Environmental Sustainability (ES)

Lesson 1.1

Common Core State Standards for English Language Arts

9-10.RST.1 - Reading Science/Technical

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.9 - Reading Science/Technical

Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.2 - Reading Science/Technical

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.7 - Reading Science/Technical

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

11-12.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Environmental Sustainability (ES)

Lesson 1.1

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling.

Environmental Sustainability (ES)

Lesson 1.1

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Biotechnology R & D Pathway Standard 6

Biotechnology R & D professionals are not isolated from the social effect of their products in our society. Science, technology and society are intertwined. Biotechnology R & D employees will be conversant with the larger ethical, moral and legal issues related to biotech research, product development and use in society.

Environmental Sustainability (ES)

Lesson 1.1

Next Generation Science Standards

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 1.1

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

2.9-12.W Students will develop an understanding of the core concepts of technology.

W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria.

2.9-12.EE Students will develop an understanding of the core concepts of technology.

EE. Management is the process of planning, organizing, and controlling work.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

4.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.H Students will develop an understanding of the role of society in the development and use of technology.

H. Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

Environmental Sustainability (ES)

Lesson 2.1

Common Core State Standards for English Language Arts

9-10.RST.1 - Reading Science/Technical

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.9 - Reading Science/Technical

Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.2 - Reading Science/Technical

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.7 - Reading Science/Technical

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

11-12.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Environmental Sustainability (ES)

Lesson 2.1

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling.

Environmental Sustainability (ES)

Lesson 2.1

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 2.1

Next Generation Science Standards

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.ESS3.1 - Earth and Human Activity

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 2.1

Standards for Technological Literacy

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

18-9-12.J Students will develop an understanding of and be able to select and use transportation technologies.

J. Transportation plays a vital role in the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture.

Environmental Sustainability (ES)

Lesson 2.2

Common Core State Standards for English Language Arts

9-10.RST.1 - Reading Science/Technical

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.7 - Reading Science/Technical

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.7 - Reading Science/Technical

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

11-12.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Environmental Sustainability (ES)

Lesson 2.2

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling.

Environmental Sustainability (ES)

Lesson 2.2

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 2.2

Next Generation Science Standards

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Environmental Sustainability (ES)

Lesson 2.2

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

Environmental Sustainability (ES)

Lesson 2.3

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 2.3

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Biotechnology R & D Pathway Standard 6

Biotechnology R & D professionals are not isolated from the social effect of their products in our society. Science, technology and society are intertwined. Biotechnology R & D employees will be conversant with the larger ethical, moral and legal issues related to biotech research, product development and use in society.

Environmental Sustainability (ES)

Lesson 2.3

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching andgenerating ideas, identifying criteria and specifying constraints, exploring possibilities,selecting an approach, developing a design proposal, making a model or prototype,

8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

Environmental Sustainability (ES)

Lesson 2.4

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 2.4

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 2.4

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.W Students will develop an understanding of the core concepts of technology.

W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.

2.9-12.X Students will develop an understanding of the core concepts of technology..

X. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.

2.9-12.Y Students will develop an understanding of the core concepts of technology.

Y. The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria.

2.9-12.EE Students will develop an understanding of the core concepts of technology.

EE. Management is the process of planning, organizing, and controlling work.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural,political, and economic landscape.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.P Students will develop an understanding of and be able to select and use manufacturing technologies.

P. The interchangeability of parts increases the effectiveness of manufacturing processes.

20.9-12.J Students will develop an understanding of and be able to select and use construction technologies.

J. Infrastructure is the underlying base or basic framework of a system.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

20.9-12.M Students will develop an understanding of and be able to select and use construction technologies.

M. Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use.

20.9-12.N Students will develop an understanding of and be able to select and use construction technologies.

N. Structures can include prefabricated materials.

Environmental Sustainability (ES)

Lesson 3.1

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 3.1

National Health Science

Biotechnology R & D Pathway Standard 1

Biotechnology R & D professionals will understand that biotechnology products are based on molecular biology of disease and health; the quality of life through finding a cure for genetic, environmental and behavioral diseases, chronic conditions, industrial enzymes and new diagnostic tools; and legal and ethical issues to protect and preserve the quality of life, with emphasis on social and diversity issues.

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 3

Biotechnology R & D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (producing recombinant DNA products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 3.1

Next Generation Science Standards

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 3.1

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

4.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

14.9-12.K Students will develop an understanding of and be able to select and use medical technologies.

K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

14.9-12.M Students will develop an understanding of and be able to select and use medical technologies.

M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

15.9-12.K Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

K. Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

Environmental Sustainability (ES)

Lesson 3.2

Common Core State Standards for English Language Arts

9-10.RST.1 - Reading Science/Technical

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 3.2

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Environmental Sustainability (ES)

Lesson 3.2

National Health Science

Biotechnology R & D Pathway Standard 1

Biotechnology R & D professionals will understand that biotechnology products are based on molecular biology of disease and health; the quality of life through finding a cure for genetic, environmental and behavioral diseases, chronic conditions, industrial enzymes and new diagnostic tools; and legal and ethical issues to protect and preserve the quality of life, with emphasis on social and diversity issues.

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 3

Biotechnology R & D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (producing recombinant DNA products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Biotechnology R & D Pathway Standard 5

Biotechnology R & D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including; R & D at the lab bench level, both pre-clinical trials, clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing

Practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).

Biotechnology R & D Pathway Standard 6

Biotechnology R & D professionals are not isolated from the social effect of their products in our society. Science, technology and society are intertwined. Biotechnology R & D employees will be conversant with the larger ethical, moral and legal issues related to biotech research, product development and use in society.

Environmental Sustainability (ES)

Lesson 3.2

Next Generation Science Standards

HS.PS2.1 - Motion and Stability: Forces and Interactions

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS.LS1.1 - From Molecules to Organisms: Structures and Processes

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

HS.LS3.1 - Heredity: Inheritance and Variation of Traits

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 3.2

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

4.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

14.9-12.K Students will develop an understanding of and be able to select and use medical technologies.

K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

14.9-12.M Students will develop an understanding of and be able to select and use medical technologies.

M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

15.9-12.K Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

K. Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols,measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

Environmental Sustainability (ES)

Lesson 3.3

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 3.3

National Health Science

Support Services Pathway Standard 2

Support services professionals will adopt work practices that maintain a clean and healthy environment. They will demonstrate best practices to reduce or eliminate pathogenic organisms.

Biotechnology R & D Pathway Standard 1

Biotechnology R & D professionals will understand that biotechnology products are based on molecular biology of disease and health; the quality of life through finding a cure for genetic, environmental and behavioral diseases, chronic conditions, industrial enzymes and new diagnostic tools; and legal and ethical issues to protect and preserve the quality of life, with emphasis on social and diversity issues.

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 3

Biotechnology R & D professionals will be introduced to the following recombinant DNA and genetic engineering, bioprocessing (producing recombinant DNA products on a large scale for profit), monoclonal antibody production, separation and purification of biotechnology products, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Biotechnology R & D Pathway Standard 5

Biotechnology R & D professionals will have the knowledge of how the product is designed, and what is involved in its development and subsequent production, including the laboratory procedures and regulatory requirements. The employee will have a general understanding of the entire process in order to know how their scope of work contributes to the result including; R & D at the lab bench level, both pre-clinical trials, clinical trials (3 phases), product license application, regulatory process for clinical trials (current Good Manufacturing Practices [cGMPs], and Good Laboratory Practices [GLPs]) for production (cGMPs, GLPs).

Environmental Sustainability (ES)

Lesson 3.3

Next Generation Science Standards

HS.LS3.1 - Heredity: Inheritance and Variation of Traits

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Environmental Sustainability (ES)

Lesson 3.3

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

4.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

14.9-12.K Students will develop an understanding of and be able to select and use medical technologies.

K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals,medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

14.9-12.M Students will develop an understanding of and be able to select and use medical technologies.

M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

15.9-12.K Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

K. Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

Environmental Sustainability (ES)

Lesson 3.4

Common Core State Standards for English Language Arts

9-10.RST.1 - Reading Science/Technical

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.7 - Reading Science/Technical

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.2 - Reading Science/Technical

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

11-12.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Environmental Sustainability (ES)

Lesson 3.4

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 3.4

Next Generation Science Standards

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 3.4

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.Y Students will develop an understanding of the core concepts of technology.

Y. The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

4.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

14.9-12.K Students will develop an understanding of and be able to select and use medical technologies.

K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals,medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

14.9-12.M Students will develop an understanding of and be able to select and use medical technologies.

M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

15.9-12.K Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

K. Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.M Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.R Students will develop an understanding of and be able to select and use manufacturing technologies.

R. Marketing involves establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.

Environmental Sustainability (ES)

Lesson 4.1

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.7 - Reading Science/Technical

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.7 - Reading Science/Technical

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 4.1

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

G.GMD.3 - Geometric Measurement and Dimension

Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Environmental Sustainability (ES)

Lesson 4.1

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 4.1

Next Generation Science Standards

HS.LS1.5 - From Molecules to Organisms: Structures and Processes

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS.LS1.6 - From Molecules to Organisms: Structures and Processes

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS.LS1.7 - From Molecules to Organisms: Structures and Processes

Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ESS3.1 - Earth and Human Activity

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 4.1

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

16.9-12.K Students will develop an understanding of and be able to select and use energy and power technologies.

K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical,chemical, nuclear, and others.

16.9-12.M Students will develop an understanding of and be able to select and use energy and power technologies.

M. Energy resources can be renewable or nonrenewable.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

Environmental Sustainability (ES)

Lesson 4.2

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 4.2

Common Core State Standards for Mathematics

N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

F.BF.1.a - Building Functions

Determine an explicit expression, a recursive process, or steps for calculation from a context.

F.BF.1.b - Building Functions

Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

G.GMD.3 - Geometric Measurement and Dimension

Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Environmental Sustainability (ES)

Lesson 4.2

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 4.2

Next Generation Science Standards

HS.PS3.3 - Energy

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS.LS1.2 - From Molecules to Organisms: Structures and Processes

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS.LS2.4 - Ecosystems: Interactions, Energy, and Dynamics

Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ESS3.1 - Earth and Human Activity

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS.ESS3.2 - Earth and Human Activity

Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

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.ETS1.3 - Engineering Design

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.ETS1.4 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 4.2

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.W Students will develop an understanding of the core concepts of technology.

W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.

2.9-12.X Students will develop an understanding of the core concepts of technology.

X. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.

2.9-12.Y Students will develop an understanding of the core concepts of technology.

Y. The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria.

2.9-12.EE Students will develop an understanding of the core concepts of technology.

EE. Management is the process of planning, organizing, and controlling work.

3.9-12.H Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

14.9-12.M Students will develop an understanding of and be able to select and use medical technologies.

M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

16.9-12.K Students will develop an understanding of and be able to select and use energy and power technologies.

K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.

16.9-12.M Students will develop an understanding of and be able to select and use energy and power technologies.

M. Energy resources can be renewable or nonrenewable.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.O Students will develop an understanding of and be able to select and use manufacturing technologies.

O. Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.

19.9-12.P Students will develop an understanding of and be able to select and use manufacturing technologies.

P. The interchangeability of parts increases the effectiveness of manufacturing processes.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

20.9-12.J Students will develop an understanding of and be able to select and use construction technologies.

J. Infrastructure is the underlying base or basic framework of a system.

20.9-12.K Students will develop an understanding of and be able to select and use construction technologies.

K. Structures are constructed using a variety of processes and procedures.

20.9-12.L Students will develop an understanding of and be able to select and use construction technologies.

L. The design of structures includes a number of requirements.

20.9-12.M Students will develop an understanding of and be able to select and use construction technologies.

M. Structures require maintenance, alteration, or renovation periodically to improve them or to alter their intended use.

20.9-12.N Students will develop an understanding of and be able to select and use construction technologies.

N. Structures can include prefabricated materials.

Environmental Sustainability (ES)

Lesson 4.3

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.7 - Reading Science/Technical

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.7 - Reading Science/Technical

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

11-12.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Environmental Sustainability (ES)

Lesson 4.3

Common Core State Standards for Mathematics

N.Q.1 - Quantities

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Environmental Sustainability (ES)

Lesson 4.3

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 4.3

Next Generation Science Standards

HS.PS1.5 - Matter and Its Interactions

Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS.PS1.6 - Matter and Its Interactions

Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS.PS3.3 - Energy

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS.LS1.2 - From Molecules to Organisms: Structures and Processes

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS.LS1.3 - From Molecules to Organisms: Structures and Processes

Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS.LS1.6 - From Molecules to Organisms: Structures and Processes

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS.LS1.7 - From Molecules to Organisms: Structures and Processes

Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

HS.LS2.7 - Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS.LS4.6 - Biological Evolution: Unity and Diversity

Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS.ESS3.1 - Earth and Human Activity

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS.ESS3.2 - Earth and Human Activity

Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS.ETS1.3 - Engineering Design

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.

Environmental Sustainability (ES)

Lesson 4.3

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria.

2.9-12.EE Students will develop an understanding of the core concepts of technology.

EE. Management is the process of planning, organizing, and controlling work.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

7.9-12.G Students will develop an understanding of the influence of technology on history.

G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

16.9-12.K Students will develop an understanding of and be able to select and use energy and power technologies.

K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.

16.9-12.M Students will develop an understanding of and be able to select and use energy and power technologies.

M. Energy resources can be renewable or nonrenewable.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.O Students will develop an understanding of and be able to select and use manufacturing technologies.

O. Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

Environmental Sustainability (ES)

Lesson 4.4

Common Core State Standards for English Language Arts

9-10.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

9-10.RST.10 - Reading Science/Technical

By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

11-12.RST.3 - Reading Science/Technical

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

11-12.RST.10 - Reading Science/Technical

By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Environmental Sustainability (ES)

Lesson 4.4

National Health Science

Biotechnology R & D Pathway Standard 2

Biotechnology R & D professionals will be knowledgeable in the fundamentals of mathematical concepts, statistics, genetics, organic chemistry, biochemistry, cell biology, molecular biology and microbiology.

Biotechnology R & D Pathway Standard 4

Biotechnology R & D professionals will understand the principles of solution preparation such as molarity, pH, and dilution; sterile techniques such as inoculum development and transfer; knowledge of contamination control; and measurement and calibration of instruments such as micropipettes and pH meters. They will maintain a sanitary, safe and hazard free laboratory environment. Employees will be adept at teamwork, oral and written communication skills, problem solving, emergency lab response, and biosafety protocols.

Environmental Sustainability (ES)

Lesson 4.4

Standards for Technological Literacy

1.9-12.J Students will develop an understanding of the characteristics and scope of technology.

J. The nature and development of technological knowledge and processes are functions of the setting.

1.9-12.K Students will develop an understanding of the characteristics and scope of technology.

K. The rate of technological development and diffusion is increasing rapidly.

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research.

1.9-12.M Students will develop an understanding of the characteristics and scope of technology.

M. Most development of technologies these days is driven by the profit motive and the market.

2.9-12.W Students will develop an understanding of the core concepts of technology.

W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.

2.9-12.X Students will develop an understanding of the core concepts of technology..

X. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.

2.9-12.Y Students will develop an understanding of the core concepts of technology.

Y. The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop.

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.

2.9-12.AA Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.

2.9-12.CC Students will develop an understanding of the core concepts of technology.

CC. New technologies create new processes.

2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria.

2.9-12.EE Students will develop an understanding of the core concepts of technology.

EE. Management is the process of planning, organizing, and controlling work.

3.9-12.J Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.

4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies.

5.9-12.G Students will develop an understanding of the cultural, social, economic, and political effects of technology.

G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.

5.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.

5.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.

5.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.

5.9-12.K Students will develop an understanding of the cultural, social, economic, and political effects of technology.

K. Humans devise technologies to reduce the negative consequences of other technologies.

5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

6.9-12.I Students will develop an understanding of the role of society in the development and use of technology.

I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.

6.9-12.J Students will develop an understanding of the role of society in the development and use of technology.

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.

7.9-12.I Students will develop an understanding of the influence of technology on history.

I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

8.9-12.H Students will develop an understanding of the attributes of design.

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.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form.

8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.

9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors.

10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.

10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved.

10.9-12.K Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

K. Not all problems are technological, and not every problem can be solved using technology.

10.9-12.L Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

L. Many technological problems require a multidisciplinary approach.

11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it.

11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process.

11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process.

11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

12.9-12.M Students will develop the abilities to use and maintain technological products and systems.

M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.

12.9-12.N Students will develop the abilities to use and maintain technological products and systems.

N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.

12.9-12.O Students will develop the abilities to use and maintain technological products and systems.

O. Operate systems so that they function in the way they were designed.

12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

13.9-12.J Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality.

13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.

13.9-12.L Students will develop the abilities to assess the impact of products and systems.

L. Use assessment techniques, such as trend analysis and experimentation, to make decisions about the future development of technology.

13.9-12.M Students will develop the abilities to assess the impact of products and systems.

M. Design forecasting techniques to evaluate the results of altering natural systems.

15.9-12.L Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.

15.9-12.N Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.

16.9-12.M Students will develop an understanding of and be able to select and use energy and power technologies.

M. Energy resources can be renewable or nonrenewable.

17.9-12.M Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

17.9-12.N Students will develop an understanding of and be able to select and use information and communication technologies.

N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

19.9-12.O Students will develop an understanding of and be able to select and use manufacturing technologies.

O. Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.

19.9-12.P Students will develop an understanding of and be able to select and use manufacturing technologies.

P. The interchangeability of parts increases the effectiveness of manufacturing processes.

19.9-12.Q Students will develop an understanding of and be able to select and use manufacturing technologies.

Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.

19.9-12.R Students will develop an understanding of and be able to select and use manufacturing technologies.

R. Marketing involves establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.