Showing Results for:
Course: PLTW Gateway
Units: 3
Lessons: L3.1, L3.2 & L3.3
Common Core State Standards for English Language Arts, Standards for Technological Literacy, Next Generation Science Standards & Common Core State Standards for Mathematical Practice (6-8)

Common Core State Standards for English Language Arts

Lesson 3.1 - Investigating Energy

Reading

Key Ideas and Details

4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. (AS.R.4)

Text Types and Purposes

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. (AS.W.2)
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (AS.W.4)

Comprehension and Collaboration

2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (AS.SL.2)

Conventions of Standard English

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (AS.L.1)
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (AS.L.2)
6. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. (AS.L.6)

Lesson 3.2 - Sustainable Energy

Reading

Key Ideas and Details

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. (AS.R.1)
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. (AS.R.2)
4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. (AS.R.4)

Text Types and Purposes

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. (AS.W.2)
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (AS.W.4)
6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. (AS.W.6)
9. Draw evidence from literary or informational texts to support analysis, reflection, and research. (AS.W.9)

Comprehension and Collaboration

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. (AS.SL.1)
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (AS.SL.2)
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. (AS.SL.4)
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. (AS.SL.5)

Conventions of Standard English

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (AS.L.1)
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (AS.L.2)
6. Acquire and use accurately a range of general academic and domain-specific words and phrases

sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. (AS.L.6)

Lesson 3.3 - Making an Impact

Reading

Key Ideas and Details

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. (AS.R.1)
7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. (AS.R.7)

Text Types and Purposes

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. (AS.W.2)
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (AS.W.4)

Comprehension and Collaboration

2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (AS.SL.2)
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. (AS.SL.4)

Conventions of Standard English

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (AS.L.1)
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (AS.L.2)
6. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. (AS.L.6)

http://www.corestandards.org/

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Standards for Technological Literacy

Lesson 3.1 - Investigating Energy

Students will develop an understanding of the characteristics and scope of technology.

6-8

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (1.6-8.F)
G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative. (1.6-8.G)
H. Technology is closely linked to creativity, which has resulted in innovation. (1.6-8.H)
I. Corporations can often create demand for a product by bringing it onto the market and advertising it. (1.6-8.I)

Students will develop an understanding of the core concepts of technology.

6-8

N. Systems thinking involves considering how every part relates to others. (2.6-8.N)
P. Technological systems can be connected to one another. (2.6-8.P)
Q. Malfunctions of any part of a system may affect the function and quality of the system. (2.6-8.Q)
R. Requirements are the parameters placed on the development of a product or system. (2.6-8.R)
S. Trade-off is a decision process recognizing the need for careful compromises among competing factors. (2.6-8.S)

Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

6-8

D. Technological systems often interact with one another. (3.6-8.D)
E. A product, system, or environment developed for one setting may be applied to another setting. (3.6-8.E)
F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems. (3.6-8.F)

9-12

G. Technology transfer occurs when a new user applies an existing innovation developed for one

purpose in a different function. (3.9-12.G)

Students will develop an understanding of the effects of technology on the environment.

6-8

D. The management of waste produced by technological systems is an important societal issue. (5.6-8.D)
E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems. (5.6-8.E)
F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another. (5.6-8.F)

9-12

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling. (5.9-12.G)
H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important. (5.9-12.H)
I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making. (5.9-12.I)
J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. (5.9-12.J)
K. Humans devise technologies to reduce the negative consequences of other technologies. (5.9-12.K)
L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. (5.9-12.L)

Students will develop an understanding of the role of society in the development and use of technology.

6-8

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies. (6.6-8.D)
E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (6.6-8.E)
G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems. (6.6-8.G)

Students will develop an understanding of engineering design.

6-8

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed. (9.6-8.F)
G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (9.6-8.G)
H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.

(9.6-8.H)

Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

6-8

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (10.6-8.F)
G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it. (10.6-8.G)
H. Some technological problems are best solved through experimentation. (10.6-8.H)

Students will develop the abilities to apply the design process.

6-8

H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H)
I. Specify criteria and constraints for the design. (11.6-8.I)
J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6-8.J)
K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (11.6-8.K)
L. Make a product or system and document the solution. (11.6-8.L)

Students will develop the abilities to use and maintain technological products and systems.

6-8

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work. (12.6-8.H)
I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems. (12.6-8.I)
J. Use computers and calculators in various applications. (12.6-8.J)
K. Operate and maintain systems in order to achieve a given purpose. (12.6-8.K)

Students will develop the abilities to assess the impact of products and systems.

6-8

F. Design and use instruments to gather data. (13.6-8.F)
G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology. (13.6-8.G)
H. Identify trends and monitor potential consequences of technological development. (13.6-8.H)
I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful. (13.6-8.I)

Students will develop an understanding of and be able to select and use energy and power technologies.

6-8

E. Energy is the capacity to do work. (16.6-8.E)
F. Energy can be used to do work, using many processes. (16.6-8.F)
G. Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done. (16.6-8.G)
H. Power systems are used to drive and provide propulsion to other technological products and systems. (16.6-8.H)
I. Much of the energy used in our environment is not used efficiently. (16.6-8.I)

9-12

J. Energy cannot be created nor destroyed; however, it can be converted from one form to another. (16.9-12.J)
K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others. (16.9-12.K)
L. It is impossible to build an engine to perform work that does not exhaust thermal energy to the surroundings. (16.9-12.L)
M. Energy resources can be renewable or nonrenewable. (16.9-12.M)
N. Power systems must have a source of energy, a process, and loads. (16.9-12.N)

Lesson 3.2 - Sustainable Energy

Students will develop an understanding of the characteristics and scope of technology.

6-8

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (1.6-8.F)
G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative. (1.6-8.G)
H. Technology is closely linked to creativity, which has resulted in innovation. (1.6-8.H)
I. Corporations can often create demand for a product by bringing it onto the market and advertising it. (1.6-8.I)

Students will develop an understanding of the core concepts of technology.

6-8

M. Technologies systems include input, processes, output, and at times, feedback. (2.6-8.M)
N. Systems thinking involves considering how every part relates to others. (2.6-8.N)
P. Technological systems can be connected to one another. (2.6-8.P)
Q. Malfunctions of any part of a system may affect the function and quality of the system. (2.6-8.Q)

Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

6-8

D. Technological systems often interact with one another. (3.6-8.D)
E. A product, system, or environment developed for one setting may be applied to another setting. (3.6-8.E)
F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems. (3.6-8.F)

Students will develop an understanding of the cultural, social, economic, and political effects of technology.

6-8

D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use. (4.6-8.D)
G. Economic, political, and cultural issues are influenced by the development and use of technology. (4.6-8.G)

Students will develop an understanding of the effects of technology on the environment.

6-8

D. The management of waste produced by technological systems is an important societal issue. (5.6-8.D)
E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems. (5.6-8.E)
F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another. (5.6-8.F)

9-12

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important. (5.9-12.H)
I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making. (5.9-12.I)
J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. (5.9-12.J)
K. Humans devise technologies to reduce the negative consequences of other technologies. (5.9-12.K)
L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. (5.9-12.L)

Students will develop an understanding of the role of society in the development and use of technology.

6-8

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies. (6.6-8.D)
E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (6.6-8.E)

F. Social and cultural priorities and values are reflected in technological devices. (6.6-8.F)
G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems. (6.6-8.G)

9-12

H. Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values. (6.9-12.H)
I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures. (6.9-12.I)
J. A number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads contribute to shaping the design of and demand for various technologies. (6.9-12.J)

Students will develop an understanding of the influence of technology on history.

6-8

C. Many inventions and innovations have evolved using slow and methodical processes of tests and refinements. (7.6-8-C)

9-12

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention. (7.9-12.G)
H. The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials. (7.9-12.H)
I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape. (7.9-12.I)
J. Early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how. (7.9-12.J)
N. The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time. (7.9-12.N)

Students will develop an understanding of the attributes of design.

6-8

E. Design is a creative planning process that leads to useful products and systems. (8.6-8.E)
F. There is no perfect design. (8.6-8.F)
G. Requirements for design are made up of criteria and constraints. (8.6-8.G)

9-12

H. The design process includes defining a problem, brainstorming, researching and generating

ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)
I. Design problems are seldom presented in a clearly defined form. (8.9-12.I)
J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)
K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Students will develop an understanding of engineering design.

6-8

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed. (9.6-8.F)
G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (9.6-8.G)
H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions. (9.6-8.H)

Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

6-8

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (10.6-8.F)
G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it. (10.6-8.G)
H. Some technological problems are best solved through experimentation. (10.6-8.H)

Students will develop the abilities to apply the design process.

6-8

H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H)
I. Specify criteria and constraints for the design. (11.6-8.I)
J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6-8.J)
K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (11.6-8.K)
L. Make a product or system and document the solution. (11.6-8.L)

Students will develop the abilities to use and maintain technological products and systems.

6-8

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work. (12.6-8.H)
I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems. (12.6-8.I)
J. Use computers and calculators in various applications. (12.6-8.J)
K. Operate and maintain systems in order to achieve a given purpose. (12.6-8.K)

Students will develop the abilities to assess the impact of products and systems.

6-8

F. Design and use instruments to gather data. (13.6-8.F)
G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology. (13.6-8.G)
H. Identify trends and monitor potential consequences of technological development. (13.6-8.H)
I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful. (13.6-8.I)

Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

6-8

G. A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other useful products and in the care of animals. (15.6-8.G)

Students will develop an understanding of and be able to select and use energy and power technologies.

6-8

I. Much of the energy used in our environment is not used efficiently. (16.6-8.I)

9-12

J. Energy cannot be created nor destroyed; however, it can be converted from one form to another. (16.9-12.J)
M. Energy resources can be renewable or nonrenewable. (16.9-12.M)

Lesson 3.3 - Making an Impact

Students will develop an understanding of the characteristics and scope of technology.

6-8

F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (1.6-8.F)
G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative. (1.6-8.G)
H. Technology is closely linked to creativity, which has resulted in innovation. (1.6-8.H)

Students will develop an understanding of the core concepts of technology.

6-8

R. Requirements are the parameters placed on the development of a product or system. (2.6-8.R)
S. Trade-off is a decision process recognizing the need for careful compromises among competing factors. (2.6-8.S)
T. Different technologies involve different sets of processes. (2.6-8.T)

Students will develop an understanding of the cultural, social, economic, and political effects of technology.

6-8

D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use. (4.6-8.D)
E. Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences. (4.6-8.E)
F. The development and use of technology poses ethical issues. (4.6-8.F)
G. Economic, political, and cultural issues are influenced by the development and use of technology. (4.6-8.G)

Students will develop an understanding of the effects of technology on the environment.

6-8

D. The management of waste produced by technological systems is an important societal issue. (5.6-8.D)
E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems. (5.6-8.E)
F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another. (5.6-8.F)

9-12

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling. (5.9-12.G)
H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important. (5.9-12.H)
I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making. (5.9-12.I)
J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. (5.9-12.J)
K. Humans devise technologies to reduce the negative consequences of other technologies. (5.9-12.K)
L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. (5.9-12.L)

Students will develop an understanding of the role of society in the development and use of technology.

6-8

D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies. (6.6-8.D)
E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants. (6.6-8.E)

Students will develop an understanding of the attributes of design.

6-8

E. Design is a creative planning process that leads to useful products and systems. (8.6-8.E)
F. There is no perfect design. (8.6-8.F)
G. Requirements for design are made up of criteria and constraints. (8.6-8.G)

Students will develop an understanding of engineering design.

6-8

F. Design involves a set of steps, which can be performed in different sequences and repeated as needed. (9.6-8.F)
G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum. (9.6-8.G)
H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions. (9.6-8.H)

Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

6-8

F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system. (10.6-8.F)
G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it. (10.6-8.G)
H. Some technological problems are best solved through experimentation. (10.6-8.H)

Students will develop the abilities to apply the design process.

6-8

H. Apply a design process to solve problems in and beyond the laboratory-classroom. (11.6-8.H)
I. Specify criteria and constraints for the design. (11.6-8.I)
J. Make two-dimensional and three-dimensional representations of the designed solution. (11.6-8.J)
K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (11.6-8.K)
L. Make a product or system and document the solution. (11.6-8.L)

Students will develop the abilities to use and maintain technological products and systems.

6-8

H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work. (12.6-8.H)
I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems. (12.6-8.I)
J. Use computers and calculators in various applications. (12.6-8.J)
K. Operate and maintain systems in order to achieve a given purpose. (12.6-8.K)

Students will develop the abilities to assess the impact of products and systems.

6-8

F. Design and use instruments to gather data. (13.6-8.F)
G. Use data collected to analyze and interpret trends in order to identify the positive and negative effects of a technology. (13.6-8.G)
H. Identify trends and monitor potential consequences of technological development. (13.6-8.H)
I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful. (13.6-8.I)

Students will develop an understanding of and be able to select and use energy and power technologies.

6-8

I. Much of the energy used in our environment is not used efficiently. (16.6-8.I)

9-12

J. Energy cannot be created nor destroyed; however, it can be converted from one form to another. (16.9-12.J)

Students will develop an understanding of and be able to select and use manufacturing technologies.

6-8

F. Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combining, and conditioning them. (19.6-8.F)
G. Manufactured goods may be classified as durable and non-durable. (19.6-8.G)
H. The manufacturing process includes the designing, development, making, and servicing of products and systems. (19.6-8.H)
J. Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining. (19.6-8.J)

International Technology Education Association. (2007). Standards for technological literacy. Reston, VA: ITEA.

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Next Generation Science Standards

Lesson 3.1 - Investigating Energy

Middle School

Matter and Its Interactions

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. (MS.PS1.3)

Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (MS.PS3.1)
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (MS.PS3.5)

Engineering Design

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 and potential impacts on people and the natural environment that may limit possible solutions. (MS.ETS1.1)
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.ETS1.2)
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.ETS1.3)
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. (MS.ETS1.4)

Lesson 3.2 - Sustainable Energy

Middle School

Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. (MS.PS3.1)

Earth and Human Activity

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human

impact on the environment.* (MS.ESS3.3)
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per.capita consumption of natural resources impact Earth's systems. (MS.ESS3.4)
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. (MS.ESS3.5)

Engineering Design

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 and potential impacts on people and the natural environment that may limit possible solutions. (MS.ETS1.1)
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.ETS1.2)
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. (MS.ETS1.4)

High School

Engineering Design

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. (HS.ETS1.1)
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. (HS.ETS1.2)
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, and environmental impacts. (HS.ETS1.3)

Lesson 3.3 - Making an Impact

Middle School

Matter and Its Interactions

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. (MS.PS1.4)

Energy

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* (MS.PS3.3)
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (MS.PS3.4)

Earth and Human Activity

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* (MS.ESS3.3)
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per.capita consumption of natural resources impact Earth's systems. (MS.ESS3.4)
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. (MS.ESS3.5)

Engineering Design

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 and potential impacts on people and the natural environment that may limit possible solutions. (MS.ETS1.1)
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.ETS1.2)
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.ETS1.3)
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. (MS.ETS1.4)

High School

Engineering Design

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. (HS.ETS1.1)
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. (HS.ETS1.2)
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, and environmental impacts. (HS.ETS1.3)

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Common Core State Standards for Mathematical Practice (6-8)

Lesson 3.1 - Investigating Energy

Grade 6

The Number System
-Compute fluently with multi-digit numbers and find common factors and multiples.

2. Fluently divide multi-digit numbers using the standard algorithm. (6.NS.B.2)
3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. (6.NS.B.3)

Expressions and Equations
-Apply and extend previous understandings of arithmetic to algebraic expressions.

2. Write, read, and evaluate expressions in which letters stand for numbers. (6.EE.A.2)
2.a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 - y. (6.EE.A.2a)
2.b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms. (6.EE.A.2b)

-Reason about and solve one-variable equations and inequalities.

6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (6.EE.B.6)
7. Solve real-world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q and x are all nonnegative rational numbers. (6.EE.B.7)

-Represent and analyze quantitative relationships between dependent and independent variables.

9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time. (6.EE.C.9)

Grade 7

The Number System
-Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. (7.NS.A.2)
2.c. Apply properties of operations as strategies to multiply and divide rational numbers. (7.NS.A.2c)
3. Solve real-world and mathematical problems involving the four operations with rational numbers. (7.NS.A.3)

Expressions and Equations
-Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply

properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation. (7.EE.B.3)
4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (7.EE.B.4)
4.a. Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? (7.EE.B.4a)

Grade 8

Functions
-Use functions to model relationships between quantities.

5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. (8.F.B.5)

Lesson 3.2 - Sustainable Energy

Grade 6

Ratios and Proportional Relationships
-Understand ratio concepts and use ratio reasoning to solve problems.

3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (6.RP.A.3)
3.c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problem (6.RP.A.3c)

The Number System
-Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

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. For example, create a story context for (2/3)/(3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) /(3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b)/(c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi? (6.NS.A.1)

Statistics and Probability

-Develop understanding of statistical variability.

1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. (6.SP.A.1)
2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (6.SP.A.2)

Grade 7

Ratios and Proportional Relationships
-Analyze proportional relationships and use them to solve real-world and mathematical problems.

2. Recognize and represent proportional relationships between quantities. (7.RP.A.2)

Lesson 3.3 - Making an Impact

Grade 6

The Number System
-Apply and extend previous understandings of multiplication and division to divide fractions by fractions.

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. For example, create a story context for (2/3)/(3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) /(3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b)/(c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi? (6.NS.A.1)

-Compute fluently with multi-digit numbers and find common factors and multiples.

3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. (6.NS.B.3) [OPTIONAL]

Expressions and Equations
-Apply and extend previous understandings of arithmetic to algebraic expressions.

2. Write, read, and evaluate expressions in which letters stand for numbers. (6.EE.A.2)
2.a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 - y. (6.EE.A.2a)

-Represent and analyze quantitative relationships between dependent and independent variables.

9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered

pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time. (6.EE.C.9)

Grade 7

The Number System

-Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. (7.NS.A.2)
3. Solve real-world and mathematical problems involving the four operations with rational numbers. (7.NS.A.3)

Expressions and Equations

-Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation. (7.EE.B.3)
4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (7.EE.B.4)
4.a. Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width? (7.EE.B.4a)

Statistics and Probability

-Use random sampling to draw inferences about a population.

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. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be. (7.SP.A.2)

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