



Spokane Public Schools Engineering by Design Year 1

Course: Engineering by Design Year 1		Total Framework Hours up to: 180 hours
CIP Code: 140102	<input checked="" type="checkbox"/> Exploratory <input type="checkbox"/> Preparatory	Date Last Modified: 1/29/2015
Career Cluster: STEM		Cluster Pathway: Engineering & Technology

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Develop a timeline of a major technological achievement
- Create a poster highlighting representative artifacts and processes from one of the technological time periods
- Develop a research report on the historical impact of a selected technological advancement
- Write a newspaper opinion column
- Design and fabricate a bulletin board display
- Research and develop a multimedia presentation on a selected twentieth century scientific advancement

Leadership Alignment:

Classroom Focus:

- History of technology presentations
- Connections and politics of technology

<p>LEARNING & INNOVATION</p> <p>Creativity and Innovation</p> <p><input type="checkbox"/> Think Creatively</p> <p><input checked="" type="checkbox"/> Work Creatively with Others</p> <p><input type="checkbox"/> Implement Innovations</p> <p>Critical Thinking and Problem Solving</p> <p><input type="checkbox"/> Reason Effectively</p> <p><input type="checkbox"/> Use Systems Thinking</p> <p><input checked="" type="checkbox"/> Make Judgments and Decisions</p> <p><input type="checkbox"/> Solve Problems</p> <p>Communication and Collaboration</p> <p><input checked="" type="checkbox"/> Communicate Clearly</p> <p><input checked="" type="checkbox"/> Collaborate with Others</p>	<p>INFORMATION, MEDIA & TECHNOLOGY SKILLS</p> <p>Information Literacy</p> <p><input type="checkbox"/> Access and /evaluate Information</p> <p><input type="checkbox"/> Use and Manage Information</p> <p>Media Literacy</p> <p><input type="checkbox"/> Analyze Media</p> <p><input 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 & CAREER SKILLS</p> <p>Flexibility and Adaptability</p> <p><input type="checkbox"/> Adapt to Change</p> <p><input type="checkbox"/> Be Flexible</p> <p>Initiative and Self-Direction</p> <p><input type="checkbox"/> Manage Goals and Time</p> <p><input type="checkbox"/> Work Independently</p> <p><input type="checkbox"/> Be Self-Directed Learners</p> <p>Social and Cross-Cultural</p> <p><input type="checkbox"/> Interact Effectively with Others</p> <p><input type="checkbox"/> Work Effectively in Diverse Teams</p> <p>Productivity and Accountability</p> <p><input type="checkbox"/> Manage Projects</p> <p><input type="checkbox"/> Produce Results</p> <p>Leadership and Responsibility</p> <p><input checked="" type="checkbox"/> Guide and Lead Others</p>
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Be Responsible to Others

Standards and Competencies

Standard/Unit: Technology: History and Connections

Knowledge of the history of technology helps people understand the world around them by seeing how people of all times and places have increased their capability by using their unique skills to innovate improvise and invent.

Understanding that interrelationships exist among technologies and between technology and other fields of study enhances our ability to use, assess, design, and produce technology.

Competencies

Total Learning Hours for Unit: 25 hours

- Explain why, early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how.
- Explain that most technological development has been evolutionary, the result of a series of refinements to a basic invention.
- Describe how the evolution of civilization has been directly affected by, and has in turn affected the development of tools and materials.
- Describe anticipated positive and negative impacts as well as the unanticipated positive and negative impacts of technological innovations.
- Conduct effective and focused research.
- Use computers and calculators to access, retrieve, organize, and evaluate data and information in order to communicate.
- Present research findings effectively using instructional technology.
- Explain mathematical functions (linear, quadratic, or exponential) and how they may represent an aspect of technological change.
- Work safely and accurately with a variety of tools, machines, and materials.
- Demonstrate curiosity, exhibit motivation for learning, and use class time effectively.
- Exhibit and refine inherent personal qualities such as creativity and resourcefulness.
- Describe the strong relationship between technology and the study of science.
- Express that mathematical concepts such as the use of measurements, symbols, estimation, accuracy, and the idea of scaling and proportion are key to the development of technology.
- Explain that technology transfer occurs when a new user applies an existing innovation developed for one purpose to a different function.
- Explain that ideas are sometimes protected through the process of patenting.
- Explain that technology usually affects society more directly than science because it solves practical problems and serves human needs (and may create new problems and needs).
- Conduct effective and focused research.
- Actively participate in group discussions, ideation exercises, and debates.

Aligned Washington State Standards

Arts	
Education Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 2.1: Practice Safety: Practice safe, legal and ethical behavior in the use of information and technology. 2.2: Operate Systems: Understand technology systems and use hardware and networks to support learning. 2.4: Adapt to Change (Technology Fluency): Transfer current knowledge to new and emerging technologies.
Health and Fitness	
Language	
Math	
Reading	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. RST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Science	
Social Studies	2.4 Understands the economic issues and problems that all societies face. 3.2 Understands human interaction with the environment. 4.1 Understands historical chronology. 4.4 Uses history to understand the present and plan for the future.
Speaking and Listening	SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i> , building on others’ ideas and expressing their own clearly and persuasively. SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
Writing	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Develop an oral presentation on one of the “Greatest Engineering Achievements of the Twentieth century.”
- Use the engineering design process to solve a problem
- Reverse-engineer a product
- Conduct research and write a newspaper article
- Create a timeline on the development and impact of a material

Leadership Alignment:

Classroom Focus:

- Brainstorming: select best solution
- Design, test, redesign
- Design and needs analysis
- Decision matrices
- Projects
- Project research
- Needs analysis
- CAD Design
- Find Product
- Engineering Notebook

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

Standard/Unit: Engineering Design
Engineering-the systematic application of mathematical, scientific, and technical principles-produces tangible end products that meet our needs and desires.

Competencies	Total Learning Hours for Unit: 90 hours
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- Describe the types of engineering disciplines.
- Explain the impact of constraints on the engineering-design process.
- Explain the role of project management in engineering enterprises.
- Analyze the functioning of the engineering resources (core technologies) in the designed world in terms of common components, basic system design, safety, simple controls, and system performance evaluation.
- Compare and contrast the properties of materials.
- Design and create tables, charts, and graphs to communicate and analyze data.
- Apply the engineering-design process to the solution of a problem.
- Explain that ideas are sometimes protected through the process of patenting.
- Troubleshoot mechanical and electrical systems.
- Describe what engineers do.
- Describe the personal characteristics involved in engineering.
- Describe the resources used in the engineering-design process.
- Explain that the design process is a systematic, iterative approach to problem solving that yields design solutions.
- Explain why designs need to be continually critiqued and refined.
- Work safely and accurately with a variety of tools, machines, and materials.
- Actively participate in group discussions, ideation exercise, and debates.

Aligned Washington State Standards

Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 2.1: Practice Safety: Practice safe, legal and ethical behavior in the use of information and technology. 2.2: Operate Systems: Understand technology systems and use hardware and networks to support learning.

	2.4: Adapt to Change (Technology Fluency): Transfer current knowledge to new and emerging technologies.
Health and Fitness	
Language	
Math	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.
Reading	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. RST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Science	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 impacts. 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. 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-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-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.*
Social Studies	
Speaking and Listening	SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i> , building on others' ideas and expressing their own clearly and persuasively. SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
Writing	
COMPONENTS AND ASSESSMENTS	
Performance Assessments:	
<ul style="list-style-type: none"> • Research, design, and fabricate a display depicting a primary manufacturing process • Develop a concept map that illustrates the common attributes of an integrated manufacturing process • Design and fabricate a three-dimensional model or display panel that illustrates the processing of the material 	

Leadership Alignment:
 Classroom Focus:

- Manufacturing tours (professional conduct norms)
- Manufacturing systems and sub systems, team assembly and learn

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

Standard/Unit: Manufacturing Technologies
 Modern Manufacturing technologies produce quality goods at low prices, enhancing the quality of life for many people.

Competencies **Total Learning Hours for Unit: 20 hours**

- Analyze manufacturing processes including designing, developing, producing, and servicing.
- Describe mechanical processes that change the form of materials including separating, forming, combining, and conditioning.
- Classify manufacturing systems as being customized production, batch production, or continuous production.
- Describe how the interchangeability of parts increase the effectiveness of a manufacturing process.
- Research and report on applications of biotechnology such as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.
- Analyze the role information and communication systems play in the operation of manufacturing and agricultural enterprises.
- Explain that intermodalism is the use of different modes of transportation in an interconnected system that moves people and goods.

Aligned Washington State Standards

Arts	
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Health and Fitness	
Language	
Math	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.
Reading	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. RST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Science	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 impacts. 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. 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-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-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-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
Social Studies	
Speaking and Listening	SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i> , building on others' ideas and expressing their own clearly and persuasively. SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
Writing	
COMPONENTS AND ASSESSMENTS	
Performance Assessments:	
<ul style="list-style-type: none"> • Research and develop a multimedia presentation on construction • Create a structural model, test a design, and optimize the design of a truss bridge 	

- Develop a display documenting the design process for their bridge

Leadership Alignment:

Classroom Focus:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & 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 & 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

Standards and Competencies

Standard/Unit: Construction Technology-SAFETY UNIT

Construction is the systematic process of erecting structures to meet human needs and desires. It reflects cultural norms, environmental conditions, and the requirements of enterprises and institutions.

Competencies

Total Learning Hours for Unit: 10 hours

- Identify and describe heavy engineering structures.
- Identify and describe types of buildings.
- Describe the major processes and procedures used to create buildings.
- Analyze construction business activity using a table.
- Conduct research.
- Develop a multimedia presentation.
- Calculate the efficiency of a structure.
- Create a structural model, test a design, and optimize a design.
- List and describe the functions of management.
- Develop a flowchart for a construction project.
- Describe the tasks that a construction manager must be able to perform.

- Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.

Aligned Washington State Standards

Arts	
Educational Technology	
Health and Fitness	
Language	
Math	
Reading	
Science	
Social Studies	
Speaking and Listening	<p>SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.</p> <p>SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>
Writing	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Design a web page on “electrification and Quality of life.”
- Research and present an oral report on automobile energy sources and attitudes toward energy use from 2000 to 2050
- Conduct a mock hearing (Debate) of the US Senate Committee for Energy and Natural Resources

Leadership Alignment:

Classroom Focus:

1. Power grid research

<p>LEARNING & INNOVATION</p> <p>Creativity and Innovation</p> <p><input type="checkbox"/> Think Creatively</p> <p><input type="checkbox"/> Work Creatively with Others</p> <p><input type="checkbox"/> Implement Innovations</p> <p>Critical Thinking and Problem Solving</p> <p><input type="checkbox"/> Reason Effectively</p> <p><input type="checkbox"/> Use Systems Thinking</p> <p><input type="checkbox"/> Make Judgments and Decisions</p> <p><input type="checkbox"/> Solve Problems</p>	<p>INFORMATION, MEDIA & TECHNOLOGY SKILLS</p> <p>Information Literacy</p> <p><input type="checkbox"/> Access and /evaluate Information</p> <p><input type="checkbox"/> Use and Manage Information</p> <p>Media Literacy</p> <p><input type="checkbox"/> Analyze Media</p> <p><input 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 & CAREER SKILLS</p> <p>Flexibility and Adaptability</p> <p><input type="checkbox"/> Adapt to Change</p> <p><input type="checkbox"/> Be Flexible</p> <p>Initiative and Self-Direction</p> <p><input type="checkbox"/> Manage Goals and Time</p> <p><input type="checkbox"/> Work Independently</p> <p><input type="checkbox"/> Be Self-Directed Learners</p> <p>Social and Cross-Cultural</p> <p><input type="checkbox"/> Interact Effectively with Others</p>
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Communication and Collaboration <input type="checkbox"/> Communicate Clearly <input type="checkbox"/> Collaborate with Others		<input type="checkbox"/> Work Effectively in Diverse Teams Productivity and Accountability <input type="checkbox"/> Manage Projects <input type="checkbox"/> Produce Results Leadership and Responsibility <input type="checkbox"/> Guide and Lead Others <input type="checkbox"/> Be Responsible to Others
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Standards and Competencies

Standard/Unit: Power and Energy

Advancements in the processing and controlling of energy resources have been an enabling factor in the development of technology.

Competencies

Total Learning Hours for Unit: 25 hours

- Define and differentiate energy, power, instrumentation, and control.
- Differentiate between kinetic and potential energy.
- Identify and describe the major sources of energy.
- Describe energy conversion processes using a systems model.
- Describe how alternative forms a energy may be used in the future.
- Explain how electric motors operate.
- Explain how engines convert energy into mechanical force and motion.
- Describe how power is transmitted.
- Explain the production, conversion, transmission, and application of different forms of energy including mechanical, radiant, chemical, thermal, electrical, and nuclear.
- Explain that energy cannot be created nor destroyed; however, it can be converted from one form to another.
- Analyze power systems, identifying the source of energy, the process, and loads.

Aligned Washington State Standards

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Health and Fitness	
Language	
Math	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.
Reading	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. RST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Science	<p>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.</p> <p>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.</p> <p>HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p>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.</p> <p>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.*</p> <p>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.</p> <p>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.*</p> <p>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.*</p> <p>HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*</p>	
Social Studies		
Speaking and Listening	<p>SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively.</p> <p>SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.</p> <p>SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p>	
Writing		
COMPONENTS AND ASSESSMENTS		
<p>Performance Assessments:</p> <ul style="list-style-type: none"> • Solve and Engineering-Design problem and optimize the design using simulation and mathematical modeling • Develop a product using a systems-thinking development process • Write a letter to a student who will take the same course the next semester that “summarizes the material covered, topics and strategies that were worthwhile, and those that cause problems and provide a general introductions to the course.” 		
<p>Leadership Alignment: Classroom Focus:</p> <ul style="list-style-type: none"> • Find environmental projects • Environmental Project energy transfer 		
LEARNING & INNOVATION Creativity and Innovation	INFORMATION, MEDIA & TECHNOLOGY SKILLS Information Literacy	LIFE & CAREER SKILLS Flexibility and Adaptability

<input type="checkbox"/> Think Creatively <input type="checkbox"/> Work Creatively with Others <input type="checkbox"/> Implement Innovations Critical Thinking and Problem Solving <input type="checkbox"/> Reason Effectively <input type="checkbox"/> Use Systems Thinking <input type="checkbox"/> Make Judgments and Decisions <input type="checkbox"/> Solve Problems Communication and Collaboration <input checked="" type="checkbox"/> Communicate Clearly <input checked="" type="checkbox"/> Collaborate with Others	<input type="checkbox"/> Access and /evaluate Information <input type="checkbox"/> Use and Manage Information Media Literacy <input type="checkbox"/> Analyze Media <input type="checkbox"/> Create Media Products Information, Communications and Technology (ICT Literacy) <input type="checkbox"/> Apply Technology Effectively	<input type="checkbox"/> Adapt to Change <input type="checkbox"/> Be Flexible Initiative and Self-Direction <input checked="" type="checkbox"/> Manage Goals and Time <input type="checkbox"/> Work Independently <input type="checkbox"/> Be Self-Directed Learners Social and Cross-Cultural <input type="checkbox"/> Interact Effectively with Others <input type="checkbox"/> Work Effectively in Diverse Teams Productivity and Accountability <input type="checkbox"/> Manage Projects <input type="checkbox"/> Produce Results Leadership and Responsibility <input checked="" type="checkbox"/> Guide and Lead Others <input type="checkbox"/> Be Responsible to Others
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Standards and Competencies

Standard/Unit: Systems Thinking: “Putting It All Together”

Systems-thinking principles provide a conceptual base for addressing the complex issues that confront us by providing ways of viewing the world as a whole and using that view to find the leverage points for fundamental change.

Competencies

Total Learning Hours for Unit: 10 hours

- Explain that systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.
- Explain that a trade-off is a decision process recognizing the need for careful compromises among competing factors.
- Explain that optimization is the process used to make a design or system as effective as possible within the given criteria (desired specifications) and constraints (limits on the design process).
- Explain that “quality control” is a planned process designed to ensure that a product, service, or system meets established criteria and is sometimes based on international standards.
- Explain that complex systems have many layers of controls and feedback loops to provided information and about a system.
- Describe how stimulation and mathematical modeling are useful in enhancing or optimizing designs.
- Explain that, when systems thinking is applied to the design and developmental process, potentially costly conflicts and incompatibilities can be avoided.
- Explain that applying systems thinking to the design and development requires managers to address societal, environmental, and economic impacts throughout the process.
- Apply systems-thinking principles to the engineering design process.
- Explain some of the techniques used in modern manufacturing technologies that produce quality goods at low process, enhancing the quality of life for many people.

Aligned Washington State Standards

Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 2.1: Practice Safety: Practice safe, legal and ethical behavior in the use of information and technology. 2.2: Operate Systems: Understand technology systems and use hardware and networks to support learning.

	2.4: Adapt to Change (Technology Fluency): Transfer current knowledge to new and emerging technologies.
Health and Fitness	
Language	
Math	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.
Reading	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. RST 11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Science	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 impacts. 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. 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-PS3-5 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-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-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-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
Social Studies	
Speaking and Listening	SL 11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i> , building on others' ideas and expressing their own clearly and persuasively. SL 11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SL 11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. SL 11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
Writing	

21st Century Skills

Check those that students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & 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 & 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