Module 1: Engineering **Core Ideas:** ETS1 Engineering Design ETS2 Links Among Engineering, Technology, Science, and Society			
Prerequisite Learning: K.ETS1.1, K.ETS1.2, 1.ETS1.1, 2.ETS1.1-4, 3.ETS1.1, 3.ETS1.2, 4.ETS1.1, K.ETS2.1, 1.ETS2.1, 2.ETS2.1, 2.ETS2.2, 3.ETS2.1, 4.ETS2.1-	**Percent of Time: 7%**		
Standard	**Questions and Phenomenon Prompts**	**Module Vocabulary**	**Teacher Background/ Clarification Statement**
5.ETS1.1 Research, test, retest, and communicate a design to solve a problem. **Learning Targets:** • Apply the engineering design process to design solutions. • Design solutions to a real-world problem, such as the effects of Hurricane Katrina or Harvey, using constraints such as time, materials, and space. • Design and research solutions to areas in a flood zone: dams holding water back, reservoirs storing flood water, levees and embankments preventing overflow, and channel straightening increasing speed of flow. **Crosscutting Concept:** • **Pattern-** Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **Science and Engineering Practice:** • **Obtaining, evaluating, and communicating information-** Students communicate technical information about proposed design solutions using tables, graphs, and diagrams.		Engineer Engineering design process Criteria Constraint Prototype Technology Variable Control	In order to effectively design a solution for a given problem, engineers must first conduct research to better understand the problem. Students should brainstorm possible solutions as well as present the results of the designed tests.
5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.			Student-developed tests should move beyond simply making a device and trying it out and should have tests designed to cause

Learning Targets: • Conduct controlled tests of a design in which only one isolated variable is tested at a time and all other design features are controlled. For example, when testing parachute prototypes, each prototype should test only one variable such as canopy size or material and all other features of the parachute should remain constant. • Identify which variables performed best after each test and apply the results to a new improved prototype. **Crosscutting Concept:** • **Cause and effect-** Students identify conditions required for specific cause and effect interactions to occur through investigation. **Science and Engineering Practice:** • **Developing and using models-** Students can identify specific limitations of their models.			failure into a specified component. Then, evaluate, make modifications, and retest.
5.ETS1.3 Explain how failure provides valuable information toward finding a solution. **Learning Targets:** • Conduct tests of prototypes that determine the point of failure. For example, at which load weight will your parachute design fail to support its load? • Research examples of failures that resulted in new scientific discoveries or inventions. (Ex: Lonnie Johnson's Super Soaker, Richard James' Slinky, or George Crum's potato chip) **Crosscutting Concept:** • **Pattern**- Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments.	Why is determining the limits of a design an important step in the engineering process? How does it provide engineers with valuable information?		Failure is essential to both science and engineering. Without failure it is not possible to understand the limitations or shortcomings of a device or explanation. Students should be encouraged to embrace productive failure as part of the design process to encourage persistent exploration.

Science and Engineering Practice: • **Engaging in argument from evidence-** Students make and support claims about a proposed device or solution.			
5.ETS2.1 Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology. **Learning Targets:** • Use measurement tools correctly in order to develop scale models or design prototypes with specified size or speed criteria. • Select appropriate tools when designing prototypes. **Crosscutting Concept:** • **Structure and function-** Students begin to attribute the shapes of sub-components to the function of the part. **Science and Engineering Practice:** • **Developing and using models-** Students can create a design plan or prototype of a tool or object which incorporates cause and effect behaviors within the device.	Develop scale models of phenomena such as eclipses, seasons, or moon phases.		Using tools allows students to acquire two important engineering skills. Students can gain an understanding of how tools have enabled humans to build. Students acquire the ability to produce actual prototypes as part of the engineering process. This skill allows for development of more involved tests of components of a design.
5.ETS2.2 Describe how human beings have made tools and machines (X-ray cameras, microscopes, satellites, computers) to observe and do things that they could not otherwise sense or do at all, or as quickly or efficiently. **Learning Targets:** • Identify the implications of the invention of the microscope and the telescope. How did these two inventions transform our understanding of the world? • Compare and contrast new technologies such as cell phones, airplanes, internet with older means of communication, travel, and research.	How does technology allow us to perform tasks that humans could not otherwise do? How do new technologies change the way people behave and interact?		Scientific understanding develops as scientists are able to observe and explain things in the natural world. Technology has enabled scientists to extend their senses through the use of tools. These tools allow data storage, complex mathematical models,

Crosscutting Concept: • **Scale, proportion, and quantity-** Students become familiar with sizes immensely large or small or durations extremely long or short. **Science and Engineering Practice:** • **Constructing explanations and designing solutions-** Students can create evidence-based explanations for relationships seen in the natural world as well as identify evidence that supports other explanations.			and increased capacity to see smaller and smaller details.
5.ETS2.3 Identify how scientific discoveries lead to new and improved technologies. **Learning Targets:** • Research a current piece of technology and identify how the invention was developed through the years and predict how that technology might continue to improve (e.g., telegraph, telephone, and cell phone). • Explain how tools, such as star charts and telescopes, have led to scientific discoveries about the universe. **Crosscutting Concept:** • **Pattern**- Students use patterns as evidence in an argument or to make predictions, construct explanations, and engage in arguments. **Science and Engineering Practice:** • **Engaging in argument from evidence-** Students make and support claims about a proposed device or solution.	How do new technologies help scientists? How do new scientific discoveries help engineers?		New scientific discoveries allow for better or new technologies to be created. In turn, these new technologies help in making new scientific discoveries. This cycle is perpetual.