Chapter 1 / Getting Started

Common Core State	Common Core State	Next Generation	K-12 Computer Science	Career Technical	21st Century
Standards (ELA)	Standards (Math)	Science Standards	Framework ¹	Education Standards	Competencies
		(NGSS)		(CTE)	-
CCSS.ELA-LITERACY.RST.9-1 0.4 • Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-1 0.7 • 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 Artifacts.3 Evaluate and refine a computational Artifacts.3 Evaluate and refine a computational Artifacts.3 Forcessibility. 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 resolution and software determine a computing system's capability to store and cases information. 	(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
	Common Core State Standards (ELA) CCSS.ELA-LITERACY.RST.9-1 0.4 Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-1 0.7 Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words	Common Core State Standards (ELA)Common Core State Standards (Math)CCSS.ELA-LITERACY.RST.9-1 0.40.4Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical contextCCSS.ELA-LITERACY.RST.9-1 0.7.7Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words	Common Core State Standards (ELA) Common Core State Standards (Math) Next Generation Science Standards (NGSS) CCSS.ELA-LITERACY.RST.9-1 0.4 Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context Image: Common Core State Standards (Math) Image: Common Core State Science Standards (NGSS) CCSS.ELA-LITERACY.RST.9-1 0.7 Image: Common Core State in words in a text into visual form and translate information expressed visually or mathematically into words Image: Common Core State in words Image: Common Core State Science Standards (NGSS)	Common Core State Standards (ELA) Common Core State Standards (Math) Next Generation Science Standards (NGSS) K-12 Computer Science Framework ¹ 0.4 • Determine meaning of symbols, key terms, and domain-specific words and phrase in scientific or technical context Practices P4 Developing and Using Abstractions.2 Model phenome and processes and simulate systems to understand and evaluate potential outcomes 0.7 • Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words 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.3 Systematically test 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.3 P6.Testing and Refining Computational Artifacts.3 P6.Testing and Refining Computational Artifacts.3 P6.Testing and Refining Computational Artifacts.3 P6.Testing and Refining Computational Artifacts.3 P7.Computer and refine a computational Artifacts.3 P7.Communicating About Computing.3 P7.Computer and refine a computational Artifacts.3 P7.Computer and refine a computational Artifacts.3 P7.Computer and refine a computational Artifacts.3 P7.Computing About Computing.3	Common Core State Standards (ELA) Common Core State Standards (Math) Next Generation Science Standards K-12 Computer Science Framework ¹ Career Technical Education Standards (NGSS) CCSS.ELA-LITERACY.RST.9-1 U.4 Practices Practices (CRP) Career Ready Practices 2. Apply codemic & technical Multip systems to undenstand and evaluate potential outdoms 2. Apply codemic & technical Multip systems to undenstand and evaluate systems to undenstand and evaluate systems to undenstand and recent evaluate potential outdoms 2. Apply codemic & technical Multip systems to undenstand and evaluate systems to undenstand and fractista. 2. Apply codemic & technical Multip systems to undenstand and evaluate systems outperstand and fractista. CCRP Career Ready Practices 2. Apply codemic & technical Multip systems to undenstand and evaluate systems outperstand and fractista. CCRP Career Ready Practices 2. Apply codemic & technical Multip systems to undenstand and evaluate system composition of interaction that computational Artifacts.3 Create and could using tec- tor address a societal issue or technical in words in a text into visual form and translate information expressed in words in a text into words PS Testing and Refining Computational Artifacts.1 Systematically text computational Artifacts.3 Evaluate and refine a computational Ar



	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
	alphalization and automation that
	computing brings



Common Core State Common Core State Concepts **Next Generation K-12 Computer Science Career Technical** 21st Century Vocabulary Standards (ELA) Standards (Math) **Science Standards Framework**¹ **Education Standards** Competencies (NGSS) (CTE) Servo CCSS.ELA-LITERACY.RST.9-1 CCSS.MATH.CONTENT.HSG. HS-PS3-1 Practices (CRP) Career Ready Practices Collaborative Motors 0.1 MG.A.3 Create a P1.Fostering an Inclusive Computing 2. Apply academic & Self-directed • Cite specific textual computational model technical skills. Career-ready Innovative Displaying Apply geometric Culture.1 Messages evidence to support methods to solve to calculate the Include the unique perspectives of others individuals readily access and Critical-thinking LED circuit analysis of science and design problems (e.g., and reflect on one's own perspectives when use the knowledge and skills Communication change in energy of • HIGH LOW technical texts, designing an object or one component in a designing and developing computational acquired through experience Reflection signals attending to precise structure to satisfy system when the products. and education. They make Revision • Storing details of explanations physical constraints or change in energy of P4.Developing and Using Abstractions.1 correct insights about when Design-thinking Variables or descriptions minimize cost: working the other Extract common features from a set of to apply the use of an Use technology CCSS.ELA-LITERACY.RST.9-1 Counting & with typographic grid component(s) and interrelated processes or complex academic skill. Repeating 0.2 systems based on energy flows in and phenomena. 4. Communicate clearly, P4.Developing and Using Abstractions.2 Determine central ratios) out of the system are effectively and with reason. ideas or conclusions of CCSS.MATH.CONTENT.HSN. known Model phenomena and processes and Career-ready individuals HS-PS3-3 a text; trace text's Q.A.1 simulate systems to understand and communicate thoughts, explanation or • Use units as a way to • Design, build, and ideas, and action plans with evaluate potential outcomes depiction of a complex understand problems refine a device that P4.Developing and Using Abstractions.3 clarity, whether using process, phenomenon, and to guide the works within given Create modules and develop points of written. verbal. and/or visual or concept: provide solution of multi-step constraints to convert interaction that can apply to multiple methods. accurate summary problems; choose and one form of energy situations and reduce complexity. 6. Demonstrate creativity and CCSS.ELA-LITERACY.RST.9-1 into another form of interpret units P5.Creating Computational Artifacts.1 innovation. Career-ready 0.3 consistently in Plan the development of a computational individuals regularly think of energy Follow precisely and formulas; choose and artifact using an iterative process that ideas that solve problems in complex multistep includes reflection on and modification of interpret the scale and new and different ways, and procedure when the origin in graphs the plan, taking into account key features, they contribute those ideas in carrying out and data displays time and resource constraints, and user a useful and productive experiments, taking CCSS.MATH.CONTENT.HSN. expectations. manner to improve their measurements. or Q.A.2 P5.Creating Computational Artifacts.2 oraanization. performing technical • Define appropriate Create a computational artifact for 8. Utilize critical thinking to tasks quantities practical intent, personal expression, or to make sense of problems and CCSS.ELA-LITERACY.RST.9-1 CCSS.MATH.CONTENT.HSN. address a societal issue. persevere in solving them. 0.4 Q.A.3 P5.Creating Computational Artifacts.3 Career-ready individuals • Determine meaning of Choose a level of Create modules and develop points of devise effective plans to solve symbols, key terms, accuracy appropriate interaction that can apply to multiple problems. and domain-specific to limitations on situations and reduce complexity. 11. Use technology to words and phrases in measurement when P6.Testing and Refining Computational enhance productivity. scientific or technical reporting quantities Artifacts.1 Career-ready individuals find CCSS.MATH.PRACTICE.MP1 Systematically test computational artifacts and maximize the productive context CCSS.ELA-LITERACY.RST.9-1 Make sense of by considering all scenarios and using test value of existing technology 0.5 problems and cases. to accomplish tasks and solve

Chapter 2 / Simple Programs / Simple Circuits



problems. They are flexible

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



experiments) noting		into a form that a computer can process.	2. Use design process to
when the findings		For example, data from an analog sensor	produce quality product or
support or contradio		must be converted into digital form. The	service
CCSS.ELA-LITERACY.RST.9		method used to automate data collection is	11. Hardware components
0.10		influenced by the availability of tools and	12. Compare software
 Read and comprehe 	d	the intended use of the data.	functions and applications
science/technical te	s	6-8. Algorithms and Programming. Variables	(IT-PRG)
independently and		Programmers create variables to store data	Programming/Software
proficiently		values of selected types. A meaningful	4. Software development
		identifier is assigned to each variable to	tools
		access and perform operations on the value	5. Software development
		by name. Variables enable the flexibility to	process
		represent different situations, process	6. Program CPU application
		different sets of data, and produce varying	7. Software testing
		outputs.	8. Quality assurance
		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 3 / Mechanical Assembly

Concepts	Common Core State	Common Core State	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA)	Standards (Math)	Science Standards	Framework ¹	Education Standards	Competencies
_			(NGSS)		(CTE)	-
 Robot Assembly Sound with Piezo Speed Control 	 CCSS.ELA-LITERACY.RST.9-1 0.1 Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-1 0.2 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.9-1 0.3 Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-1 0.4 Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-1 0.5 	 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 Artifacts.2 Create a computational Artifact for practical intent, personal expression, or to address a societal issue. P5.Creating Computational Artifact for practical intent, personal expression, or to address a societal issue. 	 (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 	the origin in graphs	Create modules and develop points of	and adaptive in acquiring and	
of the relationships	and data displays	interaction that can apply to multiple	using new technology.	
among concepts in a	CCSS.MATH-CONTENT.HSN.	situations and reduce complexity.	(ST) STEM Careers	
text, including	Q.A.2	P6.Testing and Refining Computational	6. Tech skills in STEM	
relationships among	 Define appropriate 	Artifacts.1	(ST-ET) STEM Engineering Tech	
key terms	quantities for the	Systematically test computational artifacts	1. Use STEM concepts and	
CCSS.ELA-LITERACY.RST.9-1	purpose of descriptive	by considering all scenarios and using test	processes to solve problems	
0.6	modeling	cases.	involving design and/or	
 Analyze the author's 	CCSS.MATH.CONTENT.HSN.	P6.Testing and Refining Computational	production	
purpose in providing	Q.A.3	Artifacts.2	3. Apply processes and	
an explanation	 Choose a level of 	Identify and fix errors using a systematic	concepts for the use of	
describing a	accuracy appropriate	process.	technological tools in STEM	
procedure, or	to limitations on	P6.Testing and Refining Computational	4. Apply the elements of the	
discussing an	measurement when	Artifacts.3	design process	
experiment in a text,	reporting quantities	Evaluate and refine a computational	5. Apply the knowledge	
defining the questions	CCSS.MATH.CONTENT.HSF.L	artifact multiple times to enhance its	learned in STEM to solve	
the author seeks to	EA.1.C	performance, reliability, usability, and	problems	
address	 Recognize situations in 	accessibility.	(ST-SM) Science &	
CCSS.ELA-LITERACY.RST.9-1	which a quantity grows	P7.Communicating About Computing.2	Mathematics	
0.7	or decays by a constant	Describe, justify, and document	1. Apply science and	
 Translate quantitative 	percent rate per unit	computational processes and solutions	mathematics to provide	
or technical	interval relative to	using appropriate terminology consistent	results, answers, and	
information expressed	another	with the intended audience and purpose.	algorithms for engineering	
in words in a text into	CCSS.MATH.CONTENT.HSG.		and technological activities	
visual form and	MG.A.3	Concepts	2. Apply science and	
translate information	 Apply geometric 	6-8.Computing Systems.Hardware and	mathematics concepts to the	
expressed visually or	methods to solve	Software	development of plans,	
mathematically into	design problems (e.g.,	Hardware and software determine a	processes, and projects that	
words	designing an object or	computing system's capability to store and	address real-world problems	
CCSS.ELA-LITERACY.RST.9-1	structure to satisfy	process information. The design or selection		
0.8	physical constraints or	of a computing system involves multiple		
 Assess the extent to 	minimize cost; working	tradeoffs, such as functionality, cost, size,		
which the reasoning	with typographic grid	speed, accessibility, and aesthetics.		
and evidence in a text	systems based on	6-8.Computing Systems.Troubleshooting		
support the author's	ratios)	Comprehensive troubleshooting requires		
claim or a		knowledge of how computing devices and		
recommendation for		components work and interact. A		
solving a scientific or		systematic process will identify the source		
technical problem		of a problem, whether within a device or in		
CCSS.ELA-LITERACY.RST.9-1		a larger system of connected devices.		
0.9		6-8.Networks and the Internet.Network		
 Compare and contrast 		Communication and Organization		
findings presented in a		Computers send and receive information		
text to those from		based on a set of rules called protocols.		
other sources		Protocols define how messages between		
(including own		computers are structured and sent.		



experiments) noting		Considerations of security, speed, and	
when the findings		religibility are used to determine the best	
support or contradict		nath to send and receive data	
support of contradict		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	
		nito a jorni 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 varving	
		outputs	
		6-8. Algorithms and Programming. Control	
		Programmers select and combine control	
		structures such as loops event handlers	
		and conditionals to create more complex	
		nrogram hebavior	
		program benavior.	



Chapter 4 / Basic Navigation

Concepts	Common Core State	Common Core State	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA)	Standards (Math)	Science Standards	Framework ¹	Education Standards	Competencies
			(NGSS)		(CTE)	-
 Maneuvers Distances Ramping up/down speed Subroutines/ Functions Complex Maneuvers 	 CCSS.ELA-LITERACY.RST.9-1 0.1 Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-1 0.2 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.9-1 0.3 Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-1 0.4 Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context CCSS.ELA-LITERACY.RST.9-1 0.5 	 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 Artifacts.3 Create modules and develop points of interaction that can apply to multiple situations distraction of the plan, taking into account key features, time and resource constraints, and user expectations. P5.Creating Computational Artifacts.2 Create a 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 	persevere in solving	Identify and fix errors using a systematic	3. Apply processes and	
of the relationships	them	process.	concepts for the use of	
among concepts in a	CCSS.MATH.PRACTICE.MP2	P6.Testing and Refining Computational	technological tools in STEM	
text, including	 Reason abstractly and 	Artifacts.3	4. Apply the elements of the	
relationships among	quantitatively	Evaluate and refine a computational artifact	design process	
key terms	CCSS.MATH.PRACTICE.MP3	multiple times to enhance its performance,	5. Apply the knowledge	
CCSS.ELA-LITERACY.RST.9-1	Construct viable	reliability, usability, and accessibility.	learned in STEM to solve	
0.6	arguments and critique	P7.Communicating About Computing.2	problems	
 Analyze the author's 	the reasoning of others	Describe, justify, and document	(ST-SM) Science &	
purpose in providing	CCSS.MATH.PRACTICE.MP4	computational processes and solutions using	Mathematics	
an explanation	 Model with 	appropriate terminology consistent with the	1. Apply science and	
describing a	mathematics	intended audience and purpose.	mathematics to provide	
procedure, or	CCSS.MATH.PRACTICE.MP5		results, answers, and	
discussing an	 Use appropriate tools 	Concepts	algorithms for engineering	
experiment in a text,	strategically	6-8.Computing Systems.Hardware and	and technological activities	
defining the questions	CCSS.MATH.PRACTICE.MP6	Software	2. Apply science and	
the author seeks to	 Attend to precision 	Hardware and software determine a	mathematics concepts to	
address	CCSS.MATH.PRACTICE.MP7	computing system's capability to store and	the development of plans,	
CCSS.ELA-LITERACY.RST.9-1	 Look for and make use 	process information. The design or selection	processes, and projects that	
0.7	of structure	of a computina system involves multiple	address real-world problems	
 Translate quantitative 	CCSS.MATH.PRACTICE.MP8	tradeoffs. such as functionality. cost. size.		
or technical	 Look for and express 	speed, accessibility, and aesthetics.		
information expressed	regularity in repeated	6-8. Computing Systems. Troubleshooting		
in words in a text into	reasoning	Comprehensive troubleshooting requires		
visual form and		knowledge of how computing devices and		
translate information		components work and interact. A systematic		
expressed visually or		process will identify the source of a		
mathematically into		problem, whether within a device or in a		
words		larger system of connected devices.		
CCSS.ELA-LITERACY.RST.9-1		6-8.Networks and the Internet.Network		
0.8		Communication and Organization		
 Assess the extent to 		Computers send and receive information		
which the reasoning		based on a set of rules called protocols.		
and evidence in a text		Protocols define how messages between		
support the author's		computers are structured and sent.		
claim or a		Considerations of security, speed, and		
recommendation for		reliability are used to determine the best		
solving a scientific or		path to send and receive data.		
technical problem		6-8.Data Analysis.Collection		
CCSS.ELA-LITERACY.RST.9-1		People design algorithms and tools to		
0.9		automate the collection of data by		
 Compare and contrast 		computers. When data collection is		
findings presented in a		automated, data is sampled and converted		
text to those from		into a form that a computer can process.		
other sources		For example, data from an analoa sensor		
(including own		must be converted into diaital form. The		
,				



experiments) r	noting	method used to automate data collection is	
when the findi	ngs	influenced by the availability of tools and	
support or con	tradict	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



Parallax Robotics (Boe-Bot, Shield-Bot, ActivityBot) Curricula and Tutorials

 Analyze the structure 	 Interpret expressions 	Create modules and develop points of	involving design and/or	
of the relationships	that represent a	interaction that can apply to multiple	production	
among concepts in a	quantity in terms of its	situations and reduce complexity.	3. Apply processes and	
text, including	context	P6.Testing and Refining Computational	concepts for the use of	
relationships among	CCSS.MATH.CONTENT.HSA.	Artifacts.1	technological tools in STEM	
key terms	REI.B.3	Systematically test computational artifacts	4. Apply the elements of the	
CCSS.ELA-LITERACY.RST.9-1	 Solve linear equations 	by considering all scenarios and using test	design process	
0.6	and inequalities in one	cases.	5. Apply the knowledge	
 Analyze the author's 	variable, including	P6.Testing and Refining Computational	learned in STEM to solve	
purpose in providing	equations with	Artifacts.2	problems	
an explanation	coefficients	Identify and fix errors using a systematic	(ST-SM) Science &	
describing a	represented by letters	process	Mathematics	
procedure, or	represented by letters	P6 Testing and Refining Computational	1. Apply science and	
discussing an		Artifacts 3	mathematics to provide	
experiment in a text		Evaluate and refine a computational artifact	results answers and	
defining the questions		multiple times to enhance its performance	algorithms for engineering	
the author seeks to		reliability usability and accessibility	and technological activities	
address		P7 Communicating About Computing 2	2 Annly science and	
CCSS ELA-LITERACY RST 9-1		Describe justify and document	mathematics concents to the	
0.7		computational processes and solutions using	development of plans	
 Translate quantitative 		appropriate terminology consistent with the	processes and projects that	
or technical		intended audience	address real-world problems	
information expressed		interfaca addience.	uuress reur world problems	
in words in a text into		Concents		
visual form and		6-8 Computing Systems Devices		
translate information		The interactions between humans and		
expressed visually or		computing devices presents advantages		
mathematically into		disadvantages and unintended		
words		consequences. The study of		
		human computer interaction can improve		
0.8		the design of devices and extend the abilities		
• Assass the extent to		of humans		
• Assess the extent to		6.8 Computing Systems Hardware and		
and ovidence in a text		Software		
support the author's		Hardware and coftware determine a		
support the author's		computing system's capability to store and		
recommendation for		process information. The design or selection		
recommendation for		of a computing system involves multiple		
tochnical problem		by a comparing system involves mattiple		
		speed accessibility and aesthetics		
0.0		Speed, accessibility, and describerios.		
U.7		Comprehensive troublesheating requires		
Compare and contrast findings presented in a		comprehensive troubleshooting requires		
tout to the section of a		knowledge of now computing devices and		
text to those from		components work and interact. A systematic		
other sources		process will identify the source of a problem,		
(including own				



experiments) noting when the findings support or contradictwhether 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	
when the findings system of connected devices. support or contradict 6-8.Networks and the Internet.Network Communication and Organization Communication 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	
support or contradict 6-8.Networks and the Internet.Network Communication and Organization Communication 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	
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	
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	
based on a set of rules called protocols. Protocols define how messages between computers are structured and sent. Considerations of security, speed, and	
Protocols define how messages between computers are structured and sent. Considerations of security, speed, and	
computers are structured and sent. Considerations of security, speed, and	
Considerations of security, speed, and	
considerations of secarity, speed, and	
relightlity are used to determine the hest	
nath to serve dard and receive data	
6-8 Data Analysis Collection	
Beople design allocithms and tools to	
automate the collection of data by	
computers, when dota converted	
into a form that a computer can process, For	
example, data from an analog sensor must	
be converted how to algreat form. The method	
used to automate data collection is	
influencea 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	
proaram 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
chanae people's everyday activities. Society
is faced with tradeoffs due to the increasing
alobalization and automation that
computing brings.



Concepts	Common Core State	Common Core State	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA)	Standards (Math)	Science Standards	Framework ¹	Education Standards	Competencies
-			(NGSS)		(CTE)	
Vocabulary Light-sensing Ohm's Law Adjusting light sensitivity Following a light Waves Ultrasound Time-of-flight 	Standards (ELA) CCSS.ELA-LITERACY.RST.9-1 0.1 Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions CCSS.ELA-LITERACY.RST.9-1 0.2 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.9-1 0.3 Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks CCSS.ELA-LITERACY.RST.9-1	Standards (Math) 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	 Science Standards (NGSS) 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 	Framework1PracticesP1.Fostering an Inclusive Computing Culture.1Include the unique perspectives of othersand reflect on one's own perspectives whendesigning and developing computationalproducts.P3.Recognizing and Defining ComputationalProblems.1Identify complex, interdisciplinary, real-worldproblems that can be solvedcomputationally.P3.Recognizing and Defining ComputationalProblems.2Decompose complex real-world problemsinto manageable subproblems that couldintegrate existing solutions or procedures.P3.Recognizing and Defining ComputationalProblems.3Evaluate whether it is appropriate andfeasible to solve a problem computationally.P4.Developing and Using Abstractions.1Extract common features from a set ofinterrelated processes or complexphenomena.P4.Developing and Using Abstractions.2Model phenomena and processes andsimulate systems to understand andevaluate potential outcomesP4.Developing and Using Abstractions.3Create modules and develop points of	Education Standards (CTE) (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	Competencies Competencies Collaborative Self-directed Innovative Critical-thinking Communication Reflection Revision Design-thinking Use technology
	0.4 • Determine meaning of	the origin in graphs and data displays	technological devices use the principles of	interaction that can apply to multiple situations and reduce complexity.	solve problems. They are flexible and adaptive in	
	symbols, key terms, and domain-specific	CCSS.MATH-CONTENT.HSN. Q.A.2	wave behavior and wave interactions with	P4.Developing and Using Abstractions.4 Model phenomena and processes and cimulate systems to understand and	acquiring and using new technology.	
	scientific or technical context	 Define appropriate quantities for the purpose of descriptive 	and capture information and	evaluate potential outcomes. P5.Creating Computational Artifacts.1	6. Tech skills in STEM (ST-ET) STEM Engineering	
	CCSS.ELA-LITERACY.RST.9-1	modeling	energy.	Plan the development of a computational	Tech	
	0.5	CCSS.MATH.CONTENT.HSA. SSE.A.1		artifact using an iterative process that includes reflection on and modification of	1. Use STEM concepts and processes to solve problems	

Chapter 6 / Navigation with Ultrasound / Navigation with Visible Light



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



experiments) noting		Hardware and software determine a	
when the findings		computing system's capability to store and	
support or contradict		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 analoa 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 hits. The	
		software tools used to access information	
		translate the low-level representation of hits	
		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	Common Core State	Common Core State	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA)	Standards (Math)	Science Standards	Framework ¹	Education Standards	Competencie
-			(NGSS)		(CTE)	S
 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	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.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	 (NGSS) 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 	 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. 	(CTE) (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	S Collaborative Self-directed Innovative Critical-thinking Communication Reflection Revision Design-thinking Use technology
	CCSS.ELA-LITERACY.RST.9-10	modeling	energy.	societal issue.	Tech	
	.5	SSE.A.1		P5.Creating Computational Artifacts.3	1. Use STEM concepts and processes to solve problems	



Parallax Robotics (Boe-Bot, Shield-Bot, ActivityBot) Curricula and Tutorials

 Analyze the structure 	 Interpret expressions 	Create modules and develop points of	involving design and/or	
of the relationships	that represent a	interaction that can apply to multiple	production	
among concepts in a	quantity in terms of its	situations and reduce complexity.	3. Apply processes and	
text, including	context	P6.Testing and Refining Computational	concepts for the use of	
relationships among	CCSS.MATH.CONTENT.HSA.	Artifacts.1	technological tools in STEM	
key terms	REI.B.3	Systematically test computational artifacts	4. Apply the elements of the	
CCSS.ELA-LITERACY.RST.9-10	 Solve linear equations 	by considering all scenarios and using test	design process	
.6	and inequalities in one	cases.	5. Apply the knowledge	
 Analyze the author's 	variable, including	P6.Testing and Refining Computational	learned in STEM to solve	
purpose in providing an	equations with	Artifacts.2	problems	
explanation describing	coefficients	Identify and fix errors using a systematic	(ST-SM) Science &	
a procedure, or	represented by letters	process.	Mathematics	
discussing an		P6.Testing and Refining Computational	1. Apply science and	
experiment in a text.		Artifacts 3	mathematics to provide	
defining the questions		Evaluate and refine a computational artifact	results, answers, and	
the author seeks to		multiple times to enhance its performance.	algorithms for engineering	
address		reliability, usability, and accessibility.	and technological activities	
CCSS FLA-LITERACY RST 9-10		P7 Communicating About Computing 2	2. Apply science and	
.7		Describe, justify, and document	mathematics concents to	
 Translate quantitative 		computational processes and solutions using	the development of plans.	
or technical		appropriate terminology consistent with the	processes, and projects that	
information expressed		intended audience.	address real-world problems	
in words in a text into				
visual form and		Concents		
translate information		6-8 Computing Systems Devices		
expressed visually or		The interactions between humans and		
mathematically into		computing devices presents advantages.		
words		disadvantages, and unintended		
CCSS FLA-LITERACY RST 9-10		consequences. The study of		
.8		human-computer interaction can improve		
 Assess the extent to 		the design of devices and extend the abilities		
which the reasoning		of humans		
and evidence in a text		6-8 Computing Systems Hardware and		
support the author's		Software		
claim or a		Hardware and software determine a		
recommendation for		computing system's capability to store and		
solving a scientific or		process information. The design or selection		
technical problem		of a computing system involves multiple		
CCSS FLA-LITERACY RST 9-10		tradeoffs, such as functionality, cost, size		
.9		speed, accessibility, and aesthetics		
 Compare and contrast 		6-8.Computing Systems.Troubleshooting		
findings presented in a		Comprehensive troubleshooting requires		
text to those from		knowledge of how computing devices and		
other sources		components work and interact. A systematic		
(including own		process will identify the source of a problem		
experiments) noting		process with activity the source of a problem,		
experimental noting			1	1



when the findings		whether within a device or in a larger system	
support or contradict		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 analoa sensor must	
		be converted into diaital 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

Standards (ELA)	Standards (Math)	Science Standards	Eramowork ¹		
S.ELA-LITERACY.RST.9-10			FIGHTEWOIK	Education Standards	Competencies
S.ELA-LITERACY.RST.9-10		(NGSS)		(CTE)	-
Cite specific textual evidence to support analysis of science and technical texts, attending to precise details of explanations or descriptions S.ELA-LITERACY.RST.9-10 Determine central ideas or conclusions of a text; trace text's explanation or depiction of a complex process, phenomenon, or concept; provide accurate summary S.ELA-LITERACY.RST.9-10 Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks S.ELA-LITERACY.RST.9-10 Determine meaning of symbols, key terms, and domain-specific words and phrases in scientific or technical context S.ELA-LITERACY.RST.9-10	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.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 	 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 	 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. 	(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.	 Collaborative Self-directed Innovative Critical-thinking Communication Reflection Revision Design-thinking Use technology
a a c c c c c c c c c c c c c c c c c c	Attending to precise details of explanations or descriptions ELA-LITERACY.RST.9-10 Determine central deas or conclusions of a text; trace text's explanation or lepiction of a complex process, phenomenon, or concept; provide incurate summary ELA-LITERACY.RST.9-10 Follow precisely and complex multistep procedure when carrying out experiments, taking measurements, or performing technical asks ELA-LITERACY.RST.9-10 Determine meaning of ymbols, key terms, ind domain-specific vords and phrases in cientific or technical context ELA-LITERACY.RST.9-10	 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 make use of structure CCSS.MATH.PRACTICE.MP8 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 	Attending to precise letails of explanations or descriptionsReason abstractly and quantitativelysystem when the change in energy of the other component(s) and energy flows in and out of the system are known2LA-LITERACY.RST.9-10CCSS.MATH.PRACTICE.MP3out of the system are known2LA-LITERACY.RST.9-10Model with mathematicsout of the system are known2LA-LITERACY.RST.9-10Model with mathematicsHS-PS3-30 COSS.MATH.PRACTICE.MP4Model with mathematicsDesign, build, and refine a device that works within given constraints to convert one form of energy into another form of energy10 low precisely and corcedure when arrying out experiments, taking measurements, or berforming technical asksCCSS.MATH.PRACTICE.MP7 Look for and make use of structure cCSS.MATH.PRACTICE.MP8Use mathematical regrading regularity in repeated reasoning2LA-LITERACY.RST.9-10Use 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 andUse units as and storage of information.* LA-LITERACY.RST.9-10formulas; choose and interpret the scale andHS-PS4-2	Ittending to precise letails of explanations quantitatively• Reason abstractly and quantitativelysystem when the change in energy of the otherP3.Recognizing and Defining Computational problems.1redescriptions ELA-LITERACY.RST.9-10CCSS.MATH.PRACTICE.NP3 of otherssystem when the component(s) and energy flows in and out of the system are knownP3.Recognizing and Defining Computational problems.1betermine central deas or conclusions of resplanation or lepiction of a complex rocoses, phenomenon, cost.MATH.PRACTICE.NP5Statesting solutions or mathematicsP3.Recognizing and Defining Computational problems.1CSS.MATH.PRACTICE.NP5 trace text's corcometry provide corcarte summaryCSS.MATH.PRACTICE.NP5 to Los Appropriate tools strategicallyStatesting solutions or procedures. energyP3.Recognizing and Defining Computational problems.1CCSS.MATH.PRACTICE.NP5 to concetry provide corcarte summaryCSS.MATH.PRACTICE.NP5 to Los Appropriate tools strategicallyStatesting solutions or procedures. energyP3.Recognizing and Defining Computational problems.1CCSS.MATH.PRACTICE.NP5 to constructureCCSS.MATH.PRACTICE.NP6 to Attend to precision of structureHS-PS4-1Integrate existing solutional interrelated processes or complex interrelated processes or complex problems.1CCSS.MATH.PRACTICE.NP6 to procestry synchems, data regurating in reparated regurating technical asksCCSS.MATH.PRACTICE.NP6 to solution of multi-step regurating in reparated regurating to down in regurations process and interretureP3.Recognizing and Defining Computational problems.1CC	ettending to precise letails of explanations or description cCSS.MATH.PRACTICE.MP3system when the quantitatively or description arguments and arguments and critique the reasoning of otherssystem when the change in energy of the otherP3.Recognizing and Defining Computational problems.1 problems.1 problems.2acquired through experience and education. They make correct insights about when to apply the use of an acdamic skill.2LA-LITERACY.RST.9-10Construct viable arguments and critique the reasoning of othersSystem when the component(5) and out of the system are knownP3.Recognizing and Defining Computational problems.2acquired through explanational Problems.2Lext: trace text's corescs, phenomenon, corectorest provide corectares summary strategicallyCSS.MATH.PRACTICE.MP4 to Design, build, and refine a device that works within given or concept; provide corectares summaryP3.Recognizing and Defining Computational problems.3 <i>acquire divacation.</i> the order could with reason. Career-ready individuals regresentations to phenomena.CSS.MATH.PRACTICE.MP6 to Residue to precisionDesign, build, and refine a device that works within given to active ther usingP3.Recognizing and Defining Computationally. P3.Recognizing and Defining Computational the readomic skill. <i>acquire divacation.</i> the order could with reason. Career-ready individuals regresentation to representation to representation to representations to representations to representations to representations to representations to representations to representations to representations to representations to resoning technical actint precessor and



Analyze the structure	the origin in graphs	Communicate	Create a computational artifact for practical	Career-ready individuals are	
of the relationships	and data displays	technical information	intent, personal expression, or to address a	discerning and use new	
among concepts in a	CCSS.MATH-CONTENT.HSN.	about how some	societal issue.	information to make	
text, including	Q.A.2	technological devices	P5.Creating Computational Artifacts.3	decisions.	
relationships among	 Define appropriate 	use the principles of	Create modules and develop points of	8. Utilize critical thinking to	
key terms	quantities for the	wave behavior and	interaction that can apply to multiple	make sense of problems	
CCSS.ELA-LITERACY.RST.9-10	purpose of descriptive	wave interactions	situations and reduce complexity.	and persevere in solving	
.6	modeling	with matter to	P6.Testing and Refining Computational	them. Career-ready	
 Analyze the author's 	CCSS.MATH-CONTENT.HSN.	transmit and capture	Artifacts.1	individuals devise effective	
purpose in providing an	Q.A.3	information and	Systematically test computational artifacts	plans to solve problems.	
explanation describing	 Choose a level of 	energy.	by considering all scenarios and using test	11. Use technology to	
a procedure, or	accuracy appropriate		cases.	enhance productivity.	
discussing an	to limitations on		P6.Testing and Refining Computational	Career-ready individuals	
experiment in a text,	measurement when		Artifacts.2	find and maximize the	
defining the questions	reporting quantities		Identify and fix errors using a systematic	productive value of existing	
the author seeks to	CCSS.MATH.CONTENT.HSF.		process.	technology to accomplish	
address	LEA.1.C		P6.Testing and Refining Computational	tasks and solve problems.	
CCSS.ELA-LITERACY.RST.9-10	 Recognize situations in 		Artifacts.3	They are flexible and	
.7	which a quantity		Evaluate and refine a computational artifact	adaptive in acquiring and	
 Translate quantitative 	grows or decays by a		multiple times to enhance its performance,	using new technology.	
or technical	constant percent rate		reliability, usability, and accessibility.	12. Work productively in	
information expressed	per unit interval		P7.Communicating About Computing.2	teams while using	
in words in a text into	relative to another		Describe, justify, and document	cultural/global competence.	
visual form and	CCSS.MATH.CONTENT.HSG.		computational processes and solutions using	Career-ready individuals	
translate information	MG.A.3		appropriate terminology consistent with the	positively contribute to	
expressed visually or	 Apply geometric 		intended audience.	every team, whether formal	
mathematically into	methods to solve			or informal. They find ways	
words	design problems (e.g.,		Concepts	to increase the engagement	
CCSS.ELA-LITERACY.RST.9-10	designing an object or		6-8.Computing Systems.Devices	and contribution of all team	
.8	structure to satisfy		The interactions between humans and	members.	
 Assess the extent to 	physical constraints or		computing devices presents advantages,	(IT) Information Tech Career	
which the reasoning	minimize cost; working		disadvantages, and unintended	2. Use design process to	
and evidence in a text	with typographic grid		consequences. The study of human-computer	produce quality product or	
support the author's	systems based on		interaction can improve the design of devices	service	
claim or a	ratios)		and extend the abilities of humans.	11. Hardware components	
recommendation for	CCSS.MATH.CONTENT.HSF.		6-8.Computing Systems.Hardware and	12. Compare software	
solving a scientific or	LE.A.2		Software	functions and applications	
technical problem	 Construct linear and 		Hardware and software determine a	(IT-SUP) Information Support	
CCSS.ELA-LITERACY.RST.9-10	exponential functions,		computing system's capability to store and	4. Perform installation,	
.9	including arithmetic		process information. The design or selection	configuration and	
 Compare and contrast 	and geometric		of a computing system involves multiple	maintenance of operating	1
findings presented in a	sequences, given a		tradeoffs, such as functionality, cost, size,	systems.	1
text to those from	graph, a description of		speed, accessibility, and aesthetics.	(IT-PRG)	1
other sources	a relationship, or two		6-8.Computing Systems.Troubleshooting	Programming/Software	1
(including own	input-output pairs		Comprehensive troubleshooting requires	4. Software development	1
experiments) noting			knowledge of how computing devices and	tools	1



when the findings	(include reading these	components work and interact. A systematic	5. Software development	l
support or contradict	from a table)	process will identify the source of a problem,	process	
CCSS.ELA-LITERACY.RST.9-10	CCSS.MATH.CONTENT.HSF.	whether within a device or in a larger system	6. Program CPU application	l
.10	LE.B.5	of connected devices.	7. Software testing	l
 Read and comprehend 	 Interpret the 	6-8.Networks and the Internet.Network	8. Quality assurance	l
science/technical texts	parameters in a linear	Communication and Organization	(ST) STEM Careers	l
independently and	or exponential function	Computers send and receive information	1. Apply engineering skills	
proficiently	in terms of a context	based on a set of rules called protocols.	in a project that requires	l
	CCSS.MATH.CONTENT.HSA.	Protocols define how messages between	project management,	l
	SSE.A.1	computers are structured and sent.	process control and quality	l
	 Interpret expressions 	Considerations of security, speed, and	assurance	l
	that represent a	reliability are used to determine the best	2. Use technology to	l
	quantity in terms of its	path to send and receive data.	acquire, manipulate,	
	context	6-8.Data Analysis.Collection	analyze, and report data	l
	CCSS.MATH.CONTENT.HSA.	People design algorithms and tools to	3. Describe and follow	
	REI.B.3	automate the collection of data by	safety, health and	
	 Solve linear equations 	computers. When data collection is	environmental standards	l
	and inequalities in one	automated, data is sampled and converted	related to STEM	l
	variable, including	into a form that a computer can process. For	workplaces	l
	equations with	example, data from an analog sensor must	4. Understand the nature	l
	coefficients	be converted into digital form. The method	and scope of STEM careers	l
	represented by letters	used to automate data collection is	and role of STEM in society	l
		influenced by the availability of tools and the	and the economy	l
		intended use of the data.	6. Tech skills in STEM	l
		6-8.Data Analysis.Storage	(ST-ET) STEM Engineering	l
		Applications store data as a representation.	Tech	l
		Representations occur at multiple levels,	1. Use STEM concepts and	
		from the arrangement of information into	processes to solve	l
		organized formats (such as tables in	problems involving design	l
		software) to the physical storage of bits. The	and/or production	
		software tools used to access information	3. Apply processes and	l
		translate the low-level representation of bits	concepts for the use of	l
		into a form understandable by people.	technological tools in STEM	
		6-8.Algorithms and Programming.Variables	4. Apply the elements of	l
		Programmers create variables to store data	the design process	l
		values of selected types. A meaningful	5. Apply the knowledge	l
		identifier is assigned to each variable to	learned in STEM to solve	l
		access and perform operations on the value	problems	
		by name. Variables enable the flexibility to	(ST-SM) Science &	1
		represent different situations, process	Mathematics	1
		different sets of data, and produce varvina	1. Apply science and	1
		outputs.	mathematics to provide	1
		6-8.Algorithms and Programming.Control	results, answers, and	1
		Programmers select and combine control	algorithms for engineering	1
		structures, such as loops, event handlers, and	and technological activities	1
				-



	conditional, to create more complex program	2. Apply science and	
	hohquiar	mathematics concents to	
	benuvior.	induienduits concepts to	
	6-8.Algorithms and Programming.Modularity	the development of plans,	
	Programs use procedures to organize code,	processes, and projects that	
	hide implementation details, and make code	address real-world	
	easier to reuse. Procedures can be	problems	
	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.		

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

