Spokane Public Schools
Engineering by Design Year 2

Course: Engineering by Design Yr 2		**Total Framework Hours up to: 180**
CIP Code: 140102	☒**Exploratory** ☐**Preparatory**	**Date Last Modified: 1/30/2015**
Career Cluster: STEM		**Cluster Pathway: Engineering & Technology**

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- accurately and proficiently recognizes, clarifies, and analyzes design problems
- identifying and applying design principles to a problem
- Describing the influences that impact design solutions as well as describe and use the engineering design process to solve a problem.

Leadership Alignment:

Think Creatively
Make Judgments and Decisions
Solve Problems
Access and evaluate information
Use and manage information
Adapt to Change
Manage Goals and Time
Be Self-Directed Learners
Manage Projects
Produce Results
Guide and Lead Others

Classroom Focus:

Engineering Notebooks-Brainstorm Results, Decision Matrix Evaluation
Reflective Lessons Learned
Project Opportunity
Time Management Tools
Library Research
Needs Analysis
Team Collaboration

Standards and Competencies

Standard/Unit: Principles of Design

There are fundamental principles that impact human thinking and actions when engaged in the process of designing technological products. A combination of personal qualities such as creativity and resourcefulness and design constraints imposed by numerous factors are employed in a formal process to create new or refined technologies.

Competencies	**Total Learning Hours for Unit: 45 hours**

• Recognize, analyze, and clarify specific engineering design problems using unique principles employed by engineers and technologists. • Identify specific principles of design used in engineering and use them appropriately and effectively. • Recognize, describe, and address the influences that impact a final design in contemporary market economies. • Describe and use a formal engineering design process to address a specific design brief.	
Aligned Washington State Standards	
Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 1.2: Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. 1.3: Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources. 2.1: Practice Safety: Practice safe, legal and ethical behavior in the use of information and technology. 2.3: Select and Use Applications: Use productivity tools and common applications effectively and constructively. 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-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-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-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.
Social Studies	
Speaking and Listening	

Writing	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Identifying and describing “core technologies” when analyzing technological systems/products
- using math and science resources to perform key calculations
- describing and analyzing diverse systems as part of a technology transfer
- Describing and using the U.S. patent process.

Leadership Alignment:

Use Systems Thinking
Make Judgments and Decisions
Solve Problems
Access and Evaluate Information
Use and Manage information
Adapt to Change
Manage goals and times
Be Self-Directed Learners
Manage Projects
Produce Results
Guide and Lead Others

Classroom Focus:

Subassemblies Project Opportunity
Engineering Notebook
Time Management Tools
Library Research
Needs Analysis
Team Collaboration

Standards and Competencies

Standard/Unit: Engineering Resources

There are “core technologies” that involve “systems” within a range of sophistication that are critical to all technological innovations. These include mechanical, structural, fluid, optical, electrical, electronic, thermal, biotechnical and material. In order to manage deeper understanding of these core technologies, mathematical and scientific calculations and concepts are documented and used by engineers and designers for specific applications in all engineering fields. These documents are valuable reference materials used to ensure high-quality designs.

Competencies	**Total Learning Hours for Unit: 45 hours**

- Research, refine, and apply at varying levels of sophistication the “core technologies” in the solution of a design problem in engineering.
- Identify, locate, and use the wide range of mathematical and scientific resources available for engineering.
- Identify, describe and analyze diverse systems and explain their value in the solution to a specific engineering problem or as part of a technology transfer.
- Describe and use a formal patenting process based on the current U.S. national model.

Aligned Washington State Standards

Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 1.2: Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others.

	1.3:	Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.
	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.
	2.3:	Select and Use Applications: Use productivity tools and common applications effectively and constructively.
	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 11-12.1	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 9-12.7	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-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-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-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
	HS-PS2-5	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-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.
	HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
	HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
	HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Social Studies		
Speaking and Listening		
Writing	WHST 11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
	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 understanding of the subject under investigation.
	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 information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one

	source and following a standard format for citation. WHST 11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- displays a high level of creativity and resourcefulness in proposing design solution
- effective when describing and using the formal design process
- conducts tests, presentations, and portfolios as part of a formal design process

Leadership Alignment:

Work Creatively with Others
Implement Innovations
Make Judgments and Decisions
Solve Problems
Access and Evaluate Information
Adapt to Change
Manage Goals and Time
Be Self-Directed Learners
Manage Projects
Produce Results
Guide and Lead Others

Classroom Focus:

Needs Analysis
Engineering Notebook
Project Opportunity
Time Management Tools
Team Collaboration Daily

Standards and Competencies

Standard/Unit: Engineering Design Process

A combination of personal abilities such as creativity, resourcefulness, and abstract thinking applied to a formal engineering design process, supported by full testing with documentation, can result in dynamic and dramatic technological invention or innovation.

Competencies	**Total Learning Hours for Unit: 45 hours**

- Identify, describe, and apply a formal engineering design process in the solution of diverse and challenging engineering problems.
- Complete a comprehensive, multimedia presentation and portfolio for several “final” design solutions.
- Demonstrate creativity, resourcefulness, and the ability to think abstractly while applying a formal design process in the solution of an authentic engineering problem.
- Employ fundamental design principles within the context of a sequential and iterative design process while identifying, locating, and using mathematical, scientific, and technology-based resources to solve an engineering problem.

Aligned Washington State Standards

Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 1.2: Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. 1.3: Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources.

	2.3:	Select and Use Applications: Use productivity tools and common applications effectively and constructively.
	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 11-12.1	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 11-12.7	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-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-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
	HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
	HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
	HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Social Studies		
Speaking and Listening		
Writing	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 understanding of the subject under investigation.
	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 information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
	WHST 11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- at reviewing, identifying, and analyzing design problems to determine design solution merit
- identifying, describing, and using key management processes as part of an engineering team
- designing and implementing a quality control system as part of an engineering enterprise
- applies “system thinking” approach in the solution of a design problem

Leadership Alignment:

Work Creatively with Others
Make Judgments and Decisions
Solve Problems
Communicate Clearly
Access and Evaluate Information
Adapt to Change
Manage Goals and Time
Interact Effectively with Others
Manage Projects
Produce Results
Guide and Lead Others

Classroom Focus:

Needs Analysis
Engineering Notebook
Project Opportunity
Community Partner Customers
Time Management Tools
Present Design Reviews and Prototype to community members
Team Collaboration Daily

Standards and Competencies

Standard/Unit: Project Management

Project management involves research-based techniques and strategies designed to control major business functions and ensure efficiency in the design and quality of a final product. A primary goal of any engineering enterprise is to identify problems to solve, predict overall value and success of the project, and then manage that project in the most cost-effective way.

Competencies	**Total Learning Hours for Unit: 45 hours**

- Identify, describe, and use research-based contemporary management processes in the design and development of specific engineering problems.
- Review, identify, and analyze engineering design problems, and decide whether or not to address them and defend that decision.
- Effectively apply a "systems thinking" approach in the solution of a specific and authentic engineering design challenge reflective of current industry practices.
- Design and implement a current industry standard system for quality control as part of an engineering design enterprise.

Aligned Washington State Standards

Arts	
Educational Technology	1.1: Innovate: Demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology. 1.2: Collaborate: Use digital media and environments to communicate and work collaboratively to support individual learning and contribute to the learning of others. 1.3: Investigate and Think Critically: Research, manage and evaluate information and solve problems using digital tools and resources. 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. 2.3: Select and Use Applications: Use productivity tools and common applications effectively and constructively. 2.4: Adapt to Change (Technology Fluency): Transfer current knowledge to new and emerging technologies.
Health and Fitness	

Language		
Math	MP.2 MP.4	Reason abstractly and quantitatively. Model with mathematics.
Reading	RST 11-12.1 RST 9-12.7 RST 11-12.8 RST 11-12.9	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. 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. 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. 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-ESS3-1 HS-ESS3-2 HS-ESS3-3 HS-ESS3-4 HS-ESS3-6 HSN-Q.A.1 HSN-Q.A.2 HSN-Q.A.3	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. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. Define appropriate quantities for the purpose of descriptive modeling. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Social Studies		
Speaking and Listening		
Writing	WHST 11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

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 ☒**U**se 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