

Everett School District Framework: Research in Science and Engineering

Course: Introduction to Science Research in Engineering

Total Framework Hours: 180 Hours

CIP Code: 149994

Type: Exploratory

Career Cluster: Science, Technology, Engineering and Mathematics

Date Last Modified: Friday, December 20, 2013

Resources and Standard used in Framework Development:

Standards used for this framework are taken from the Project Lead the Way "Engineering Design and Development" course.

Unit 1 INTRODUCTION TO EXPERIMENTAL/ENGINEERING DESIGN/DEFINE THE QUESTION AND PR

Hours: 36

Performance Assessment(s):

Students will:

Identify the design process steps used in given scenarios and be able to list the steps.

Explain the process used to organize a research project.

Apply engineering notebook standards and protocols when documenting work.

Define and demonstrate time management skills as related to his or her project.

Distinguish between when it is appropriate to use technical writing and expository writing styles.

Be able to speak to experts appropriately.

Ask valid questions that will be used to further the student's knowledge of the problem statement.

Write a problem statement as well as verify and justify the statement.

Document the project process in an engineering notebook.

Use strong oral and written skills to communicate with experts.

Study cases (articles supplied by the teacher) regarding research and development and its impact on the invention and innovation of products, processes, or services.

Create market research to investigate and determine the merit of their solution.

Self-assess their performance and research based on the goals for developing a solution to a problem.

Use a list of specifications and constraints identified in a decision matrix to develop a list of alternative solutions to the stated problem.

Research and identify patents related to their identified problem.

Conduct research to investigate and determine the merit of his or her alternative solution based on past solutions to the problem.

Explain the feasibility of his or her solution based on his or her research.

Develop research strategies for his or her solution, including the use of surveys, phone interviews, and personal contact with experts related to the field of his or her technical problem.

Create a matrix table to analyze the data found from the patent research.

Conduct research to identify the difference between innovation and invention.

Write a fictional scenario for an innovation of interest.

Discuss the pros and cons of a decision matrix.

Conduct research and perform a trend analysis on a technical problem.

Sketch one invention and one innovation related to the technical problem.

Create a description of the product specifications for the design solution.

Objectively evaluate proposed design solutions using specific criteria.

Select the best design solution option using a decision matrix.

Graphically represent the results of the design solution evaluation.

Leadership Alignment:

Student will develop a testable question/engineering problem and design an experiment/solution. They will work independently on this project by seeking out mentors to assist with project design and execution. Students will compete in local competitions.

Standards and Competencies

Part 1: Introduction to Experimental/ Engineering Design and Development

Part 2 : Introduction to Question/Problem Statement

Part 3: Question/Problem Identification – Verify and Justify the Problem

Part 4: Research – Research and Development

Aligned to Washington State Standards

Arts

Communication - Speaking and Listening

Health and Fitness

Language

Mathematics

CC: Mathematical Practices (MP)

- 1 - Make sense of problems and persevere in solving them.
- 2 - Reason abstractly and quantitatively.
- 3 - Construct viable arguments and critique the reasoning of others.
- 4 - Model with mathematics.
- 5 - Use appropriate tools strategically.
- 6 - Attend to precision.
- 7 - Look for and make use of structure.
- 8 - Look for and express regularity in repeated reasoning.

Reading

Science

Science and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Physical Sciences

HS-PS1 Matter and Its Interactions

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

- HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- HS-PS1-5. 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. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
- HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-PS2 Motion and Stability: Forces and Interactions

- HS-PS2-1. 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-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
- HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
- HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS3 Energy

- HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.
- HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in th
- HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

- HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.
- HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
- HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter
- HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Life Sciences

HS-LS1 From Molecules to Organisms: Structures and Processes

- HS-LS1-1. 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-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-6. 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. 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 Ecosystems: Interactions, Energy, and Dynamics

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3 Heredity: Inheritance and Variation of Traits

HS-LS3-1. 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-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS4 Biological Evolution: Unity and Diversity

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Earth and Space Sciences

HS-ESS1 Earth's Place in the Universe

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS2 Earth's Systems

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.
- HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

HS-ESS3 Earth and Human Activity

- HS-ESS3-1. 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. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Science Crosscutting Concepts

1. Patterns.
2. Cause and effect: Mechanism and explanation.
3. Scale, proportion, and quantity.
4. Systems and system models.
5. Energy and matter: Flows, cycles, and conservation.
6. Structure and function.
7. Stability and change.

Engineering, Technology, and Applications of Science

HS-ETS1 Engineering Design

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes (11-12)

WHST.11-12.1 Write arguments focused on discipline-specific content.

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons,

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that a

WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counter

WHST.11-12.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.11-12.1e Provide a concluding statement or section that follows from or supports the argument presented.

WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and mult

WHST.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

WHST.11-12.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as

Production and Distribution of Writing (11-12)

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge (11-12)

WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstratin

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate infor

WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing (11-12)

WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

21st Century Skills

LEARNING AND INNOVATION

Creativity and Innovation

- ☒ Think Creatively
- ☒ Work Creatively with Others
- ☐ Implement Innovations

Creative Thinking and Problem Solving

- ☒ Reason Effectively
- ☒ Use Systems Thinking
- ☒ Make Judgements and Decisions
- ☒ Solve Problems

Communication and Collaboration

- ☒ Communicate Clearly
- ☐ Collaborate with Others

INFORMATION, MEDIA AND TECHNOLOGY SKILLS

Information Literacy

- ☒ Access and Evaluate Information
- ☒ Use and Manage Information

Media Literacy

- ☒ Analyze Media
- ☐ Create Media Products

Information, Communications, and Technology (ICT Literacy)

- ☒ Apply Technology Effectively

LIFE AND CAREER SKILLS

Flexibility and Adaptability

- ☐ Adapt to Change
- ☐ Be Flexible

Initiative and Self-Direction

- ☒ Manage Goals and Time
- ☒ Work Independently
- ☒ Be Self-Directed Learners

Social and Cross-Cultural

- ☒ Interact Effectively with Others
- ☐ Work Effectively in Diverse Teams

Productivity and Accountability

- ☒ Manage Projects
- ☒ Produce Results

Leadership and Responsibility

- ☐ Guide and Lead Others
- ☐ Be Responsible to Others

Unit 2 RESEARCH PAST SOLUTIONS/EVIDENCE	Hours: 36
Performance Assessment(s):	
<p>Engineering Research:</p> <p>Sketch all parts of their design solution including an isometric view of the assembled product.</p> <p>Create a set of working drawings for their design solution.</p> <p>Interpret and apply the feedback they receive from experts to improve their design solution.</p> <p>Refine their design solution, if necessary, based upon expert feedback.</p> <p>Document the project's progress in their engineering notebooks.</p> <p>Use a list of specifications and constraints identified in a decision matrix to develop a list of alternative solutions to the stated problem.</p> <p>Research and identify patents related to their identified problem.</p> <p>Conduct research to investigate and determine the merit of his or her alternative solution based on past solutions to the problem.</p> <p>Explain the feasibility of his or her solution based on his or her research.</p> <p>Develop research strategies for his or her solution, including the use of surveys, phone interviews, and personal contact with experts related to the field of his or her technical problem.</p> <p>Create a matrix table to analyze the data found from the patent research.</p> <p>Conduct research to identify the difference between innovation and invention.</p> <p>Write a fictional scenario for an innovation of interest.</p> <p>Discuss the pros and cons of a decision matrix.</p> <p>Conduct research and perform a trend analysis on a technical problem.</p> <p>Sketch one invention and one innovation related to the technical problem.</p> <p>Select and describe a valid testing method that will be used to accurately evaluate their design solution's ability to solve their problem.</p> <p>Prepare a description of the testing method that will be used to valid the designed solution.</p> <p>Create a valid justification for the selected testing method.</p> <p>Devise a list of testing criteria that will be used to evaluate the success or failure of their prototype testing</p> <p>Identify, define, and implement needed modifications to their testing method based on expert feedback and their ongoing research.</p> <p>Science Research:</p> <p>Identify current researchers and research institutions relate directly to the investigative question.</p> <p>Outline current experimental approaches and laboratory techniques/tools that can be used to investigate the question.</p> <p>Specify experimental constraints the will inhabit the explanatory scope of the investigation</p> <p>Explain the feasibility of the investigation based on laboratory, budget, and time constraints.</p>	
Leadership Alignment:	
Student will develop a testable question/engineering problem and design an experiment/solution. They will work independently on this project by seeking out mentors to assist with project design and execution. Students will compete in local competitions.	
Standards and Competencies	
<p>Part 5: Research – Investigate Current and Past Solutions</p> <p>Part 6: Invent or Innovate</p> <p>Part 7: Decision Process – Defining Product Specifications</p>	

Aligned to Washington State Standards

Arts

Communication - Speaking and Listening

Health and Fitness

Language

Mathematics

Reading

CC: Reading for Literacy in Science and Technical Subjects

Key Ideas and Details (9-10)

RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

Craft and Structure (9-10)

RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas (9-10)

RST.9-10.7 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.

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

RST.9-10.9 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.

Range of Reading and Level of Text Complexity (9-10)

RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Key Ideas and Details (11-12)

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

RST.11-12.2 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.

RST.11-12.3 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.

Craft and Structure (11-12)

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Ideas (11-12)

RST.11-12.7 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.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Range of Reading and Level of Text Complexity (11-12)

RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.

Science

Physical Sciences

HS-PS1 Matter and Its Interactions

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

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HS-LS3 Heredity: Inheritance and Variation of Traits

HS-LS3-1. 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-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS4 Biological Evolution: Unity and Diversity

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Science Crosscutting Concepts

1. Patterns.

2. Cause and effect: Mechanism and explanation.
3. Scale, proportion, and quantity.
4. Systems and system models.
5. Energy and matter: Flows, cycles, and conservation.
6. Structure and function.
7. Stability and change.

Science and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Engineering, Technology, and Applications of Science

HS-ETS1 Engineering Design

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Earth and Space Sciences

HS-ESS1 Earth's Place in the Universe

- HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
- HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
- HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
- HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS2 Earth's Systems

- HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.
- HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

HS-ESS3 Earth and Human Activity

HS-ESS3-1. 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. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes (11-12)

WHST.11-12.1 Write arguments focused on discipline-specific content.

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons,

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that a

WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counter

WHST.11-12.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.11-12.1e Provide a concluding statement or section that follows from or supports the argument presented.

WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and mult

WHST.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

WHST.11-12.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as

WHST.11-12.2e Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing (11-12)

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge (11-12)

WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstratin

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate infor

WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing (11-12)

WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

21st Century Skills

LEARNING AND INNOVATION	INFORMATION, MEDIA AND TECHNOLOGY SKILLS	LIFE AND CAREER SKILLS
<p>Creativity and Innovation</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Think Creatively <input checked="" type="checkbox"/> Work Creatively with Others <input type="checkbox"/> Implement Innovations <p>Creative Thinking and Problem Solving</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Reason Effectively <input type="checkbox"/> Use Systems Thinking <input checked="" type="checkbox"/> Make Judgements and Decisions <input checked="" type="checkbox"/> Solve Problems <p>Communication and Collaboration</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Communicate Clearly <input checked="" type="checkbox"/> Collaborate with Others 	<p>Information Literacy</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Access and Evaluate Information <input checked="" type="checkbox"/> Use and Manage Information <p>Media Literacy</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Analyze Media <input type="checkbox"/> Create Media Products <p>Information, Communications, and Technology (ICT Literacy)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Apply Technology Effectively 	<p>Flexibility and Adaptability</p> <ul style="list-style-type: none"> <input type="checkbox"/> Adapt to Change <input type="checkbox"/> Be Flexible <p>Initiative and Self-Direction</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mange Goals and Time <input checked="" type="checkbox"/> Work Independently <input checked="" type="checkbox"/> Be Self-Directed Learners <p>Social and Cross-Cultural</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Interact Effectively with Others <input type="checkbox"/> Work Effectively in Diverse Teams <p>Productivity and Accountability</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Manage Projects <input checked="" type="checkbox"/> Produce Results <p>Leadership and Responsibility</p> <ul style="list-style-type: none"> <input type="checkbox"/> Guide and Lead Others <input type="checkbox"/> Be Responsible to Others

Unit 3 DESIGNING, BUILDING, AND TESTING	Hours: 36
Performance Assessment(s): Students will: Sketch all parts of their experimental/design solution Create a set of working drawings for their design solution. Label parts of the experimental set-up related to the veracity of results Interpret and apply the feedback they receive from experts to improve their experimental set-up/design solution. Refine their design solution, if necessary, based upon expert feedback. Document the project's progress in their engineering notebooks. Gather data and information compiled throughout the project and create a technical research paper, PowerPoint, and three panel display of their design solution. Create a website, if they choose, in order to depict all aspects of their design solution. Choose one of the formats used to depict the design solution, such as technical reseach paper, PowerPoint, three panel display, or website, if created, for the presentation of the solution to their chosen problem. Identify safe practices for the use of tools and equipment. Create a detailed set of instructions for producing a testable prototype based on the information gained through their research. Identify methods and sources for obtaining materials and supplies. Compile a materials list that includes vendors and cost for all necessary materials and equipment to build their prototype. Write a step-by-step procedure for the assembly of their prototype. Build a working prototype that can be tested. Select and describe a valid testing method that will be used to accurately evaluate their design solution's ability to solve their problem. Prepare a description of the testing method that will be used to valid the designed solution. Create a valid justification for the selected testing method. Devise a list of testing criteria that will be used to evaluate the success or failure of their prototype testing Identify, define, and implement needed modifications to their testing method based on expert feedback and their ongoing research. Document their project's progress in their engineer's notebook. Identify safe practices for scientific tools and equipment. Create a detailed procedure for testing questions based on information gained through research Compile a list of materials and laboratory specifications Verify ability to maintain control variables at a constant state.	
Leadership Alignment:	
Student will develop a testable question/engineering problem and design an experiment/solution. They will work independently on this project by seeking out mentors to assist with project design and execution. Students will compete in local competitions.	
Standards and Competencies	

Aligned to Washington State Standards

Arts

Communication - Speaking and Listening

Health and Fitness

Language

Mathematics

CC: Mathematical Practices (MP)

- 1 - Make sense of problems and persevere in solving them.
- 2 - Reason abstractly and quantitatively.
- 3 - Construct viable arguments and critique the reasoning of others.
- 4 - Model with mathematics.
- 5 - Use appropriate tools strategically.
- 6 - Attend to precision.
- 7 - Look for and make use of structure.
- 8 - Look for and express regularity in repeated reasoning.

Reading

Science

Physical Sciences

HS-PS1 Matter and Its Interactions

- HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- HS-PS1-5. 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. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
- HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-PS2 Motion and Stability: Forces and Interactions

- HS-PS2-1. 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-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS3 Energy

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in th

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Life Sciences

HS-LS1 From Molecules to Organisms: Structures and Processes

HS-LS1-1. 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-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-6. 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. 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 Ecosystems: Interactions, Energy, and Dynamics

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3 Heredity: Inheritance and Variation of Traits

HS-LS3-1. 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-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

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HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Earth and Space Sciences

HS-ESS1 Earth's Place in the Universe

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

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HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS2 Earth's Systems

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

HS-ESS3 Earth and Human Activity

HS-ESS3-1. 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. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

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Engineering, Technology, and Applications of Science

HS-ETS1 Engineering Design

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practices

1. Asking questions and defining problems
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3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
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8. Obtaining, evaluating, and communicating information

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6. Structure and function.
7. Stability and change.

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes (11-12)

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that a

Production and Distribution of Writing (11-12)

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge (11-12)

WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating

Range of Writing (11-12)

21st Century Skills

LEARNING AND INNOVATION

Creativity and Innovation

- ☒ Think Creatively
- ☒ Work Creatively with Others
- ☒ Implement Innovations

Creative Thinking and Problem Solving

- ☒ Reason Effectively
- ☒ Use Systems Thinking
- ☒ Make Judgements and Decisions
- ☒ Solve Problems

Communication and Collaboration

- ☒ Communicate Clearly
- ☒ Collaborate with Others

INFORMATION, MEDIA AND TECHNOLOGY SKILLS

Information Literacy

- ☒ Access and Evaluate Information
- ☒ Use and Manage Information

Media Literacy

- ☐ Analyze Media
- ☒ Create Media Products

Information, Communications, and Technology (ICT Literacy)

- ☒ Apply Technology Effectively

LIFE AND CAREER SKILLS

Flexibility and Adaptability

- ☐ Adapt to Change
- ☐ Be Flexible

Initiative and Self-Direction

- ☒ Manage Goals and Time
- ☒ Work Independently
- ☒ Be Self-Directed Learners

Social and Cross-Cultural

- ☒ Interact Effectively with Others
- ☒ Work Effectively in Diverse Teams

Productivity and Accountability

- ☒ Manage Projects
- ☒ Produce Results

Leadership and Responsibility

- ☒ Guide and Lead Others
- ☒ Be Responsible to Others

Unit 4 INVESTIGATE/ TEST	Hours: 36
Performance Assessment(s):	
<p>Students will:</p> <p>Create a detailed set of instructions for testing the prototype that will be valid, repeatable, and reliable.</p> <p>Apply the appropriate statistical analysis tools to the test results to ensure validity.</p> <p>Identify, define, and implement necessary modifications to their design based upon their test results.</p> <p>Identify how their solution has removed obsolescence of the original product, if appropriate.</p> <p>Evaluate and explain the effectiveness of their design at solving the problem they have defined.</p> <p>Document the test results and project progress in their engineering notebooks.</p> <p>Conduct the scientific investigation following the intended procedure</p> <p>Identify experimental elements that may affected the data's veracity.</p> <p>Determine if the procedure matched experimental specifications.</p> <p>Choose a means of depicting the results graphically and statistically that conform to the data needed to answer the investigative question.</p> <p>Document the experimental results in scientific journal</p> <p>Analyze results and write a detailed conclusion to the experimental question.</p>	
Leadership Alignment:	
<p>Student will develop a testable question/engineering problem and design an experiment/solution. They will work independently on this project by seeking out mentors to assist with project design and execution. Students will compete in local competitions.</p>	
Standards and Competencies	

Aligned to Washington State Standards
Arts
Communication - Speaking and Listening
Health and Fitness
Language
Mathematics
<p><u>CC: Mathematical Practices (MP)</u></p> <p>1 - Make sense of problems and persevere in solving them.</p> <p>2 - Reason abstractly and quantitatively.</p> <p>3 - Construct viable arguments and critique the reasoning of others.</p> <p>4 - Model with mathematics.</p> <p>5 - Use appropriate tools strategically.</p> <p>6 - Attend to precision.</p> <p>7 - Look for and make use of structure.</p> <p>8 - Look for and express regularity in repeated reasoning.</p>

Reading

CC: Reading for Literacy in Science and Technical Subjects

Key Ideas and Details (9-10)

RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3 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.

Key Ideas and Details (11-12)

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

Science

Physical Sciences

HS-PS1 Matter and Its Interactions

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-5. 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. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-PS2 Motion and Stability: Forces and Interactions

HS-PS2-1. 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-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

HS-PS3 Energy

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in th

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Earth and Space Sciences

HS-ESS1 Earth's Place in the Universe

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS2 Earth's Systems

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

HS-ESS3 Earth and Human Activity

HS-ESS3-1. 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. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Science and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking

6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Science Crosscutting Concepts

1. Patterns.
2. Cause and effect: Mechanism and explanation.
3. Scale, proportion, and quantity.
4. Systems and system models.
5. Energy and matter: Flows, cycles, and conservation.
6. Structure and function.
7. Stability and change.

Engineering, Technology, and Applications of Science

HS-ETS1 Engineering Design

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Life Sciences

HS-LS1 From Molecules to Organisms: Structures and Processes

- HS-LS1-1. 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-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS-LS1-6. 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. 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 Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3 Heredity: Inheritance and Variation of Traits

HS-LS3-1. 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-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS4 Biological Evolution: Unity and Diversity

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes (11-12)

WHST.11-12.1 Write arguments focused on discipline-specific content.

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons,

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that a

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and mult

WHST.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

WHST.11-12.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as

WHST.11-12.2e Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing (11-12)

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge (11-12)

WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstratin

Range of Writing (11-12)

WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

21st Century Skills

LEARNING AND INNOVATION

Creativity and Innovation

- ☒ Think Creatively
- ☒ Work Creatively with Others
- ☐ Implement Innovations

Creative Thinking and Problem Solving

- ☒ Reason Effectively
- ☒ Use Systems Thinking
- ☐ Make Judgements and Decisions
- ☒ Solve Problems

Communication and Collaboration

- ☐ Communicate Clearly
- ☐ Collaborate with Others

INFORMATION, MEDIA AND TECHNOLOGY SKILLS

Information Literacy

- ☒ Access and Evaluate Information
- ☒ Use and Manage Information

Media Literacy

- ☐ Analyze Media
- ☐ Create Media Products

Information, Communications, and Technology (ICT Literacy)

- ☒ Apply Technology Effectively

LIFE AND CAREER SKILLS

Flexibility and Adaptability

- ☐ Adapt to Change
- ☐ Be Flexible

Initiative and Self-Direction

- ☒ Manage Goals and Time
- ☒ Work Independently
- ☒ Be Self-Directed Learners

Social and Cross-Cultural

- ☒ Interact Effectively with Others
- ☒ Work Effectively in Diverse Teams

Productivity and Accountability

- ☒ Manage Projects
- ☐ Produce Results

Leadership and Responsibility

- ☒ Guide and Lead Others
- ☒ Be Responsible to Others

Unit 5 PRESENT	Hours: 36
Performance Assessment(s):	
Students will: Identify appropriate techniques for delivering formal presentations. Orally present an effective scientific/technical presentation on the chosen design solution. Write a resume to prepare for an interview in college or the workforce. Update their portfolio with accompanying resume as professional documentation of their knowledge and skills and work completed in this course.	
Leadership Alignment:	
Student will develop a testable question/engineering problem and design an experiment/solution. They will work independently on this project by seeking out mentors to assist with project design and execution. Students will compete in local competitions.	
Standards and Competencies	
Part 12: Presentation – Project Documentation Part 13: Presentation – Juried Presentation	
Aligned to Washington State Standards	
Arts	
Communication - Speaking and Listening	
Health and Fitness	
Language	
Mathematics	
Reading	
Science	
<u>Physical Sciences</u> <u>HS-PS1 Matter and Its Interactions</u> HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS-PS1-5. 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. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. <u>HS-PS2 Motion and Stability: Forces and Interactions</u>	

- HS-PS2-1. 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.
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HS-LS3-1. 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-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

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HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (11-12)

Text Types and Purposes (11-12)

WHST.11-12.1 Write arguments focused on discipline-specific content.

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons,

WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that a

WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counter

WHST.11-12.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.11-12.1e Provide a concluding statement or section that follows from or supports the argument presented.

WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and mult

WHST.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

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WHST.11-12.2e Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing (11-12)

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

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Research to Build and Present Knowledge (11-12)

WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstratin

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate infor

WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing (11-12)

WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

21st Century Skills		
<p>LEARNING AND INNOVATION</p> <p>Creativity and Innovation</p> <p><input checked="" type="checkbox"/> Think Creatively</p> <p><input type="checkbox"/> Work Creatively with Others</p> <p><input type="checkbox"/> Implement Innovations</p> <p>Creative Thinking and Problem Solving</p> <p><input checked="" type="checkbox"/> Reason Effectively</p> <p><input type="checkbox"/> Use Systems Thinking</p> <p><input checked="" type="checkbox"/> Make Judgements and Decisions</p> <p><input checked="" type="checkbox"/> Solve Problems</p> <p>Communication and Collaboration</p> <p><input checked="" type="checkbox"/> Communicate Clearly</p> <p><input type="checkbox"/> Collaborate with Others</p>	<p>INFORMATION, MEDIA AND TECHNOLOGY SKILLS</p> <p>Information Literacy</p> <p><input type="checkbox"/> Access and Evaluate Information</p> <p><input checked="" type="checkbox"/> Use and Manage Information</p> <p>Media Literacy</p> <p><input type="checkbox"/> Analyze Media</p> <p><input checked="" type="checkbox"/> Create Media Products</p> <p>Information, Communications, and Technology (ICT Literacy)</p> <p><input checked="" type="checkbox"/> Apply Technology Effectively</p>	<p>LIFE AND CAREER SKILLS</p> <p>Flexibility and Adaptability</p> <p><input checked="" type="checkbox"/> Adapt to Change</p> <p><input checked="" type="checkbox"/> Be Flexible</p> <p>Initiative and Self-Direction</p> <p><input checked="" type="checkbox"/> Mange Goals and Time</p> <p><input type="checkbox"/> Work Independently</p> <p><input checked="" type="checkbox"/> Be Self-Directed Learners</p> <p>Social and Cross-Cultural</p> <p><input checked="" type="checkbox"/> Interact Effectively with Others</p> <p><input type="checkbox"/> Work Effectively in Diverse Teams</p> <p>Productivity and Accountability</p> <p><input checked="" type="checkbox"/> Manage Projects</p> <p><input type="checkbox"/> Produce Results</p> <p>Leadership and Responsibility</p> <p><input type="checkbox"/> Guide and Lead Others</p> <p><input type="checkbox"/> Be Responsible to Others</p>