Foundations of Technology Scope and Sequence

Days	Unit	Lesson	Standard(s)/Outcome(s)	Essential/Guiding Questions
4	First Week		• 1. Collaborate with others to effectively solve a problem. • 2. Design, construct, test, and modify design solutions to satisfy a problem. • 3. Apply steps in the simplified Engineering Design Process to design a solution to a problem. • 4. Communicate effectively and engage in conversations required to master the Engineering Design Process. • 5. Use an Engineering Design Journal (EDJ) to document the process used to solve engineering problems. • 6. Learn to apply brainstorming techniques within the Engineering Design Process as a way to document a variety of solutions to a proposed problem.	How do we solve problems? What is the Engineering Design Process?
4	Unit 1- Technological Inventions and Innovation	Lesson 1: History of Technology	1. Compare and contrast technology that was used during the different historical periods. 2. Research a technological device from one of the historical periods that produced long-lasting effects on technology and society. 3. Explain that the Industrial Revolution saw	Why is it important to understand the way people from all times have used their unique skills to innovate, improvise, and invent?

	s		the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, improved education, and leisure time. • 4. Describe societal events from the 1900s that led to progress in science and invention. • 5. Select one of the following areas of technology and explain how technology changed the way people live and work: agriculture, manufacturing, sanitation and medicine, warfare, transportation, information processing, and communications. • 6. Demonstrate how Information Age devices are used to process and exchange information	
4	•	Lesson 2 Inventions and Innovations: An Evolutionary Process	• 1. Interpret charts and graphs that illustrate the rapidly increasing rate of technological development and diffusion. • 2. Approximate and interpret rate of change from graphical and numerical data. • 3. Support the statement that most technological developments have been evolutionary, the result of a series of refinements to a basic invention, through an electronic presentation. • 4. Present the evolutionary history of a technological devise specifically mentioning	What evidence do we have that invention and innovation have been evolutionary?

			the original inventions and the series of refinements to that invention that led up to the given technological device. • 5. Describe a technological innovation that resulted when ideas, knowledge, or skills were shared within a technology, among technologies, or across other fields. • 6. Support the statement that the human ability to shape the future comes from a capacity for generating knowledge and developing new technologies, and for communication ideas to others. •	
2	•	• Lesson 3 The Role of Research and Development	• 1. Illustrate that research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace by researching a specific company within the local vicinity. • 2. Present how a company's research and development department used specific problem solving approaches to prepare devices and systems for the market place, using a specific company within the local community. • 3. List examples of inventions and/or innovations that are the result of specific, goal-oriented research.	How do businesses and industry use research and development to problem solve to prepare products for the marketplace?

4		Lesson 4: Advertising and Marketing Effects on Technology	1. Support the statement that 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. 2. Identify how advertising, the strength of the economy, the goals of a company, and the latest fads contribute to the design of the product and the success or failure of the product, given various technological innovations. 3. Describe an example of a technology in which the development was driven by the profit motive and the market 4. Describe the patenting process that is sometime used to protect technological ideas. 5. Describe how a technology may have effects other than those intended by the design, some of which may have been predictable and some not. 6. Explain how the value of any given technology may be different for different groups of people and at different points in time.	How do factors such as advertising, strength of the economy, goals of the company and fads impact the demand for and design of technology?
6	Unit 2- Process of	Lesson 1: Design	1. Apply the steps of the design process, including defining a problem, brainstorming,	What is the Engineering Design Process and how is it

	Engineering Design	Process	researching and generating ideas, identifying criteria, specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing, and communicating results. • 2. Use symbolic algebra to represent and explain mathematical relationships. • 3. Draw reasonable conclusions about a situation being modeled. • 4. Analyze the cross sections of three-dimensional objects and spaces from different perspectives • 5. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 6. Work safely and accurately with a variety of tools, machines, and materials. • 7. Actively participate in group discussions, ideation exercises, and debates.	used to help us produce solutions to meet human needs and desires?
4	•	Lesson 2 Collecting and processing of Information	• 1. Collect data and information and use computers and calculators to organize, process, and present the collected data and information. • 2. Collect information and evaluate its quality. • 3. Draw reasonable conclusions about a situation being modeled.	How do computers assist us in organizing and analyzing data used in the engineering design process?

6	•	Lesson 3 Design Principles	• 1. Identify the design principles used in a current design, collect data on the effectiveness of the design principles used and propose a redesign using the design process. • 2. Describe the importance of creativity, resourcefulness, and the ability to visualize and think abstractly when engaged in engineering design. • 3. List three factors that must be considered when engaged in engineering design. • 4. Use mathematical modeling aids in technological design by simulating how a proposed system might behave. • 5. Identify human values and limitations when using scientific knowledge to solve practical design problems. • 6. Use symbolic algebra to represent and explain mathematical relationships. • 7. Use geometric ideas to solve problems in and gain insights into, other disciplines and other areas of interest such as art and architecture. • 8. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 9. Work safely and accurately with a variety of tools, machines, and materials. • 10. Actively participate in group discussions,	What are the factors that significantly influence the design process?

			ideation exercises, and debates.	
2	•	Lesson 4 Criteria and Constraints	• 1. Describe a design problem that does not clearly define all criteria and constraints. • 2. Describe a design where the requirements, such as criteria, constraints, and efficiency, compete with each other. • 3. Distinguish the criteria and constraints and reflect on how the criteria and constraints affected their final solution • 4. Identify pertinent information needed to solve a given problem on two or more case studies. • 5. Draw reasonable conclusions about a situation being modeled. • 6. Explain how design usually requires taking into account not only physical and biological constraints, but also economic, political, social, ethical, and aesthetic ones. • 7. Identify human values and limitations when using scientific knowledge to solve practical design problems.	Why are specifying criteria and identifying constrains an essential to defining the problem and determining the most appropriate solution?
5	•	Lesson 5 Prototypes and Modeling	• 1. Demonstrate how to check or test a design in order to redefine and improve the design. • 2. Demonstrate the use of a prototype to test a design concept. • 3. Use prototypes and models to ensure quality, efficiency, and productivity of their	How are conceptual, mathematical and physical models used to evaluate a design solution during the engineering design process?

			final product. • 4. Demonstrate how mathematical modeling aids are used when simulating how a proposed system might behave. • 5. Use symbolic algebra to represent and explain mathematical relationships. • 6. Analyze the cross sections of three-dimensional objects and spaces from different perspectives. • 7. Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture. •	
6	•	Lesson 6 Applying the Design Process and Documentation	• 1. Communicate their observation, processes, and results of the entire design process and the final solutions, using appropriate verbal, graphic, quantitative, virtual, and written means, in addition to three dimensional models. • 2. Present their completion of the design process through a presentation with two target audiences, using appropriate oral and written techniques. • 3. Analyze the cross sections of three dimensional object and spaces from different perspectives. • 4. Draw and construct representations of two-	How is the documentation of the engineering design process essential to communicating the solution to your intended audience?

			and three-dimensional geometric objects using a variety of tools.	
6	Unit 3-The Designed World	Lesson 1:Energy and Power	1. Identify technology and processes designed for specific functions of a given system. 2. Explain that scientific laws, engineering principles, properties of materials, and constructions techniques must be taken into account in designing engineering solutions to problems. 3. Categorize examples of energy given by the teacher as one of the major forms; thermal, radiant, electrical, mechanical, chemical, and nuclear. 4. Trace the conversion of energy from one form to another within an electronic device. 5. Describe how energy is conserved within an electronic device. 6. Diagram how a power plant converts energy from one form to another while conserving energy. 7. Explain that the Earth has many natural resources of great importance to human life. 8. Make decisions about units and scales that are appropriate for problem situations involving measurement. 9. Describe a power system, such as a car, and identify the source of energy, the process, and the load.	How has the advancement in the processing and controlling of energy influenced the development of technology?

		•	• 10. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 11. Work safely and accurately with a variety of tools, machines, and materials. • 12. Actively participate in group discussions, ideation exercises, and debates.	
6	•	Lesson 2: Manufacturing	1. Classify materials as natural, synthetic, or mixed based on the mechanical, thermal, and electrical properties of the material. • 2. List three products that are manufactured using each of the following manufacturing systems: customized production, batch production, and continuous production. • 3. Select a manufactured product and explain how the interchangeability of parts increases the effectiveness of manufacturing processes. • 4. Explain that scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. • 5. Use tables, charts, and graphs in making arguments and claims in oral, written, and visual presentations. • 6. Make decisions about units and scales that are appropriate for problem situations. • 7. Contribute to a group endeavor by offering	How are the qualities of materials evaluated? Why is it important to select appropriate materials when manufacturing products?

			useful ideas, supporting the efforts of others, and focusing on the task. • 8. Work safely and accurately with a variety of tools, machines, and materials. • 9. Actively participate in group discussions, ideation exercises, and debates.	
5	•	Lesson 3: Construction	1. Identify the appropriate assembly procedures to create a structure based on the supplied resources, the given budget of the project, and the skills of the workers. • 2. Make decisions about units and scales that are appropriate for problem situations. • 3. Explain that scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. • 4. Identify the components of the infrastructure that assist in the function of the school within the student's local community. • 5.Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 6. Work safely and accurately with a variety of tools, machines, and materials. • 7. Actively participate in group discussions, ideation exercises, and debates. •	What is infrastructure? How is construction used to meet the needs of a community?

4	•	Lesson 4 Information and Communication	1. Identify the inputs, processes, and outputs associated with a given information and communication system. 2. Identify examples of how information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine. 3. Demonstrate the use of an information and communication system to inform, persuade, entertain, control, manage, or educate. 4. Identify the function of the source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination from information and communication systems. 5. Demonstrate the use of visual, auditory, and tactile stimuli to communicate using symbols, measurement, conventions, icons, graphic images, and language. 6. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. 7. Work safely and accurately with a variety of tools, machines, and materials. 8. Actively participate in group discussions, ideation exercises, and debates.	How has information and communications systems impacted the quality of our life and changed business and industry?
7	•	Lesson 5	1. Identify, for a specific food, fiber, fuel,	How does transportation play

		Agriculture and Transportation	chemical, or other agriculture product, the systems, individuals, corporations, financial institutions, and government used to produce and regulate the specific product. • 2.List three fresh resources that are readily renewable, three that are renewable only at great cost, and three that are not renewable at all. • 3. Use tables, charts, and graphs in making arguments and claims in oral, written, and visual presentations. • 4. Identify the transportation utilized within a given system such as manufacturing, construction, communication, health and safety, or agriculture. • 5. Describe the advantages and disadvantages to consider when selecting fuels to be used in a transportation system. • 6. Explain that scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. • 7. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 8. Work safely and accurately with a variety of tools, machines, and materials. • 9. Actively participate in group discussions,	a vital role in the production, processing, and distribution of food, fiber, fuel, chemicals, and other useful products?

		•	ideation exercises, and debates.	
2	•	Lesson 6: Telemedicine	1. Identify the medicine, telecommunications, virtual presence, computer engineering, informatics, artificial intelligence, robotics, materials science, and perceptual psychology that integrate to complete the problem solution to a given case study scenario. • 2. Provide examples of new medical techniques and efficient healthcare delivery systems that allow human beings a better chance of staying healthy. • 3. Analyze the dietary and sanitation needs of an area that has just experienced a natural disaster such as an earthquake, tsunami, or flood. • 4. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. • 5. Work safely and accurately with a variety of tools, machines, and materials. • 6. Actively participate in group discussions, ideation exercises, and debates. •	How is the convergence of technological advances such as medicine, telecommunications, virtual presence, computer engineering, informatics, artificial intelligence, robotics, material science, and perceptual psychology reflected in telemedicine?
8	Unit 4- Systems Engineerin •	Lesson 1: Core Technolo •	1. Explain that systems, which are the building blocks of technology, are embedded within larger technological, social, and	What are the 9 core technologies?

	g and Technology	gies	environmental systems. • 2. Use systems in the design and development of technology. • 3. Differentiate between larger technological, social, or environmental systems from smaller components and subsystems. • 4. Identify the various systems embedded within the larger system (technological, social, or environmental), using the language of the core technologies. 5.Calculate algebraic equations representing scientific principles related to a design challenge to refine a solution to the problem.	
2	•	Lesson 2:Systems Model	• 1. Operate systems so that they function in the way they were designed. • 2. Identify the safe procedures and directions so a new user can recognize the input, process, output, and feedback components of a system as well as how to operate it. • 3. Explain that system, which are the building blocks of technology, are embedded within larger technological social, and environmental systems. • 4. Use systems in the design and development of technology • 5. Differentiate between larger technological, social, or environmental systems and smaller components and subsystems	What are the parts of the universal systems model?

			• 6. Identify the various systems embedded within a larger system (technological, social, or environmental), using the language of the core technologies (input, process, output, feedback). • 7. Design a troubleshooting diagram and manual for another user to maintain the safe and proper operation of a system or product.	
3	•	Lesson 3: Reverse Engineering	• 1. Differentiate between larger technological, social, or environmental systems and smaller components and subsystems. • 2. Explain that systems fail because they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. • 3. Identify an opportunity for redesign of a product and choose to reverse engineer the design flaw. • 4. Define a system by identifying its subsystems, their relationship to other systems, and the intended input and output of the system.	How do companies use reverse engineering to develop and improve products?
5	•	Lesson 4: Troubleshooting	• 1. Use tools, materials, machines, and knowledge to repair a system or product that is malfunctioning. • 2. Explain that systems fail because they have faulty or poorly matched parts, are used in	How does troubleshooting allow a user to maintain proper operation of a system or product?

			ways that exceed what was intended by the design, or were poorly designed to begin with. • 3. Troubleshoot common mechanical and electrical system, checking for possible causes of malfunction, and decide whether to fix it or get help from an expert. • 4. Design a troubleshooting diagram and manual for another user to maintain the safe and proper operation of a system or product. • 5. Trouble shoot, analyze, and maintain systems to ensure safe and proper function and precision, • 6. Explain the most common ways to prevent failure are: pretesting of parts and procedures, overdesign, and redundancy. • 7. Follow instructions in manuals or seek help from an experienced user to learn how to operate new mechanical or electrical devices. • 8. Diagnose a system that is malfunctioning and distinguish tools, materials, machines, and knowledge to repair it.	
2	Unit 5- Lunar Plant Growth Chamber	Lesson 1: Introduction to STS-118 Mission and the Design	• 1. Explain that the design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities selecting and approach, developing a design proposal, making a model or prototype, testing and evaluating	How can the Engineering Design Process be used to improve the Constellation Programs space vehicles?

		Challenge	the design using specifications, refining the design, creating or making it, and communicating process and results. • 2. Explain how problems are seldom presented in a clearly defined form. • 3. Explain that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and to think abstractly. • 4. Describe how technological problems often create a demand for new scientific knowledge and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. • 5. Describe how to analyze properties and determine attributes of two- and three-dimensional objects. • 6. Describe how to use visualization, spatial reasoning, and geometric modeling to solve problems. • 7. Contribute to a group endeavor by offering useful ideas supporting the efforts of others and focusing on the task. • 8. Actively participate in group discussions, exercises, and debates.	
2		Lesson 2: Choosing Plant	1. Explain that requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other	What means of transportation are used to move people from place to place?

		Specie	2. Explain that the chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in a food web, some energy is stored in newly-made structures, but much is dissipated into the environment as heat. 3. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. 4. Actively participate in group discussions, exercises, and debates.	
2		Lesson 3: Identifying Criteria and Specifying Constraints.	1. Explain that the stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop. 2. Explain that requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 3. Describe how optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 4. Describe how complex systems have many layers of controls and feedback loops to provide information.	How do checklists and comprehensive testing programs ensure the best possibility of successful development of a product?

			5. Identify criteria and constraints and determine how these will affect the design process. 6. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 7. Explain that the more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for minor failures. 8. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. 9. Actively participate in group discussions, exercises, and debates.	
2		Lesson 4:Designing the Plant Growth Chamber	1. Explain that a design needs to be continually checked and critiqued, and the ideas of the design must be refined and improved. 2. Explain that engineering design is influenced by personal characteristic, such as creativity, resourcefulness, and the ability to visualize and to think abstractly. 3. Describe how to evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for	Why is decision making procedures so vital to the development of a product?

			proper design and to note areas where improvements are needed. 4. Explain that when designing a devise or process thought should be given to how it will be manufactured, operated, maintained, replaced, and disposed of and who will sell, operate, and take care of it. The costs associated with these functions may introduce yet more constraints on the design. 5. Explain that the more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for minor failures. 6. Explain that to reduce the chance of system failure, performance testing is often conducted using small scale models, computer simulations, analogous systems, or just the parts of the system thought to be least reliable. 7. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task. 8. Actively participate in group discussions, exercises, and debates.	
2		Lesson 5: Building the Plant	1. Describe how to refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final	What concepts are most important to include in your discussion when developing

		Growth Chamber	product. 2.Describe how to evaluate the design solution using conceptual, physical and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 3. Explain that when designing a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced, and disposed of and who will sell, operate, and take care of it. The costs associated with these functions may introduce yet more constraints on the design. 4. Explain that the more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for minor failures. 5. Explain that to reduce the chance of system failure, performance testing is often conducted using small-scale models, computer simulations, analogous systems, or just the parts of the system thought to be least reliable. 6. Work safety and accurately with a variety of tools, machines, and materials. 7. Actively participate in group discussions, ideation exercises, and debates.	new products?

TBD	3-D Printing	Lesson 1: History and Basic Understanding of 3D printing	1. Understand the history and development of 3D Printing 2. Identify and describe basic components of 3D Printing technology. 3. Identify and Define key components of 3D Printers.	What is the history of 3-D Printing? How do we use 3D printing applications?
TBD		Lesson 2: 3D printing Process	4. 1. Understand the different 3D Printing Processes - FDM, SLA, SLS 5. 2. Identify and describe details of FDM printing - Rafting and Bridging, Extruder Technology, and Technical Terminology. 6. 3. Identify and analyze 3D printing materials and real-world applications.	What is the 3D printing process?
TBD		Lesson 3: How to apply 3D printing to Engineering Projects	7. Utilize the Engineering Design Process to Research, Design, and prepare a model or prototype for the 3D Printing Process. 8. Apply technical drafting skills to generate two-dimensional orthographic drawings 9. Utilize professional software systems to	How do we apply 3D printing to the Engineering Design Process?

			generate 2D and 3D models; AutoCAD, Google SketchUp, Inventor, Fusion 360. 10. Use appropriate scaling, measurement, and dimensions for effective and efficient use of 3D printing applications and materials.	