle School	NGSS MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Research the role of electrical power plants in producing pollution. Compare natural gas, coal, nuclear, and renewable sources including not only their operation, but also their construction, maintenance, and dismantling. Pg 49

Grade Level	Discipline and Standard	Where and how the standard is addressed
Middle School	MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Assign that groups of students develop a system to generate and distribute electricity in a manner that minimizes harmful impacts. Pg 49
High School	NGSS.HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. SS.G.3.9-12. Analyze and explain how humans impact and interact with the	Evaluate modern power plants. Pg 31
High School	NGSS.HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Design a completely “green” power grid by assigning different parts of the system to groups. Pg 31
High School	NGSS.HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural,	Build a functioning model of an ancient power source such as a water wheel or other machine. Evaluate its performance. Improve it using modern technology but for use in an area lacking in technology. Pg 11

Grade Level	Discipline and Standard	Where and how the standard is addressed
High School	NGSS.HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	Gather data on human performance and design a machine to most efficiently use human power for something that is now powered by electricity. Pg 12
High School	CCSS.MATH.PRACTICE.MP2. Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.MP3. Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP4. Model with mathematics. CCSS.MATH.PRACTICE.MP5. Use appropriate tools strategically. CCSS.MATH.PRACTICE.MP6. Attend to precision.	Conduct mathematical calculations. See ***Your Horsepower*** and ***STEM of Energy*** . Pgs 12, 36, 47, and 48
High School	CCSS.MATH.CONTENT.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	Conduct mathematical calculations. See ***Your Horsepower*** and ***STEM of Energy*** . Pgs 12, 36, 47, and 48
High School	CCSS.MATH.CONTENT.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	Conduct mathematical calculations. See ***Your Horsepower*** and ***STEM of Energy*** . Pgs 12, 36, 47, and 48
High School	CCSS.Math.Content.HSA.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	Compare horsepower output based on time by varying the speed of running up the stairs. Also, graph and compare changes to horsepower when carrying extra weight. Pg 12

Grade Level	Discipline and Standard	Where and how the standard is addressed
High School	CCSS.Math.Content.HSF.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*	Graph human performance varying weight, speed, and other variables. See ***Your Horsepower*** pg 12
High School	CCSS.Math.Content.HSS.ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.	Graph human performance varying weight, speed, and other variables. See ***Your Horsepower*** pg 12
High School	CCSS.Math.Content.HSS.ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	Graph human performance varying weight, speed, and other variables. See ***Your Horsepower*** pg 12
High School	CCSS.Math.Content.HSS.ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.	Graph human performance varying weight, speed, and other variables. See ***Your Horsepower*** pg 12
High School	CCSS.Math.Content.HSS.ID.C.9 Distinguish between correlation and causation.	Gather data on electrical power plants including fuel, power generation, carbon emissions, water pollution, etc. Compare different types of power plants. Pg 31
High School	CCSS.Math.Content.HSS.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	Graph human performance varying weight, speed, and other variables. See ***Your Horsepower*** pg 12
High School	CCSS.Math.Content.HSS.IC.B.6 Evaluate reports based on data.	Gather data on electrical power plants including fuel, power generation, carbon emissions, water pollution, etc. Compare different types of power plants. Pg 31

Grade Level	Discipline and Standard	Where and how the standard is addressed
High School	CCSS.Math.Content.HSS.MD.B.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	Consider that you are planning the power grid in the late 1800s. Where should the power plants be located? Where should the lines be run? What can be done to maximize return on the investment? Model you plan using quantitative date. Pg 38
High School	NGSS.HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. NGSS.HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	Research current issues through scientific literature involving power equipment in manufacturing. Identify a solution that is currently being used and design an alternative that would reduce the harm to the environment and biodiversity. Pg 18
High School	NGSS.HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	Design, build, and refine a steam engine or a generator. Pg 13 and 17
High School	SS.CV.9.9-12: Evaluate public policies in terms of intended and unintended outcomes and related consequences.	Research current government policies and incentives for renewable energy, noting intended and unintended outcomes and consequences. Pg 31
High School	SS.G.1.9-12. Use maps (created using geospatial and related technologies, if possible), satellite images, and photographs to display and explain the spatial patterns of physical, cultural, political, economic, and environmental characteristics. SS.G.2.9-12. Use self-collected or pre-existing data sets to generate spatial patterns at multiple scales that can be used to conduct analyses or to take civic action.	Propose the building of a power plant (any energy source, including renewables) in Illinois. Plan its location and map the route that it will feed into the existing power grid. Page 42
High School	SS.EC.2.9-12. Use marginal benefits and marginal costs to propose a solution to a significant issue for an individual or community. SS.EC.4.9-12. Evaluate the effectiveness of government policies to improve market outcomes,	Research electrical power grids in developing parts of the world. What is being done to get reliable electrical power to these communities? What government programs are in place? Are they effective? What challenges are yet to be over-come? Pg 49

Grade Level	Discipline and Standard	Where and how the standard is addressed
High School	SS.H.1.9-12. Evaluate how historical developments were shaped by time and place as well as broader historical contexts. SS.H.2.9-12. Analyze change and continuity within and across historical eras. SS.H.3.9-12. Evaluate the methods utilized by people and institutions to promote change.	Study the history of technological development. Why did it advance at different rates across the world? What factors contributed to its success or failure? Pg 15
High School	SS.H.4.9-12. Analyze how people and institutions have reacted to environmental, scientific, and technological challenges.	What effect did the electric light bulb have on society? Pg 30
High School	Reading standard 1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.	Read publications that promote the construction of wind farms and compare them to publications that oppose their development. Make a chart of the pros and cons of wind farms. Pg 49
High School	Writing Standard 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and fol-	Assign a research/writing project on an energy-related topic of the student's choice. Provide an avenue for publication/ dissemination including poster displays, presentations, social media, etc. as appropriate. Pg 50