Scientific & Engineering Practices Progression

	1a. Asking Questions & Defining Problems	
Asking Questions	ask *testable* questions based on observations *and predict reasonable outcomes based on patterns*	**Skill Progression**
	ask questions and make predictions based on observations	
	ask questions that can be investigated *and predict reasonable outcomes*	
	ask questions about what would happen if a variable is changed	
	identify scientific and non-scientific questions	
	ask questions to determine relationships between independent and dependent variables	
	ask questions and develop hypotheses to determine relationships between independent and dependent variables	
	ask questions that require empirical evidence to answer	
	ask questions that arise from careful observation of phenomena *and/or organisms*, examination of models and theories, or unexpected results, and/or to seek additional information	
	determine which questions can be investigated within the scope of the school laboratory or field to determine relationships between independent and dependent variables	
Developing Hypotheses	make predictions based on observations *and prior experiences*	**Skill Progression**
	develop hypotheses as cause-and-effect relations	
	develop hypotheses and identify independent and dependent variables	
	develop hypotheses indicating relationships between independent and dependent variables	
	generate hypotheses based on research and scientific principles	
	make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated	
Defining Problems	identify a problem based on need	**Skill Progression**
	identify a simple problem that can be solved through the development of a new tool or improved object	
	define a simple design problem that can be solved through the development of an object, tool, process, or system	
	offer simple solutions to design problems	
	define design problems that involve the development of a process or system with interacting components, criteria and constraints	

Scientific & Engineering Practices Progression

	1b. Planning & Carrying Out Investigations	
Planning & Conducting Investigations	make observations to collect data	
	identify characteristics and properties of objects *by observation*	Skill Progression
	with guidance, *plan and* conduct investigations to produce data	
	with guidance, plan and conduct investigations	
	identify variables when planning an investigation	
	collaboratively plan and conduct investigations *to produce data*	
	identify independent variable, dependent variables, and constants	
	determine data that should be collected to answer a testable question	
	independently and collaboratively plan and conduct observational and experimental investigations; identify variables, constants, and controls where appropriate, including the safe use of chemicals and equipment	
	individually and collaboratively plan and conduct observational and experimental investigations	
	determine appropriate sample size and techniques	
Recording Data	record information from investigation	
	measure relative length and weight of common objects	Skill Progression
	use tools to measure relative length, weight, volume, and temperature of common objects	
	use appropriate tools to measure length, weight, and temperature of common objects using U.S. Customary units	
	measure time intervals using proper tools	
	measure elapsed time	
	use appropriate methods and/or tools for collecting data	
	estimate length, mass, volume, and temperature	
	measure length, mass, volume, and temperature in metric and U.S. Customary units using proper tools	
	take metric measurements using appropriate tools *and technologies including the use of microscopes*	
	evaluate the accuracy of various methods for collecting data	
	select and use appropriate tools and technology to collect, record, analyze, and evaluate data	

Scientific & Engineering Practices Progression

	1b. Planning & Carrying Out Investigations	
Applying Engineering Practices	use tools and/or materials to design and/or build a device that solves a specific problem	**Skill Progression** ↓
	apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process, or system	
	plan and conduct investigations or test design solutions in a safe and ethical manner including considerations of environmental, social, and personal effects	

Scientific & Engineering Practices Progression

|	**1c. Interpreting, Analyzing, & Evaluating Data**	
Recording and Representing Data	organize and represent data	Skill Progression ↓
	classify and/or sequence objects based on a single physical characteristic or property	
	describe patterns *and relationships*	
	use and share pictures, drawings, and/or writings of observations	
	organize and represent various forms of data using tables, picture graphs, and object graphs	
	classify and arrange objects based on a single physical characteristic or property	
	organize and represent data in pictographs and/*or* bar graphs	
	organize and represent data in bar graphs and line graphs	
	organize *simple* data sets to reveal patterns that suggest relationships	
	record and present data in an organized format that communicates relationships and quantities in appropriate mathematical or algebraic forms	
Applying Engineering Practices	analyze data from tests of an object or tool to determine if it works as intended	Skill Progression ↓
	use data to evaluate and refine design solutions *to best meet criteria*	
	use data in building and revising models, supporting an explanation for phenomena, or testing solutions to problems	
	evaluate the impact of new data on a working explanation and/or model of a proposed process or system	
	analyze data to optimize a design	

Scientific & Engineering Practices Progression

	1c. Interpreting, Analyzing, & Evaluating Data
Interpreting & Analyzing Data	read and interpret data in object graphs, picture graphs, and tables
	read and interpret data displayed in tables, picture graphs, and object graphs, using the vocabulary *more, less, fewer, greater than, less than, and equal to*
	read and interpret data represented in pictographs and bar graphs
	read, interpret, and analyze data represented in pictographs and bar graph
	interpret and analyze data represented in bar graphs and line graphs
	compare two different representations of the same data (e.g., a set of data displayed on a chart and a graph)
	represent and analyze data using tables and graphs
	construct, analyze, and interpret graphical displays of data
	compare and contrast data collected by different groups and discuss similarities and differences in their findings
	consider limitations of data analysis and/or seek to improve precision and accuracy of data
	identify, interpret, and evaluate patterns in data
	construct, analyze, and interpret graphical displays of data
	compare and contrast data collected by different groups and discuss similarities and differences in their findings
	construct and interpret data tables showing independent and dependent variables, repeated trials, and means
	construct, analyze, and interpret graphical displays of data, *including scatterplots and line plots, and consider limitations of data analysis*
	apply mathematical concepts and processes to scientific questions
	solve problems using mathematical manipulations including the International System of Units (SI), scientific notation, derived units, significant digits, and dimensional analysis
	analyze data using tools, technologies, and/or models *(e.g., computational, mathematical, **statistical**)* to make valid and reliable scientific claims or determine an optimal design solution
	analyze data graphically and use graphs to make predictions
	differentiate between accuracy and precision of measurements
	consider limitations of data analysis when analyzing and interpreting data

Skill Progression

Scientific & Engineering Practices Progression

	1d. Constructing & Critiquing Conclusions & Explanations	
Constructing Conclusions	make simple conclusions based on data or observations	**Skill Progression**
	recognize unusual or unexpected results	
	distinguish between opinion and evidence	
	use evidence (i.e., measurements, observations, patterns) to construct or support explanations *and to make inferences*	
	construct and/or support arguments with evidence, data, and/or a model	
	construct explanations that include qualitative or quantitative relationships between variables	
	construct scientific explanations based on valid and reliable evidence obtained from sources (including the students' own investigations)	
	construct arguments supported by empirical evidence and scientific reasoning	
	differentiate between a scientific hypothesis and theory *and law*	
	make quantitative and/or qualitative claims regarding the relationship between dependent and independent variables	
	make quantitative and/or qualitative claims based on data	
	construct and revise explanations based on valid and reliable evidence obtained from a variety of sources including students' own investigations, models, theories, simulations, and peer review	
	construct arguments or counterarguments based on data and evidence	
Applying Engineering Practices	generate and/or compare multiple solutions to a problem	**Skill Progression**
	describe how scientific ideas apply to design solutions	
	generate and compare multiple solutions to problems based on how well they meet the criteria and constraints	
	apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and design solutions	
	compare and evaluate competing arguments or design solutions in light of currently accepted explanations and new scientific evidence	

Scientific & Engineering Practices Progression

	1e. Developing & Using Models

Develop & Interpret Models	distinguish between a model and an actual object	Skill Progression
	use *physical* models to demonstrate simple phenomena and natural processes	
	use models to demonstrate simple phenomena and natural processes	
	develop a model (e.g., diagram or simple physical prototype) to illustrate a proposed object, tool, or process	
	develop and/or use models to explain natural phenomena	
	identify *(evaluate)* limitations of models	
	develop models using an analogy, example, or abstract representation to describe a scientific principle or design solution	
	use, develop, and revise models to predict and explain phenomena	
	use scale models to represent and estimate distance	
	construct, **develop**, and use models and simulations to illustrate, *predict*, and/or explain observable and unobservable phenomena, *life processes, or mechanisms*	
	evaluate the merits and limitations of models	
	develop, revise, and/or use models based on evidence to illustrate or predict relationships	
	construct and interpret scales; diagrams; classification charts; graphs; tables; imagery; models; including geologic cross sections and topographic profiles	
	read and interpret topographic and basic geologic maps and globes, including location by latitude and longitude	
	develop and/or use models *(including mathematical and computational)* to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems	
	use models and simulations to visualize and explain the movement of particles, to represent chemical reactions, to formulate mathematical equations, and to interpret data sets	
	identify and communicate components of a system orally, graphically, textually, and mathematically	

Adapted from VDOE Science and Engineering Practices Progression K-12

Scientific & Engineering Practices Progression

	1f. Obtaining, Evaluating, & Communicating Information	
Obtaining & Evaluating Information	read and comprehend reading-level appropriate texts and/or other reliable media	**Skill Progression** ↓
	read scientific texts, including those adapted for classroom use, to obtain scientific and/or technical information	
	gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication	
	gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and credibility of each source	
	compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem	
Communicating Information	communicate comparative measures (e.g., heavier, lighter, longer, shorter, more, less, hotter, colder)	**Skill Progression** ↓
	communicate observations using pictures, drawings, and/or speech	
	communicate observations and data using simple graphs, *pictures*, drawings, numbers, speech and/or writing	
	communicate scientific information, design ideas, and/or solutions with others	
	construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning	
	communicate scientific and/or technical information about phenomena in multiple formats	