Chapter 1 / Getting Started

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• PBASIC • BASIC Stamp Editor • Arduino • ArduinoIDE • Propeller C • SimpleIDE • BlocklyProp	CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words			*Practices* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.3 *Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution.* *Concepts* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple*	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* (IT) Information Tech Career *11. Hardware components* *12. Software functions* (IT-SUP) Info Support & Services *4. Installation, configuration* (IT-PRG) Programming/Software *4. Software development tools* *5. Software development process* *6. Program CPU application* *7. Software testing* *8. Quality assurance* (ST) STEM Careers *6. Tech skills in STEM*	• Collaborative • Self-directed • Use technology

				tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics. 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Impacts of Computing.Culture *Advancements in computing technology change people's everyday activities. Society is faced with tradeoffs due to the increasing globalization and automation that computing brings.*		

Chapter 2 / Simple Programs / Simple Circuits

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Servo Motors • Displaying Messages • LED circuit • HIGH LOW signals • Storing Variables • Counting & Repeating	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.CONTENT.HSG.MG.A.3 • Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) CCSS.MATH.CONTENT.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 CCSS.MATH.CONTENT.HSN.Q.A.2 • Define appropriate quantities CCSS.MATH.CONTENT.HSN.Q.A.3 • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities CCSS.MATH.PRACTICE.MP1 • Make sense of problems and	HS-PS3-1 • Create a computational model to calculate the change in energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known 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	*Practices* P1.Fostering an Inclusive Computing Culture.1 *Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.*	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *6. Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	● Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 ● Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 ● Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 ● Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 ● Compare and contrast findings presented in a text to those from other sources (including own	persevere in solving them CCSS.MATH.PRACTICE.MP2 ● Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 ● Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 ● Model with mathematics CCSS.MATH.PRACTICE.MP5 ● Use appropriate tools strategically CCSS.MATH.PRACTICE.MP6 ● Attend to precision CCSS.MATH.PRACTICE.MP7 ● Look for and make use of structure CCSS.MATH.PRACTICE.MP8 ● Look for and express regularity in repeated reasoning		P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience.* *Concepts* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted*	*and adaptive in acquiring and using new technology.* (ST) STEM Careers *1. Apply engineering skills in project requiring project management process control & quality assurance* 2. Use tech to acquire, manipulate, analyze, & report data 3. Describe & follow safety, health, and environmental STEM standards 4. Understand nature and scope of STEM career and STEM in society and economy *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems* (IT) Information Tech Career *1. Demonstrate effective professional communication*	

	experiments) noting when the findings support or contradict CCSS.ELA-LITERACY.RST.9-10.10 ● Read and comprehend science/technical texts independently and proficiently			*into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.*	*2. Use design process to produce quality product or service* *11. Hardware components* *12. Compare software functions and applications* (IT-PRG) Programming/Software *4. Software development tools* *5. Software development process* *6. Program CPU application* *7. Software testing* *8. Quality assurance*	

Chapter 3 / Mechanical Assembly

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Robot Assembly • Sound with Piezo • Speed Control	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.PRACTICE.MP1 • Make sense of problems and persevere in solving them CCSS.MATH.PRACTICE.MP2 • Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 • Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 • Model with mathematics CCSS.MATH.PRACTICE.MP5 • Use appropriate tools strategically CCSS.MATH.PRACTICE.MP6 • Attend to precision CCSS.MATH.PRACTICE.MP7 • Look for and make use of structure CCSS.MATH.PRACTICE.MP8 • Look for and express regularity in repeated reasoning CCSS.MATH-CONTENT.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	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-PS4-1 • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-5 • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	*Practices* P1.Fostering an Inclusive Computing Culture.1 *Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P4.Developing and Using Abstractions.4 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *6. Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	• Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 • Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 • Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 • Compare and contrast findings presented in a text to those from other sources (including own	the origin in graphs and data displays CCSS.MATH-CONTENT.HSN.Q.A.2 • Define appropriate quantities for the purpose of descriptive modeling CCSS.MATH.CONTENT.HSN.Q.A.3 • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities CCSS.MATH.CONTENT.HSF.LEA.1.C • Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another CCSS.MATH.CONTENT.HSG.MG.A.3 • Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios)		*Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.* *Concepts* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent.*	*and adaptive in acquiring and using new technology.* (ST) STEM Careers *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

	experiments) noting when the findings support or contradict			*Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.*		

Chapter 4 / Basic Navigation

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Maneuvers • Distances • Ramping up/down speed • Subroutines/ Functions • Complex Maneuvers	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.CONTENT.HSG.MG.A.3 • Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) CCSS.MATH.CONTENT.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 CCSS.MATH.CONTENT.HSN.Q.A.2 • Define appropriate quantities CCSS.MATH.CONTENT.HSN.Q.A.3 • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities CCSS.MATH.PRACTICE.MP1 • Make sense of problems and	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	*Practices* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *6. Demonstrate creativity and innovation. Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* (ST) STEM Careers *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems involving design and/or production*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	● Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 ● Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 ● Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 ● Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 ● Compare and contrast findings presented in a text to those from other sources (including own	persevere in solving them CCSS.MATH.PRACTICE.MP2 ● Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 ● Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 ● Model with mathematics CCSS.MATH.PRACTICE.MP5 ● Use appropriate tools strategically CCSS.MATH.PRACTICE.MP6 ● Attend to precision CCSS.MATH.PRACTICE.MP7 ● Look for and make use of structure CCSS.MATH.PRACTICE.MP8 ● Look for and express regularity in repeated reasoning		*Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.* *Concepts* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The*	*3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

	experiments) noting when the findings support or contradict			*method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.* 6-8.Algorithms and Programming.Modularity *Programs use procedures to organize code, hide implementation details, and make code easier to reuse. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.*		

Chapter 5 / Navigation with Whiskers

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Touch sensors • Escaping corners	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.PRACTICE.MP1 • Make sense of problems and persevere in solving them CCSS.MATH.PRACTICE.MP2 • Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 • Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 • Model with mathematics CCSS.MATH.PRACTICE.MP5 • Use appropriate tools strategically CCSS.MATH-CONTENT.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 CCSS.MATH-CONTENT.HSN.Q.A.2 • Define appropriate quantities for the purpose of descriptive modeling CCSS.MATH.CONTENT.HSA.SSE.A.1	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-PS4-1 • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2 • Evaluate questions about the advantages of using a digital transmission and storage of information. HS-PS4-5 • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	*Practices* P3.Recognizing and Defining Computational Problems.1 *Identify complex, interdisciplinary, real-world problems that can be solved computationally.* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P3.Recognizing and Defining Computational Problems.3 *Evaluate whether it is appropriate and feasible to solve a problem computationally.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible and adaptive in acquiring and using new technology.* (ST) STEM Careers *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	• Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 • Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 • Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 • Compare and contrast findings presented in a text to those from other sources (including own	• Interpret expressions that represent a quantity in terms of its context CCSS.MATH.CONTENT.HSA.REI.B.3 • Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters		*Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience.* *Concepts* 6-8.Computing Systems.Devices *The interactions between humans and computing devices presents advantages, disadvantages, and unintended consequences. The study of human-computer interaction can improve the design of devices and extend the abilities of humans.* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem,*	*involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

	experiments) noting when the findings support or contradict			*whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.* 6-8.Algorithms and Programming.Modularity		

				Programs use procedures to organize code, hide implementation details, and make code easier to reuse. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability. 6-8.Impacts of Computing.Culture *Advancements in computing technology change people's everyday activities. Society is faced with tradeoffs due to the increasing globalization and automation that computing brings.*		

Chapter 6 / Navigation with Ultrasound / Navigation with Visible Light

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
● Light-sensing ● Ohm's Law ● Adjusting light sensitivity ● Following a light ● Waves ● Ultrasound ● Time-of-flight	CCSS.ELA-LITERACY.RST.9-10.1 ● Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 ● Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 ● Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 ● Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.PRACTICE.MP1 ● Make sense of problems and persevere in solving them CCSS.MATH.PRACTICE.MP2 ● Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 ● Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 ● Model with mathematics CCSS.MATH.PRACTICE.MP5 ● Use appropriate tools strategically CCSS.MATH-CONTENT.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 CCSS.MATH-CONTENT.HSN.Q.A.2 ● Define appropriate quantities for the purpose of descriptive modeling CCSS.MATH.CONTENT.HSA.SSE.A.1	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-PS4-1 ● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2 ● Evaluate questions about the advantages of using a digital transmission and storage of information. HS-PS4-5 ● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	*Practices* P1.Fostering an Inclusive Computing Culture.1 *Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.* P3.Recognizing and Defining Computational Problems.1 *Identify complex, interdisciplinary, real-world problems that can be solved computationally.* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P3.Recognizing and Defining Computational Problems.3 *Evaluate whether it is appropriate and feasible to solve a problem computationally.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P4.Developing and Using Abstractions.4 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of*	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible and adaptive in acquiring and using new technology.* (ST) STEM Careers *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems*	● Collaborative ● Self-directed ● Innovative ● Critical-thinking ● Communication ● Reflection ● Revision ● Design-thinking ● Use technology

	● Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 ● Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 ● Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 ● Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 ● Compare and contrast findings presented in a text to those from other sources (including own	● Interpret expressions that represent a quantity in terms of its context CCSS.MATH.CONTENT.HSA.REI.B.3 ● Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters		*the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.1 *Select, organize, and interpret large data sets from multiple sources to support a claim.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience.* *Concepts* 6-8.Computing Systems.Devices *The interactions between humans and computing devices presents advantages, disadvantages, and unintended consequences. The study of human-computer interaction can improve the design of devices and extend the abilities of humans.* 6-8.Computing Systems.Hardware and Software	*involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

	experiments) noting when the findings support or contradict			*Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Data and Analysis.Visualization and Transformation		

				Data can be transformed to remove errors, highlight or expose relationships, and/or make it easier for computers to process. 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.* 6-8.Algorithms and Programming.Modularity *Programs use procedures to organize code, hide implementation details, and make code easier to reuse. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.* 6-8.Impacts of Computing.Culture *Advancements in computing technology change people's everyday activities. Society is faced with tradeoffs due to the increasing globalization and automation that computing brings*		

Chapter 7 / Navigation with Infrared Headlights

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Navigating with IR • Sniffing for IR interference • Adjusting IR range • High performance IR navigation • Detecting a cliff (drop-off)	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.PRACTICE.MP1 • Make sense of problems and persevere in solving them CCSS.MATH.PRACTICE.MP2 • Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 • Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 • Model with mathematics CCSS.MATH.PRACTICE.MP5 • Use appropriate tools strategically CCSS.MATH-CONTENT.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 CCSS.MATH-CONTENT.HSN.Q.A.2 • Define appropriate quantities for the purpose of descriptive modeling CCSS.MATH.CONTENT.HSA.SSE.A.1	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-PS4-1 • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2 • Evaluate questions about the advantages of using a digital transmission and storage of information. HS-PS4-5 • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	*Practices* P3.Recognizing and Defining Computational Problems.1 *Identify complex, interdisciplinary, real-world problems that can be solved computationally.* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P3.Recognizing and Defining Computational Problems.3 *Evaluate whether it is appropriate and feasible to solve a problem computationally.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2 *Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3	(CRP) Career Ready Practices *2. Apply academic & technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible and adaptive in acquiring and using new technology.* (ST) STEM Careers *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	• Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 • Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 • Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 • Compare and contrast findings presented in a text to those from other sources (including own experiments) noting	• Interpret expressions that represent a quantity in terms of its context CCSS.MATH.CONTENT.HSA.REI.B.3 • Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters		*Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience.* *Concepts* 6-8.Computing Systems.Devices *The interactions between humans and computing devices presents advantages, disadvantages, and unintended consequences. The study of human-computer interaction can improve the design of devices and extend the abilities of humans.* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and components work and interact. A systematic process will identify the source of a problem,*	*involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities* *2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

	when the findings support or contradict			*whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and conditionals, to create more complex program behavior.* 6-8.Algorithms and Programming.Modularity		

				Programs use procedures to organize code, hide implementation details, and make code easier to reuse. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.		

Chapter 8 / Advanced Navigation

Concepts Vocabulary	Common Core State Standards (ELA)	Common Core State Standards (Math)	Next Generation Science Standards (NGSS)	K-12 Computer Science Framework[1]	Career Technical Education Standards (CTE)	21st Century Competencies
• Detecting distance with IR • Following (shadowing) a moving object • Following a stripe	CCSS.ELA-LITERACY.RST.9-10.1 • Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-10.2 • Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary CCSS.ELA-LITERACY.RST.9-10.3 • Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-10.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-10.5	CCSS.MATH.PRACTICE.MP1 • Make sense of problems and persevere in solving them CCSS.MATH.PRACTICE.MP2 • Reason abstractly and quantitatively CCSS.MATH.PRACTICE.MP3 • Construct viable arguments and critique the reasoning of others CCSS.MATH.PRACTICE.MP4 • Model with mathematics CCSS.MATH.PRACTICE.MP5 • Use appropriate tools strategically CCSS.MATH.PRACTICE.MP6 • Attend to precision CCSS.MATH.PRACTICE.MP7 • Look for and make use of structure CCSS.MATH.PRACTICE.MP8 • Look for and express regularity in repeated reasoning CCSS.MATH-CONTENT.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	HS-PS3-1 • Create a computational model to calculate the change in energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known 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-PS4-1 • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2 • Evaluate questions about the advantages of using a digital transmission and storage of information. HS-PS4-5	*Practices* P1.Fostering an Inclusive Computing Culture *Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.* P3.Recognizing and Defining Computational Problems.1 *Identify complex, interdisciplinary, real-world problems that can be solved computationally.* P3.Recognizing and Defining Computational Problems.2 *Decompose complex real-world problems into manageable subproblems that could integrate existing solutions or procedures.* P3.Recognizing and Defining Computational Problems.3 *Evaluate whether it is appropriate and feasible to solve a problem computationally.* P4.Developing and Using Abstractions.1 *Extract common features from a set of interrelated processes or complex phenomena.* P4.Developing and Using Abstractions.2 *Model phenomena and processes and simulate systems to understand and evaluate potential outcomes* P4.Developing and Using Abstractions.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P5.Creating Computational Artifacts.1 *Plan the development of a computational artifact using an iterative process that includes reflection on and modification of the plan, taking into account key features, time and resource constraints, and user expectations.* P5.Creating Computational Artifacts.2	(CRP) Career Ready Practices *2. Apply academic & technical skills.* *Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make correct insights about when to apply the use of an academic skill.* *4. Communicate clearly, effectively and with reason.* *Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods.* *5. Consider the environmental, social, and economic impacts of decisions. Career-ready individuals are aware and utilize new technologies, understandings, procedures, materials, and regulations.* *6. Demonstrate creativity and innovation.* *Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization.* *7. Employ valid and reliable research strategies.*	• Collaborative • Self-directed • Innovative • Critical-thinking • Communication • Reflection • Revision • Design-thinking • Use technology

	• Analyze the structure of the relationships among concepts in a text, including relationships among key terms CCSS.ELA-LITERACY.RST.9-10.6 • Analyze the author's purpose in providing an explanation describing a procedure, or discussing an experiment in a text, defining the questions the author seeks to address CCSS.ELA-LITERACY.RST.9-10.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words CCSS.ELA-LITERACY.RST.9-10.8 • Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem CCSS.ELA-LITERACY.RST.9-10.9 • Compare and contrast findings presented in a text to those from other sources (including own experiments) noting	the origin in graphs and data displays CCSS.MATH-CONTENT.HSN.Q.A.2 • Define appropriate quantities for the purpose of descriptive modeling CCSS.MATH-CONTENT.HSN.Q.A.3 • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities CCSS.MATH.CONTENT.HSF.LEA.1.C • Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another CCSS.MATH.CONTENT.HSG.MG.A.3 • Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios) CCSS.MATH.CONTENT.HSF.LE.A.2 • Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs	• Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	*Create a computational artifact for practical intent, personal expression, or to address a societal issue.* P5.Creating Computational Artifacts.3 *Create modules and develop points of interaction that can apply to multiple situations and reduce complexity.* P6.Testing and Refining Computational Artifacts.1 *Systematically test computational artifacts by considering all scenarios and using test cases.* P6.Testing and Refining Computational Artifacts.2 *Identify and fix errors using a systematic process.* P6.Testing and Refining Computational Artifacts.3 *Evaluate and refine a computational artifact multiple times to enhance its performance, reliability, usability, and accessibility.* P7.Communicating About Computing.2 *Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience.* *Concepts* 6-8.Computing Systems.Devices *The interactions between humans and computing devices presents advantages, disadvantages, and unintended consequences. The study of human-computer interaction can improve the design of devices and extend the abilities of humans.* 6-8.Computing Systems.Hardware and Software *Hardware and software determine a computing system's capability to store and process information. The design or selection of a computing system involves multiple tradeoffs, such as functionality, cost, size, speed, accessibility, and aesthetics.* 6-8.Computing Systems.Troubleshooting *Comprehensive troubleshooting requires knowledge of how computing devices and*	*Career-ready individuals are discerning and use new information to make decisions.* *8. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals devise effective plans to solve problems.* *11. Use technology to enhance productivity. Career-ready individuals find and maximize the productive value of existing technology to accomplish tasks and solve problems. They are flexible and adaptive in acquiring and using new technology.* *12. Work productively in teams while using cultural/global competence. Career-ready individuals positively contribute to every team, whether formal or informal. They find ways to increase the engagement and contribution of all team members.* (IT) Information Tech Career *2. Use design process to produce quality product or service* *11. Hardware components* *12. Compare software functions and applications* (IT-SUP) Information Support *4. Perform installation, configuration and maintenance of operating systems.* (IT-PRG) Programming/Software *4. Software development tools*	

	when the findings support or contradict CCSS.ELA-LITERACY.RST.9-10.10 ● Read and comprehend science/technical texts independently and proficiently	(include reading these from a table) CCSS.MATH.CONTENT.HSF.LE.B.5 ● Interpret the parameters in a linear or exponential function in terms of a context CCSS.MATH.CONTENT.HSA.SSE.A.1 ● Interpret expressions that represent a quantity in terms of its context CCSS.MATH.CONTENT.HSA.REI.B.3 ● Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters		*components work and interact. A systematic process will identify the source of a problem, whether within a device or in a larger system of connected devices.* 6-8.Networks and the Internet.Network Communication and Organization *Computers send and receive information based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and reliability are used to determine the best path to send and receive data.* 6-8.Data Analysis.Collection *People design algorithms and tools to automate the collection of data by computers. When data collection is automated, data is sampled and converted into a form that a computer can process. For example, data from an analog sensor must be converted into digital form. The method used to automate data collection is influenced by the availability of tools and the intended use of the data.* 6-8.Data Analysis.Storage *Applications store data as a representation. Representations occur at multiple levels, from the arrangement of information into organized formats (such as tables in software) to the physical storage of bits. The software tools used to access information translate the low-level representation of bits into a form understandable by people.* 6-8.Algorithms and Programming.Variables *Programmers create variables to store data values of selected types. A meaningful identifier is assigned to each variable to access and perform operations on the value by name. Variables enable the flexibility to represent different situations, process different sets of data, and produce varying outputs.* 6-8.Algorithms and Programming.Control *Programmers select and combine control structures, such as loops, event handlers, and*	*5. Software development process* *6. Program CPU application* *7. Software testing* *8. Quality assurance* (ST) STEM Careers *1. Apply engineering skills in a project that requires project management, process control and quality assurance* *2. Use technology to acquire, manipulate, analyze, and report data* *3. Describe and follow safety, health and environmental standards related to STEM workplaces* *4. Understand the nature and scope of STEM careers and role of STEM in society and the economy* *6. Tech skills in STEM* (ST-ET) STEM Engineering Tech *1. Use STEM concepts and processes to solve problems involving design and/or production* *3. Apply processes and concepts for the use of technological tools in STEM* *4. Apply the elements of the design process* *5. Apply the knowledge learned in STEM to solve problems* (ST-SM) Science & Mathematics *1. Apply science and mathematics to provide results, answers, and algorithms for engineering and technological activities*	

				conditional, to create more complex program behavior. 6-8.Algorithms and Programming.Modularity *Programs use procedures to organize code, hide implementation details, and make code easier to reuse. Procedures can be repurposed in new programs. Defining parameters for procedures can generalize behavior and increase reusability.* 6-8.Impacts of Computing.Culture *Advancements in computing technology change people's everyday activities. Society is faced with tradeoffs due to the increasing globalization and automation that computing brings.*	*2. Apply science and mathematics concepts to the development of plans, processes, and projects that address real-world problems*	

1. K-12 Computer Science Framework. (2016). *Framework view by grade band.* Retrieved from http://www.k12cs.org