SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Engineering 1	**Length of Course:** 15 cycles
Grade Level(s): 9-12	**Periods Per Cycle:** 6
Units of Credit: .5	**Length of Period:** 43 minutes
Classification: Elective	**Total Instructional Time:** 64.5 hours

Course Description

This course promotes a hands-on focus to learning the concepts and roles of engineering, design, invention, and innovation in creating technology systems that improve the quality of life. The students apply and transfer this knowledge to real-life scenarios. The course incorporates the applications of math and science concepts and provides a strong background for students investigating careers.

Instructional Strategies, Learning Practices, Activities, and Experiences

Teacher Demonstration	Formal Assessments	Bell Ringers
Online Tutorials/Resources	Guided Practice	Class Discussion
Critical Thinking		Flexible Groups

Assessments

Final Exam	Unit Projects	Skills Mastery Checklists
Student Portfolio	Design/Lesson Rubrics	

Materials/Resources

Computer Lab	Variety of Power and Hand Tools.	Laser Cutter/Engraver
Materials Lab		3D Printer

Adopted: 6/20/11
Revised: 5/21/18; 12/9/20

Human Factors Affecting Design	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Ergonomics B. Human capabilities C. Biotechnology D. Human engineering E. Human factors in engineering	The students will be able to: • Define terms associated with human factors affecting designs • Identify ergonomic factors that must be addressed to facilitate human use. • Identify, define, and describe current Americans with Disabilities Act (ADA) requirements affecting product design. • Describe and perform key anthropometric measurements and calculations that must be considered during an ergonomic assessment. • Present information in a written form, with supporting data and graphs. • Contribute to group work. • Work cooperatively in a group. • Use materials, tools, and equipment safely. **3.4.10.A3** ~ Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A1** ~ Compare and contrast the rate of technological development over time. **3.4.10.B1** ~ Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects. **3.4.10.B2** ~ Demonstrate how humans devise technologies to reduce the negative consequences of other technologies. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.10.C2** ~ Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments. **3.4.10.D1** ~ Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product. **3.4.10.D2** ~ Diagnose a malfunctioning system and use tools, materials, and knowledge to repair it.

Industrial Factors Affecting Design	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Environmental factors B. Environmental engineering	The students will be able to: • Compare and contrast federal, state, and local environmental legislation impacting construction design. • Identify, describe, and assess specific local environmental requirements for construction design. • Identify, describe, analyze, and apply the process for conducting an Environmental Protection Agency (EPA) environmental impact study. • Analyze engineering design failures in terms of environmental impacts. **3.4.10.A1** ~ Illustrate how the development of technologies is often driven by profit and an economic market. **3.4.10.A2** ~ Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems. **3.4.10.A3** ~ Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A3** ~ Demonstrate how technological progress promotes the advancement of science, technology, engineering and mathematics (STEM). **3.4.10.B3** ~ Compare and contrast how a number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads, contribute to shaping the design of and demand for various technologies. **3.4.10.B4** ~ Recognize that technological development has been evolutionary, the result of a series of refinements to a basic invention. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.10.C2** ~ Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments. **3.4.12.C3** ~ Apply the concept that many technological problems require a multi-disciplinary approach. **3.4.10.D1** ~ Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product. **3.4.10.D2** ~ Diagnose a malfunctioning system and use tools, materials, and knowledge to repair it. **3.4.12.D2** ~ Verify that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. **3.4.10.E7** ~ Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. **3.4.12.E6** ~ Compare and contrast the importance of science, technology, engineering, and math (STEM) as it pertains to the manufactured world. **3.4.12.E7** ~ Analyze the technologies of prefabrication and new structural materials and processes as they pertain to constructing the modern world.

Design through Research	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Comprehensive research B. Scientific Method	The students will be able to: • Define and describe comprehensive research techniques and tools used by scientists, designers, and engineers. • Describe and apply the scientific method as part of an investigation. • Work cooperatively and efficiently within groups. • Use materials, tools, and equipment safely. • Present ideas using a variety of communication techniques (written and multimedia). **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.12.C2** ~ Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. **3.4.12.C3** ~ Apply the concept that many technological problems require a multi-disciplinary approach. **3.4.10.D1** ~ Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product. **3.4.10.D2** ~ Diagnose a malfunctioning system and use tools, materials, and knowledge to repair it. **3.4.10.E1** ~ Assess how medical technologies, over time, have impacted prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, and genetic engineering. **3.4.10.E4** ~ Evaluate the purpose and effectiveness of information and communication systems. **3.4.10.E7** ~ Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. **3.4.12.E6** ~ Compare and contrast the importance of science, technology, engineering, and math (STEM) as it pertains to the manufactured world. **3.4.12.E7** ~ Analyze the technologies of prefabrication and new structural materials and processes as they pertain to constructing the modern world.

Design and Market and Profit Influence	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Product platform B. Profit margin C. Market analysis D. Profit motive	The students will be able to: • Define, describe, and analyze new product platforms. • Define, describe, and analyze derivatives of existing products. • Define, describe, and analyze incremental improvements to existing products. • Define, describe, and analyze fundamentally new products. • Define, describe, and analyze "profit margin" concept. • Define, describe, and conduct a "market analysis" for a product design. • Describe, analyze, and apply "profit motive" for product design. **3.4.10.A1** ~ Illustrate how the development of technologies is often driven by profit and an economic market. **3.4.10.A2** ~ Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems. **3.4.12.B1** ~ Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.10.C2** ~ Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments. **3.4.12.C2** ~ Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. **3.4.10.E7** ~ Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency.

Design a Formal Process	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Engineering design process	The students will be able to: • Identify, describe, and apply the engineering design process. • Work cooperatively within groups. • Define, describe, plan, and use required documentation in the design process. • Use materials, tools, and equipment safely. • Communicate design work in a comprehensive and professional manner. **3.4.10.A1** ~ Illustrate how the development of technologies is often driven by profit and an economic market. **3.4.10.A2** ~ Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems. **3.4.10.A3** ~ Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A1** ~ Compare and contrast the rate of technological development over time. **3.4.12.A3** ~ Demonstrate how technological progress promotes the advancement of science, technology, engineering and mathematics (STEM). **3.4.12.B1** ~ Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies. **3.4.12.B2** ~ Illustrate how, with the aid of technology, various aspects of the environment can be monitored to provide information for decision making. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.10.C2** ~ Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments. **3.4.10.E7** ~ Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency.

Technology Transfer	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Technological transfer B. Interchangeable parts	The students will be able: • Define and describe the concept of "technology transfer." • Identify, analyze, and describe diverse examples of "technology transfers." • Investigate, analyze, identify, and describe technology transfer methods among specific industries (medical, agricultural, power/energy, communication, transportation, manufacturing, construction). • Analyze and describe the U.S. government's role in technology transfer. • Recognize and explain how some technologies can have multiple applications in diverse technology systems. • Identify, analyze, and describe the concept of technology "spin-offs." • Describe numerous and diverse spin-offs and explain the resulting social impacts. • Present information in a written form with supporting data, charts, and graphs. • Contribute to group work. • Use materials, tools, and equipment safely. **3.4.10.A2** ~ Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems. **3.4.10.A3** ~ Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A1** ~ Compare and contrast the rate of technological development over time. **3.4.10.B1** ~ Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.12.C3** ~ Apply the concept that many technological problems require a multi-disciplinary approach. **3.4.10.D1** ~ Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product.

Technology Systems: Building Blocks	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Core technologies B. Mechanical systems C. Structural systems D. Electronic systems E. Thermal systems F. Material systems	The students will be able to: • Describe and analyze mechanical systems. • Describe and analyze structural systems. • Describe and analyze electrical systems. • Describe and analyze electronic systems. • Describe and analyze thermal systems. • Describe and analyze material systems. **3.4.10.A2** ~ Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems. **3.4.10.A3** ~ Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A1** ~ Compare and contrast the rate of technological development over time. **3.4.10.B1** ~ Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects. **3.4.10.C1** ~ Apply the components of the technological design process. **3.4.12.C3** ~ Apply the concept that many technological problems require a multi-disciplinary approach. **3.4.10.D1** ~ Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product.