PRE-REQUISITE(S)

Software Set-up for micro:bit

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
Editor Firmware Flash micro:bit Microbit Module Python	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3			Practices P4. Developing and Using Abstractions. 2 Evaluate existing technological functionalities and incorporate them into new designs. P5. Creating Computational Artifacts. 3 Modify an existing artifact to improve or customize it. 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. Concepts To 12. Computing Systems: Hardware and Software Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing. To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one	(CRP) Career Ready Practices 2. Apply appropriate academic skills 11. Use technology to enhance productivity (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 3. Apply processes and concepts for the use of technological tools in STEM. (IT-PRG) Programming & Software Dev. 3. Analyze system and software requirements to ensure maximum operating efficiency. 6. Program a computer application using the appropriate programming language.	Self-direction Technology Use

Follow precisely a complex they have seen before or adapt solutions multistep procedure when that have worked in the past. carrying out experiments, To 12. Algorithms and Programming: Control taking measurements, or Programmers consider tradeoffs related to performing technical tasks, implementations, readability, and program attending to special cases or performance when selecting and combining exceptions defined in the text. control structures. CCSS.ELA-LITERACY.RST.9-10.4 To 12. Impacts of Computing: Modularity Complex programs are designed as systems Determine the meaning of symbols, key terms, and other of interacting modules, each with a specific domain-specific words and role, coordinating for a common overall phrases as they are used in a purpose. These procedures; or independent, specific scientific or technical but interrelated, programs. Modules allow context relevant to grades for better management of complex tasks. 9-10 texts and topics. To 12. Impacts of Computing: Program CCSS.ELA-LITERACY.RST.9-10.5 Development Diverse teams can develop programs with a Analyze the structure of the relationships among concepts broad impact through careful review and by in a text, including drawing on the strengths of members in relationships among key terms different roles. Design decisions often (e.g., force, friction, reaction involve tradeoffs. The development of force, energy). complex programs is aided by resources CCSS.ELA-LITERACY.RST.9-10.10 such as libraries and tools to edit and By the end of grade 10, read manage parts of the program. Systematic and comprehend analysis is critical for identifying the effects science/technical texts in the of lingering bugs. grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCS	CSS.ELA-LITERACY.RST.11-12.1			
	By the end of grade 12, read and comprehend			
gr ba	grades 11-CCR text complexity pand independently and proficiently.			

Writing micro:bit Programs

Concepts	Common Core State	Common Core	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA) ²	State Standards	Science Standards	Framework ¹	Education Standards	Competencies
,	(,	(Math) ²	(NGSS) ⁴		(CTE) ³	
		(iviatii)	(14033)		(CIL)	
Comment (line,	CCSS.ELA-LITERACY.CCRA.R.1	CCSS.MATH.PRACTICE.M		Practices	(CRP) Career Ready Practices	Self-direction
block,	Read closely to determine	P2		P4: Developing and Using Abstractions. 2	2. Apply appropriate	Technology Use
docstring)	what the text says explicitly	Reason abstractly and		Evaluate existing technological	academic skills	Critical-thinking
 Condition 	and to make logical inferences	quantitatively.		functionalities and incorporate them into	11. Use technology to	Reflection
 Constant 	from it; cite specific textual	CCSS.MATH.PRACTICE.M		new designs.	enhance productivity	Revision
 Declaration 	evidence when writing or	P6		P4. Developing and Using Abstractions. 3	(ST) Stem Careers	Design-thinking
 Documenting 	speaking to support	Attend to precision.		Create modules and develop points of	Use technology to acquire,	
 Floating point 	conclusions drawn from the			interaction that can apply to multiple	manipulate, analyze and	
Function	text.			situations and reduce complexity.	report data.	
 LED matrix 	CCSS.ELA-LITERACY.CCRA.R.4			P5. Creating Computational Artifacts. 1	6. Demonstrate technical	
Loop	Interpret words and phrases as			Plan the development of a computational	skills needed in a chosen	
 Method 	they are used in a text,			artifact using an iterative process that	STEM field.	
micro:bit	including determining			includes reflection on and modification of	(ST-ET) Engineering &	
 Modulus 	technical, connotative, and			the plan, taking into account key features,	Technology	
 Object 	figurative meanings, and			time and resource constraints, and user	1. Use STEM concepts and	
 Operators 	analyze how specific word			expectations	processes to solve problems	
(arithmetic,	choices shape meaning or			P5. Creating Computational Artifacts. 2	involving design and/or	
comparison,	tone.			Create a computational artifact for practical	production.	
boolean,	CCSS.ELA-LITERACY.CCRA.R.7			intent, personal expression, or to address a	(IT-PRG) Programming &	
assignment,	Integrate and evaluate content			societal issue.	Software Dev.	
binary,	presented in diverse media			P5. Creating Computational Artifacts. 3	6. Program a computer	
ternary)	and formats, including visually			Modify an existing artifact to improve or	application using the	
Parameter	and quantitatively, as well as in			customize it.	appropriate programming	
Pixel	words.			P6. Testing and Refining Computational	language.	
Script	CCSS.ELA-LITERACY.CCRA.R.10			Artifacts. 1	3 -0-	
Strings	Read and comprehend			Systematically test computational artifacts		
Variable	complex literary and			by considering all scenarios and using test		
(global, local)	informational texts			cases.		
.5 , ,	independently and proficiently.					

CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.RST.11-12.3

P6. Testing and Refining Computational Artifacts. 2
Identify and fix errors using a systematic process.

P6. Testing and Refining Computational Artifacts. 3

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.

Evaluate and refine a computational artifact

Concepts

To 12. Computing Systems: Devices
Computing devices are often integrated with
other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.1 0 By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.	To 12. Algorithms People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information. To 12. Algorithms and Programming: Variables Data structures are used to manage program complexity. Programmers choose data structures based on functionality, storage, and performance tradeoffs. To 12. Algorithms and Programming: Control Programmers consider tradeoffs. To 12. Algorithms and Programming: Control Programmers consider tradeoffs related to implementations, readability, and program performance when selecting and combining control structures. To 12. Impacts of Computing: Modularity Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. These procedures; or independent, but interrelated, programs. Modules allow for better management of complex tasks. To 12. Impacts of Computing: Program Development Diverse teams can develop programs with a broad impact through careful review and by drawing on the strengths of members in different roles. Design decisions often involve tradeoffs. The development of complex programs is aided by resources such as libraries and tools to edit and manage parts of the program. Systematic analysis is critical for identifying the effects	
	analysis is critical for identifying the effects of lingering bugs.	

Add Modules to Your micro:bit

Concepts	Common Core State	Common Core	Next Generation	K-12 Computer Science	Career Technical	21st Century	1
Vocabulary	Standards (ELA) ²	State Standards	Science Standards	Framework ¹	Education Standards	Competencies	l
		(Math) ²	(NGSS)⁴		(CTE) ³		
							!

cyberbot	CCSS.ELA-LITERACY.CCRA.R.1		Practices	(CRP) Career Ready Practices	Technology Use
cyber:bot	Read closely to determine		P4: Developing and Using Abstractions. 2	2. Apply appropriate	reciniology osc
• File system	what the text says explicitly		Evaluate existing technological	academic skills	
• Library	and to make logical inferences		functionalities and incorporate them into	11. Use technology to	
Library	from it; cite specific textual		new designs.	enhance productivity	
	evidence when writing or		P6. Testing and Refining Computational	(ST) Stem Careers	
			Artifacts. 2	• •	
	speaking to support			2. Use technology to acquire,	
	conclusions drawn from the		Identify and fix errors using a systematic	manipulate, analyze and	
	text.		process.	report data.	
	CCSS.ELA-LITERACY.CCRA.R.4		Consider	6. Demonstrate technical	
	Interpret words and phrases as		Concepts	skills needed in a chosen	
	they are used in a text,		To 12. Computing Systems: Devices	STEM field.	
	including determining		Computing devices are often integrated with	(IT-PRG) Programming &	
	technical, connotative, and		other systems, including biological,	Software Dev.	
	figurative meanings, and		mechanical, and social systems. These	6. Program a computer	
	analyze how specific word		devices can share data with one another.	application using the	
	choices shape meaning or		The usability, dependability, security, and	appropriate programming	
	tone.		accessibility of these devices, and the	language.	
	CCSS.ELA-LITERACY.CCRA.R.7		systems they are integrated with, are		
	Integrate and evaluate content		important considerations in their design as		
	presented in diverse media and		they evolve.		
	formats, including visually and		To 12. Computing Systems: Hardware and		
	quantitatively, as well as in		Software		
	words.		Levels of interaction exist between the		
	CCSS.ELA-LITERACY.CCRA.R.10		hardware, software, and user of a		
	Read and comprehend		computing system. The most common levels		
	complex literary and		of software that a user interacts with		
	informational texts		include system software and applications.		
	independently and proficiently.		System software controls the flow of		
	CCSS.ELA-LITERACY.RST.9-10.1		information between hardware components		
	Cite specific textual evidence		used for input, output, storage, and		
	to support analysis of science		processing.		
	and technical texts, attending		To 12. Computing Systems: Troubleshooting		
	to the precise details of		Troubleshooting complex problems involves		
	explanations or descriptions.		the use of multiple sources when		
	CCSS.ELA-LITERACY.RST.9-10.3		researching, evaluating, and implementing		
	Follow precisely a complex		potential solutions. Troubleshooting also		
	multistep procedure when		relies on experience, such as when people		
	carrying out experiments,		recognize that a problem is similar to one		
	taking measurements, or		they have seen before or adapt solutions		
	performing technical tasks,		that have worked in the past.		
	attending to special cases or		To 12. Impacts of Computing: Modularity		
	exceptions defined in the text.		Complex programs are designed as systems		
	CCSS.ELA-LITERACY.RST.9-10.4		of interacting modules, each with a specific		
	Determine the meaning of		role, coordinating for a common overall		
	symbols, key terms, and other		purpose. These procedures; or independent,		
			purpose. These procedures, or independent,		
	domain-specific words and				

phrases as they are used in a		but interrelated, programs. Modules allow	
specific scientific or technical		for better management of complex tasks.	
context relevant to <i>grades 9-10</i>		To 12. Impacts of Computing: Program	
texts and topics.		Development	
CCSS.ELA-LITERACY.RST.9-10.5		Diverse teams can develop programs with a	
Analyze the structure of the		broad impact through careful review and by	
relationships among concepts		drawing on the strengths of members in	
in a text, including		different roles. Design decisions often	
relationships among key terms		involve tradeoffs. The development of	
(e.g., force, friction, reaction		complex programs is aided by resources	
force, energy).		such as libraries and tools to edit and	
CCSS.ELA-LITERACY.RST.9-10.7		manage parts of the program. Systematic	
Translate quantitative or		analysis is critical for identifying the effects	
technical information		of lingering bugs.	
expressed in words in a text		3, 3, 3, 5,	
into visual form (e.g., a table or			
chart) and translate			
information expressed visually			
or mathematically (e.g., in an			
equation) into words.			
CCSS.ELA-LITERACY.RST.9-10.10			
By the end of grade 10, read			
and comprehend			
science/technical texts in the			
grades 9-10 text complexity			
band independently and			
proficiently.			
CCSS.ELA-LITERACY.RST.11-12.3			
Follow precisely a complex			
multistep procedure when			
carrying out experiments,			
taking measurements, or			
performing technical tasks;			
analyze the specific results			
based on explanations in the			
text.			
CCSS.ELA-LITERACY.RST.11-12.4			
Determine the meaning of			
symbols, key terms, and other			
domain-specific words and			
phrases as they are used in a			
specific scientific or technical			
context relevant to grades			
11-12 texts and topics.			
CCSS.ELA-LITERACY.RST.11-12.10			
By the end of grade 12, read			
and comprehend	 		

science/technical texts in the			
grades 11-CCR text complexity			
band independently and			
proficiently.			

Convert to a cyber:bot

Concepts	Common Core State	Common Core	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA) ²	State Standards (Math)²	Science Standards (NGSS) ⁴	Framework ¹	Education Standards (CTE) ³	Competencies
• Jumper	CCSS.ELA-LITERACY.CCRA.R.1			Practices	(CRP) Career Ready Practices	Technology Use
ServosPort	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or			P4: Developing and Using Abstractions. 2 Evaluate existing technological functionalities and incorporate them into new designs. P5. Creating Computational Artifacts. 2	Apply appropriate academic skills 11. Use technology to enhance productivity (ST) Stem Careers	
	speaking to support conclusions drawn from the text.			Create a computational artifact for practical intent, personal expression, or to address a societal issue.	6. Demonstrate technical skills needed in a chosen STEM field.	
	CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text,			P6. Testing and Refining Computational Artifacts. 2 Identify and fix errors using a systematic	(ST-ET) Engineering & Technology 3. Apply processes and	
	including determining technical, connotative, and figurative meanings, and			process. Concepts	concepts for the use of technological tools in STEM. (IT-PRG) Programming &	
	analyze how specific word choices shape meaning or tone.			To 12. Computing Systems: Devices Computing devices are often integrated with other systems, including biological,	Software Dev. 6. Program a computer application using the	
	CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media			mechanical, and social systems. These devices can share data with one another. The usability, dependability, security, and	appropriate programming language.	
	and formats, including visually and quantitatively, as well as in words.			accessibility of these devices, and the systems they are integrated with, are important considerations in their design as		
	CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and			they evolve. To 12. Computing Systems: Hardware and Software		
	informational texts independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1			Levels of interaction exist between the hardware, software, and user of a		
	Cite specific textual evidence to support analysis of science			computing system. The most common levels of software that a user interacts with include system software and applications. System		
	and technical texts, attending to the precise details of explanations or descriptions.			software controls the flow of information between hardware components used for input, output, storage, and processing.		

CCSS.ELA-LITERACY.RST.9-10.3			
Follow precisely a complex			
multistep procedure when			
carrying out experiments,			
taking measurements, or			
performing technical tasks,			
attending to special cases or			
exceptions defined in the text.			
CCSS.ELA-LITERACY.RST.9-10.4			
Determine the meaning of			
symbols, key terms, and other			
domain-specific words and			
phrases as they are used in a			
specific scientific or technical			
context relevant to grades			
9-10 texts and topics.			
CCSS.ELA-LITERACY.RST.9-10.5			
Analyze the structure of the			
relationships among concepts			
in a text, including			
relationships among key terms			
(e.g., force, friction, reaction			
force, energy).			
CCSS.ELA-LITERACY.RST.9-10.7			
Translate quantitative or			
technical information			
expressed in words in a text			
into visual form (e.g., a table or			
chart) and translate			
information expressed visually			
or mathematically (e.g., in an			
equation) into words.			
CCSS.ELA-LITERACY.RST.9-10.10			
By the end of grade 10, read			
and comprehend science/technical texts in the			
grades 9-10 text complexity			
band independently and			
proficiently.			
CCSS.ELA-LITERACY.RST.11-12.3			
Follow precisely a complex			
multistep procedure when			
carrying out experiments,			
taking measurements, or			
performing technical tasks;			
analyze the specific results			
analyze the specific results	<u> </u>		

based on explanations in the			
text.			
CCSS.ELA-LITERACY.RST.11-12.4			
Determine the meaning of			
symbols, key terms, and other			
domain-specific words and			
phrases as they are used in a			
specific scientific or technical			
context relevant to grades			
11-12 texts and topics.			
CCSS.ELA-LITERACY.RST.11-12.1			
0			
By the end of grade 12, read			
and comprehend			
science/technical texts in the			
grades 11-CCR text complexity			
band independently and			
proficiently.			

MAIN LESSON(S)

Build Your cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
3 position	CCSS.ELA-LITERACY.CCRA.R.1			Practices	(CRP) Career Ready Practices	Technology Use
switch	Read closely to determine			P4: Developing and Using Abstractions. 2	2. Apply appropriate	Design-thinking
 Breadboard 	what the text says explicitly			Evaluate existing technological	academic skills	
 Chassis 	and to make logical inferences			functionalities and incorporate them into	11. Use technology to	
cyber:bot	from it; cite specific textual			new designs.	enhance productivity	
 Input/Output 	evidence when writing or			P5. Creating Computational Artifacts. 3	(ST) Stem Careers	
pins (I/O)	speaking to support			Modify an existing artifact to improve or	6. Demonstrate technical	
Jumper	conclusions drawn from the			customize it.	skills needed in a chosen	
micro:bit	text.			P6. Testing and Refining Computational	STEM field.	
 Microcontroller 	CCSS.ELA-LITERACY.CCRA.R.4			Artifacts. 2	(ST-ET) Engineering &	
 Multicore 	Interpret words and phrases			Identify and fix errors using a systematic	Technology	
Servo	as they are used in a text,			process.	3. Apply processes and	
	including determining				concepts for the use of	
	technical, connotative, and			Concepts	technological tools in STEM.	
	figurative meanings, and			To 12. Computing Systems: Devices	(IT-PRG) Programming &	
	analyze how specific word				Software Dev.	

choices shape meaning or		Computing devices are often integrated with	6. Program a computer	
tone.		other systems, including biological,	application using the	
CCSS.ELA-LITERACY.CCRA.R.7		mechanical, and social systems. These	appropriate programming	
Integrate and evaluate		devices can share data with one another.	language.	
content presented in diverse		The usability, dependability, security, and	5 5	
media and formats, including		accessibility of these devices, and the		
visually and quantitatively, as		systems they are integrated with, are		
well as in words.		important considerations in their design as		
CCSS.ELA-LITERACY.CCRA.R.10		they evolve.		
Read and comprehend		To 12. Computing Systems: Hardware and		
complex literary and		Software		
informational texts		Levels of interaction exist between the		
independently and		hardware, software, and user of a		
proficiently.		computing system. The most common levels		
CCSS.ELA-LITERACY.RST.9-10.1		of software that a user interacts with		
Cite specific textual evidence		include system software and applications.		
to support analysis of science		System software controls the flow of		
and technical texts, attending		information between hardware components		
to the precise details of		used for input, output, storage, and		
explanations or descriptions.		processing.		
CCSS.ELA-LITERACY.RST.9-10.3		To 12. Computing Systems: Troubleshooting		
Follow precisely a complex		Troubleshooting complex problems involves		
multistep procedure when		the use of multiple sources when		
carrying out experiments,		researching, evaluating, and implementing		
taking measurements, or		potential solutions. Troubleshooting also		
performing technical tasks,		relies on experience, such as when people		
attending to special cases or		recognize that a problem is similar to one		
exceptions defined in the text.		they have seen before or adapt solutions		
CCSS.ELA-LITERACY.RST.9-10.4		that have worked in the past.		
Determine the meaning of		·		
symbols, key terms, and other				
domain-specific words and				
phrases as they are used in a				
specific scientific or technical				
context relevant to grades				
9-10 texts and topics.				
CCSS.ELA-LITERACY.RST.9-10.5				
Analyze the structure of the				
relationships among concepts				
in a text, including				
relationships among key terms				
(e.g., force, friction, reaction				
force, energy).				
CCSS.ELA-LITERACY.RST.9-10.7				
Translate quantitative or				
technical information				
expressed in words in a text				

			,
into visual form (e.g., a table			
or chart) and translate			
information expressed visually			
or mathematically (e.g., in an			
equation) into words.			
CCSS.ELA-LITERACY.RST.9-10.10			
By the end of grade 10, read			
and comprehend			
science/technical texts in the			
grades 9-10 text complexity			
band independently and			
proficiently.			
CCSS.ELA-LITERACY.RST.11-12.3			
Follow precisely a complex			
multistep procedure when			
carrying out experiments,			
taking measurements, or			
performing technical tasks;			
analyze the specific results			
based on explanations in the			
text.			
CCSS.ELA-LITERACY.RST.11-12.4			
Determine the meaning of			
symbols, key terms, and other			
domain-specific words and			
phrases as they are used in a			
specific scientific or technical			
context relevant to grades			
11-12 texts and topics.			
CCSS.ELA-LITERACY.RST.11-12.1			
0			
By the end of grade 12, read			
and comprehend			
science/technical texts in the			
grades 11-CCR text complexity			
band independently and			
proficiently.			
 . ,	ı		

Navigation with the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
 Centering 	CCSS.ELA-LITERACY.CCRA.R.1	CCSS.MATH.PRACTICE.M	HS-PS3-3.	Practices	(CRP) Career Ready Practices	Self-direction
 Potentiometer 		P2		P4: Developing and Using Abstractions. 1		Technology Use

• Scripts	Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and informational texts	Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.M P4 Model with mathematics. CCSS.MATH.PRACTICE.M P5 Use appropriate tools strategically. CCSS.MATH.PRACTICE.M P6 Attend to precision. CCSS.MATH.CONTENT.HS N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. CCSS.MATH.CONTENT.HS G.MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	Extract common features from a set of interrelated processes or complex phenomena. P4: Developing and Using Abstractions. 2 Evaluate existing technological functionalities and incorporate them into new designs. 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 Modify an existing artifact to improve or customize it. P6. Testing and Refining Computational Artifacts. 1	2. Apply appropriate academic skills 11. Use technology to enhance productivity (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 3. Apply processes and concepts for the use of technological tools in STEM. (IT-PRG) Programming & Software Dev. 6. Program a computer application using the appropriate programming language.	Critical-thinking Reflection Revision Design-thinking
	analyze how specific word choices shape meaning or	CCSS.MATH.CONTENT.HS N.Q.A.2		includes reflection on and modification of the plan, taking into account key features,	concepts for the use of technological tools in STEM.	
	CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media	quantities for the purpose of descriptive modeling.		expectations. P5. Creating Computational Artifacts. 2 Create a computational artifact for practical	Software Dev. 6. Program a computer application using the	
	and quantitatively, as well as in words.	G.MG.A.3 Apply geometric		societal issue. P5. Creating Computational Artifacts. 3		
	Read and comprehend complex literary and	design problems (e.g., designing an object or		customize it. P6. Testing and Refining Computational		
	independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1	physical constraints or minimize cost; working with typographic grid		Systematically test computational artifacts by considering all scenarios and using test cases.		
	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of	systems based on ratios).		P6. Testing and Refining Computational Artifacts. 2 Identify and fix errors using a systematic process.		
	explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex			P6. Testing and Refining Computational Artifacts. 3 Evaluate and refine a computational artifact		
	multistep procedure when carrying out experiments, taking measurements, or performing technical tasks,			multiple times to enhance its performance, usability, and accessibility. P7. Communicating About Computing. 2 Describe, justify, and document		
	attending to special cases or exceptions defined in the text. CCSS.ELA-LITERACY.RST.9-10.4			computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.		
	Determine the meaning of symbols, key terms, and other domain-specific words and			Concepts To 12. Computing Systems: Devices		

phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades* 11-12 texts and topics. CCSS.ELA-LITERACY.RST.11-12.7

Integrate and evaluate

multiple sources of

Computing devices are often integrated with other systems, including biological, mechanical, and social systems. These devices can share data with one another. The usability, dependability, security, and accessibility of these devices, and the systems they are integrated with, are important considerations in their design as they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

To 12. Algorithms and Programming: Control Programmers consider tradeoffs related to implementations, readability, and program performance when selecting and combining control structures.

To 12. Impacts of Computing: Modularity Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. These procedures; or independent,

information presented in		but interrelated, programs. Modules allow	
diverse formats and media		for better management of complex tasks.	
(e.g., quantitative data, video,			
multimedia) in order to			
address a question or solve a			
problem.			
CCSS.ELA-LITERACY.RST.11-12.1			
0			
By the end of grade 12, read			
and comprehend			
science/technical texts in the			
grades 11-CCR text complexity			
band independently and			
proficiently.			

Sound for the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
		(iviatii)	(14033)		(CIL)	
Array Frequency Function Index List Parameter Piezospeaker Schematic symbol	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.		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 P4: Developing and Using Abstractions. 1 Extract common features from a set of interrelated processes or complex phenomena. P4: Developing and Using Abstractions. 2 Evaluate existing technological functionalities and incorporate them into new designs. 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.	(CRP) Career Ready Practices 2. Apply appropriate academic skills 6. Demonstrate creativity and innovation 11. Use technology to enhance productivity (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 3. Apply processes and concepts for the use of technological tools in STEM. 5. Apply the elements of the design process. (IT-PRG) Programming & Software Dev. 6. Program a computer	Self-direction Technology Use Innovation Critical-thinking Communication Reflection Revision Design-thinking
	CCSS.ELA-LITERACY.CCRA.R.10			P5. Creating Computational Artifacts. 3	application using the	

Read and comprehend Modify an existing artifact to improve or appropriate programming complex literary and customize it. language. informational texts P6. Testing and Refining Computational independently and Artifacts. 1 Systematically test computational artifacts proficiently. CCSS.ELA-LITERACY.RST.9-10.1 by considering all scenarios and using test Cite specific textual evidence P6. Testing and Refining Computational to support analysis of science and technical texts, attending Artifacts. 2 to the precise details of Identify and fix errors using a systematic explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 P6. Testing and Refining Computational Follow precisely a complex Artifacts. 3 multistep procedure when Evaluate and refine a computational artifact carrying out experiments, multiple times to enhance its performance, taking measurements, or usability, and accessibility. performing technical tasks, P7. Communicating About Computing. 2 attending to special cases or Describe, justify, and document exceptions defined in the text. computational processes and solutions using CCSS.ELA-LITERACY.RST.9-10.4 appropriate terminology consistent with the Determine the meaning of intended audience and purpose. symbols, key terms, and other domain-specific words and Concepts To 12. Computing Systems: Devices phrases as they are used in a specific scientific or technical Computing devices are often integrated with context relevant to grades other systems, including biological, 9-10 texts and topics. mechanical, and social systems. These CCSS.ELA-LITERACY.RST.9-10.5 devices can share data with one another. Analyze the structure of the The usability, dependability, security, and relationships among concepts accessibility of these devices, and the in a text, including systems they are integrated with, are relationships among key terms important considerations in their design as (e.g., force, friction, reaction they evolve. force, energy). To 12. Computing Systems: Hardware and CCSS.ELA-LITERACY.RST.9-10.7 Software Translate quantitative or Levels of interaction exist between the technical information hardware, software, and user of a expressed in words in a text computing system. The most common levels into visual form (e.g., a table of software that a user interacts with or chart) and translate include system software and applications. information expressed visually System software controls the flow of or mathematically (e.g., in an information between hardware components equation) into words. used for input, output, storage, and CCSS.ELA-LITERACY.RST.9-10.10 processing. By the end of grade 10, read To 12. Computing Systems: Troubleshooting and comprehend *Troubleshooting complex problems involves* science/technical texts in the the use of multiple sources when

grades 9-10 text complexity	researching, evaluating, and implementing	
band independently and	potential solutions. Troubleshooting also	
proficiently.	relies on experience, such as when people	
CCSS.ELA-LITERACY.RST.11-12.3	recognize that a problem is similar to one	
Follow precisely a complex	they have seen before or adapt solutions	
multistep procedure when	that have worked in the past.	
carrying out experiments,	To 12. Data and Analysis: Storage	
taking measurements, or	Data can be composed of multiple data	
performing technical tasks;	elements that relate to one another. For	
analyze the specific results	example, population data may contain	
based on explanations in the	information about age, gender, and height.	
text.	People make choices about how data	
CCSS.ELA-LITERACY.RST.11-12.4	elements are organized and where data is	
Determine the meaning of	stored. These choices affect cost, speed,	
symbols, key terms, and other	reliability, accessibility, privacy, and	
domain-specific words and	integrity.	
phrases as they are used in a	To 12. Algorithms and Programming:	
specific scientific or technical	Algorithms	
context relevant to grades	People evaluate and select algorithms based	
11-12 texts and topics.	on performance, reusability, and ease of	
CCSS.ELA-LITERACY.RST.11-12.1	implementation. Knowledge of common	
0	algorithms improves how people develop	
By the end of grade 12, read	software, secure data, and store	
and comprehend	information.	
science/technical texts in the	To 12. Algorithms and Programming:	
grades 11-CCR text complexity	Variables	
band independently and	Data structures are used to manage	
proficiently.	program complexity. Programmers choose	
proneiently.	data structures based on functionality,	
	storage, and performance tradeoffs.	
	To 12. Algorithms and Programming: Control	
	Programmers consider tradeoffs related to	
	implementations, readability, and program	
	performance when selecting and combining	
	control structures.	
	To 12. Impacts of Computing: Modularity	
	Complex programs are designed as systems	
	of interacting modules, each with a specific	
	role, coordinating for a common overall	
	purpose. These procedures; or independent,	
	but interrelated, programs. Modules allow	
	1 '' 2	
	for better management of complex tasks.	

Circuits on the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
 Active-low Active-high Anode Cathode Circuit Diode Jumper wire LED Ohms Prototyping Pushbutton Pull-down resistor Resistor Socket 	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks,			Practices P4: Developing and Using Abstractions. 1 Extract common features from a set of interrelated processes or complex phenomena. P4: Developing and Using Abstractions. 2 Evaluate existing technological functionalities and incorporate them into new designs. 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 Modify an existing artifact to improve or customize it. 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, usability, and accessibility. P7. Communicating About Computing. 2	(CRP) Career Ready Practices 2. Apply appropriate academic skills 11. Use technology to enhance productivity (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 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. 5. Apply the elements of the design process. 6. Apply the knowledge learned in STEM to solve problems. (ST-SM) Science & Math 2. Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. (IT-PRG) Programming & Software Dev. 6. Program a computer application using the appropriate programming language.	Self-direction Technology Use Innovation Critical-thinking Reflection Revision Design-thinking

attending to special cases or exceptions defined in the text. CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a

Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose.

Concepts

To 12. Computing Systems: Devices
Computing devices are often integrated
with other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

To 12. Algorithms and Programming: Control Programmers consider tradeoffs related to implementations, readability, and program

specific scientific or technical	performance when selecting and combining
context relevant to grades	control structures.
11-12 texts and topics.	To 12. Impacts of Computing: Modularity
CCSS.ELA-LITERACY.RST.11-12.1	Complex programs are designed as systems
0	of interacting modules, each with a specific
By the end of grade 12, read	role, coordinating for a common overall
and comprehend	purpose. These procedures; or independent,
science/technical texts in the	but interrelated, programs. Modules allow
grades 11-CCR text complexity	for better management of complex tasks.
band independently and	
proficiently.	

Touch Navigation for the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
 Autonomous Boolean Initialization Normally open Momentary Nested Sketch Single-pole Single-throw Tactile switches 	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and informational texts			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 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 Evaluate existing technological functionalities and incorporate them into new designs. 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	(CRP) Career Ready Practices 2. Apply appropriate academic skills 6. Demonstrate creativity and innovation 7. Employ valid and reliable research strategies 8. Utilize critical thinking to make sense of problems and persevere in solving them. 11. Use technology to enhance productivity (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 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.	Self-direction Technology Use Innovation Critical-thinking Reflection Revision Design-thinking

independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

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

 Modify an existing artifact to improve or customize it.
- 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, 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

To 12. Computing Systems: Devices
Computing devices are often integrated with
other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

- 4. Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.
 5. Apply the elements of the
- Apply the elements of the design process.
- 6. Apply the knowledge learned in STEM to solve problems.
- (ST-SM) Science & Math
 2. Apply science and
 mathematics concepts to the
 development of plans,
 processes and projects that
 address real world problems.
 (IT-PRG) Programming &
- 6. Program a computer application using the appropriate programming language.

Software Dev.

CCSS.ELA-LITERACY.RST.11-12.3 Levels of interaction exist between the Follow precisely a complex hardware, software, and user of a multistep procedure when computing system. The most common levels carrying out experiments, of software that a user interacts with include system software and applications. taking measurements, or performing technical tasks; System software controls the flow of analyze the specific results information between hardware components based on explanations in the used for input, output, storage, and text. processing. CCSS.ELA-LITERACY.RST.11-12.4 To 12. Computing Systems: Troubleshooting Determine the meaning of Troubleshooting complex problems involves symbols, key terms, and other the use of multiple sources when researching, evaluating, and implementing domain-specific words and phrases as they are used in a potential solutions. Troubleshooting also specific scientific or technical relies on experience, such as when people context relevant to grades recognize that a problem is similar to one 11-12 texts and topics. they have seen before or adapt solutions CCSS.ELA-LITERACY.RST.11-12.7 that have worked in the past. Integrate and evaluate To 12. Algorithms and Programming: multiple sources of Algorithms information presented in People evaluate and select algorithms based diverse formats and media on performance, reusability, and ease of implementation. Knowledge of common (e.g., quantitative data, video, multimedia) in order to algorithms improves how people develop address a question or solve a software, secure data, and store problem. information. CCSS.ELA-LITERACY.RST.11-12.1 To 12. Algorithms and Programming: Variables By the end of grade 12, read Data structures are used to manage and comprehend program complexity. Programmers choose science/technical texts in the data structures based on functionality, grades 11-CCR text complexity storage, and performance tradeoffs. band independently and To 12. Algorithms and Programming: Control proficiently. Programmers consider tradeoffs related to implementations, readability, and program performance when selecting and combining control structures. To 12. Impacts of Computing: Modularity Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. These procedures; or independent, but interrelated, programs. Modules allow

for better management of complex tasks.

Visible Light Navigation for the cyber:bot

Concepts	Common Core State	Common Core	Next Generation	K-12 Computer Science	Career Technical	21st Century
Vocabulary	Standards (ELA) ²	State Standards (Math) ²	Science Standards (NGSS) ⁴	Framework ¹	Education Standards (CTE) ³	Competencies
Phototransistor Terminal (base, emitter, collector) Nanometer Voltage Ambient light Analog to digital conversion (A/D) Sensor (binary, analog, digital) Digitized (quantized) measurement Series Parallel Ohm's Law Capacitor Farad Current valve Charge transfer (QT) Decay Normalized differential measurement Zero-justified normalized diff. measurement	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. CCSS.ELA-LITERACY.CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently. CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science	CCSS.MATH.PRACTICE.M P1 Make sense of problems and persevere in solving them. CCSS.MATH.PRACTICE.M P2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.M P4 Model with mathematics. CCSS.MATH.PRACTICE.M P6 Attend to precision. CCSS.MATH.CONTENT.H SN.Q.A.1 Use units as a way to understand problems and to guide the solution of the 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.H SN.Q.A.2	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 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 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 Evaluate existing technological functionalities and incorporate them into new designs. 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 appropriate academic skills 6. Demonstrate creativity and innovation 7. Employ valid and reliable research strategies 8. Utilize critical thinking to make sense of problems and persevere in solving them. 11. Use technology to enhance productivity. (ST) Stem Careers 2. Use technology to acquire, manipulate, analyze and report data. 6. Demonstrate technical skills needed in a chosen STEM field. (ST-ET) Engineering & Technology 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 knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.	Self-direction Technology Use Innovation Critical-thinking Reflection Revision Design-thinking

and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the

Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

CCSS.ELA-LITERACY.RST.9-10.7

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.10
By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or Define appropriate quantities for the purpose of descriptive modeling.

CCSS.MATH.CONTENT.H SN.Q.A.3

Choose a level of accuracy appropriate to the limitations on measurement when reporting quantities.

CCSS.MATH.CONTENT.H

Interpret expressions that represent a quantity in terms of its context.

SA.SSE.A.1

CCSS.MATH.CONTENT.H SA.SSE.B.3

Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

CCSS.MATH.CONTENT.H SA.REI.A.1

Explain each step in solving a simple equation as following from and equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

CCSS.MATH.CONTENT.H

CCSS.MATH.CONTENT.H SA.REI.A.2

Solve simple rational and radical equations in one variable, and give examples showing 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

Modify an existing artifact to improve or customize it.

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, 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

Software

To 12. Computing Systems: Devices
Computing devices are often integrated with
other systems, including biological,
mechanical, and social systems. These devices
can share data with one another. The
usability, dependability, security, and
accessibility of these devices, and the systems
they are integrated with, are important
considerations in their design as they evolve.
To 12. Computing Systems: Hardware and

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting

5. Apply the elements of the design process.

6. Apply the knowledge learned in STEM to solve problems.

(ST-SM) Science & Math
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-PRG) Programming & Software Dev.

6. Program a computer application using the appropriate programming language.

	1		
performing technical tasks;	how extraneous	Troubleshooting complex problems involves	
analyze the specific results	solutions may arise.	the use of multiple sources when researching,	
based on explanations in the	CCSS.MATH.CONTENT.H	evaluating, and implementing potential	
text.	SA.REI.B.3	solutions. Troubleshooting also relies on	
CCSS.ELA-LITERACY.RST.11-12.4	Solve linear equations	experience, such as when people recognize	
Determine the meaning of	and inequalities in one	that a problem is similar to one they have	
symbols, key terms, and other	variable, including	seen before or adapt solutions that have	
domain-specific words and	equations with	worked in the past.	
phrases as they are used in a	coefficients	To 12. Algorithms and Programming:	
specific scientific or technical	represented by letters.	Algorithms	
context relevant to grades		People evaluate and select algorithms based	
11-12 texts and topics.		on performance, reusability, and ease of	
CCSS.ELA-LITERACY.RST.11-12.7		implementation. Knowledge of common	
Integrate and evaluate		algorithms improves how people develop	
multiple sources of		software, secure data, and store information.	
information presented in		To 12. Algorithms and Programming: Variables	
diverse formats and media		Data structures are used to manage program	
(e.g., quantitative data, video,		complexity. Programmers choose data	
multimedia) in order to		structures based on functionality, storage,	
address a question or solve a		and performance tradeoffs.	
problem.		To 12. Algorithms and Programming: Control	
CCSS.ELA-LITERACY.RST.11-12.1		Programmers consider tradeoffs related to	
0		implementations, readability, and program	
By the end of grade 12, read		performance when selecting and combining	
and comprehend		control structures.	
science/technical texts in the		To 12. Impacts of Computing: Modularity	
grades 11-CCR text complexity		Complex programs are designed as systems of	
band independently and		interacting modules, each with a specific role,	
proficiently.		coordinating for a common overall purpose.	
		These procedures; or independent, but	
		interrelated, programs. Modules allow for	
		better management of complex tasks.	
 		-	

Infrared Light Navigation for the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
 Infrared 	CCSS.ELA-LITERACY.CCRA.R.1	CCSS.MATH.PRACTICE.M	HS-PS3-3.	Practices	(CRP) Career Ready Practices	Self-direction
 Infrared LED 	Read closely to determine	P2	Design, build, and	P3. Recognizing and Defining Computational	2. Apply appropriate	Technology Use
 Infrared receiver 	what the text says explicitly and to make logical inferences	Reason abstractly and quantitatively.	refine a device that works within given	Problems. 1	academic skills	Innovation Critical-thinking

• Cubaustam	from its site angeific toutual	constraints to convert	Identify compley interdisciplings	6 Damanstrata arastivity and	Deflection
• Subsystem	from it; cite specific textual	constraints to convert	Identify complex, interdisciplinary,	6. Demonstrate creativity and	Reflection
testing	evidence when writing or	one form of energy	real-world problems that can be solved	innovation	Revision
 Interference 	speaking to support	into another form of	computationally.	7. Employ valid and reliable	Design-thinking
	conclusions drawn from the	energy.	P3. Recognizing and Defining Computational	research strategies	
	text.	HS-PS4-1.	Problems. 2	8. Utilize critical thinking to	
	CCSS.ELA-LITERACY.CCRA.R.4	Use mathematical	Decompose complex real-world problems	make sense of problems and	
	Interpret words and phrases as	representations to	into manageable subproblems that could	persevere in solving them.	
	they are used in a text,	support a claim	integrate existing solutions or procedures.	11. Use technology to	
	including determining	regarding relationships	P3. Recognizing and Defining Computational	enhance productivity.	
	technical, connotative, and	among the frequency,	Problems. 3	(ST) Stem Careers	
	figurative meanings, and	wavelength, and speed	Evaluate whether it is feasible to solve a	2. Use technology to acquire,	
	analyze how specific word	of waves traveling in	problem computationally.	manipulate, analyze and	
	choices shape meaning or	various media.	P4: Developing and Using Abstractions. 1	report data.	
	tone.		Extract common features from a set of	6. Demonstrate technical	
	CCSS.ELA-LITERACY.CCRA.R.7	HS-PS4-5.	interrelated processes or complex	skills needed in a chosen	
	Integrate and evaluate content	Communicate	phenomena.	STEM field.	
	presented in diverse media	technical information	P4: Developing and Using Abstractions. 2	(ST-ET) Engineering &	
	and formats, including visually	about how some	Evaluate existing technological	Technology	
	and quantitatively, as well as	technological devices	functionalities and incorporate them into	1. Use STEM concepts and	
	in words.	use the principles of	new designs.	processes to solve problems	
	CCSS.ELA-LITERACY.CCRA.R.10	wave behavior and	P4. Developing and Using Abstractions. 3	involving design and/or	
	Read and comprehend	wave interactions with	Create modules and develop points of	production.	
	complex literary and	matter to transmit and	interaction that can apply to multiple	3. Apply processes and	
	informational texts	capture information	situations and reduce complexity.	concepts for the use of	
	independently and	and energy.	P5. Creating Computational Artifacts. 1	technological tools in STEM.	
	proficiently.		Plan the development of a computational	4. Apply the knowledge	
	CCSS.ELA-LITERACY.RST.9-10.1		artifact using an iterative process that	learned in the study of STEM	
	Cite specific textual evidence		includes reflection on and modification of	to provide solutions to human	
	to support analysis of science		the plan, taking into account key features,	and societal problems in an	
	and technical texts, attending		time and resource constraints, and user	ethical and legal manner.	
	to the precise details of		expectations.	5. Apply the elements of the	
	explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.3		P5. Creating Computational Artifacts. 2	design process.	
			Create a computational artifact for practical	6. Apply the knowledge	
	Follow precisely a complex		intent, personal expression, or to address a societal issue.	learned in STEM to solve problems.	
	multistep procedure when		P5. Creating Computational Artifacts. 3	(ST-SM) Science & Math	
	carrying out experiments,		Modify an existing artifact to improve or	1. Apply science and	
	taking measurements, or performing technical tasks,		customize it.	mathematics to provide	
	attending to special cases or		P6. Testing and Refining Computational	results, answers and	
	exceptions defined in the text.		Artifacts. 1	algorithms for engineering	
	CCSS.ELA-LITERACY.RST.9-10.4		Systematically test computational artifacts	and technological activities.	
	Determine the meaning of		by considering all scenarios and using test	Apply science and	
	symbols, key terms, and other		cases.	mathematics concepts to the	
	domain-specific words and		P6. Testing and Refining Computational	development of plans,	
	phrases as they are used in a		Artifacts. 2	processes and projects that	
	specific scientific or technical		Identify and fix errors using a systematic	address real world problems.	
	specific scientific of teciffical		identify and fix errors using a systematic	address real world problems.	

process.

context relevant to grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments. taking measurements, or performing technical tasks; analyze the specific results based on explanations in the CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate

multiple sources of

information presented in

diverse formats and media

P6. Testing and Refining Computational Artifacts. 3

Evaluate and refine a computational artifact multiple times to enhance its performance, 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

To 12. Computing Systems: Devices

Computing devices are often integrated with other systems, including biological, mechanical, and social systems. These devices can share data with one another. The usability, dependability, security, and accessibility of these devices, and the systems they are integrated with, are important considerations in their design as they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common

(IT-PRG) Programming & Software Dev.

6. Program a computer application using the appropriate programming language.

(e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.RST.11-12.1 0 By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.	algorithms improves how people develop software, secure data, and store information. To 12. Algorithms and Programming: Variables Data structures are used to manage program complexity. Programmers choose data structures based on functionality, storage, and performance tradeoffs. To 12. Algorithms and Programming: Control Programmers consider tradeoffs related to implementations, readability, and program performance when selecting and combining control structures. To 12. Impacts of Computing: Modularity Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall
	of interacting modules, each with a specific role, coordinating for a common overall
	purpose. These procedures; or independent, but interrelated, programs. Modules allow for better management of complex tasks.

PROJECTS

QTI Line Follower for the cyber:bot

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
QTI sensor Argument	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining	CCSS.MATH.PRACTICE.M P7 Look for and make use of structure.	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-PS4-5. Communicate technical information about how some	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	(CRP) Career Ready Practices 2. Apply appropriate academic skills 6. Demonstrate creativity and innovation 7. Employ valid and reliable research strategies 8. Utilize critical thinking to make sense of problems and persevere in solving them. 11. Use technology to enhance productivity. (ST) Stem Careers	Self-direction Technology Use Critical-thinking Reflection Revision Design-thinking

technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

CCSS.ELA-LITERACY.CCRA.R.10
Read and comprehend
complex literary and
informational texts
independently and
proficiently.

CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

CCSS.ELA-LITERACY.RST.9-10.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS.ELA-LITERACY.RST.9-10.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS.ELA-LITERACY.RST.9-10.5
Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
CCSS.ELA-LITERACY.RST.9-10.7

technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Evaluate whether it is 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 Evaluate existing technological functionalities and incorporate them into new designs.

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

Modify an existing artifact to improve or customize it.

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, 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.

2. Use technology to acquire, manipulate, analyze and report data.

6. Demonstrate technical skills needed in a chosen STEM field.

(ST-ET) Engineering & Technology

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 knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.
5. Apply the elements of the design process.

6. Apply the knowledge learned in STEM to solve problems.

(ST-SM) Science & Math.

2. Apply science and mathematics concepts to the development of plans, processes and projects that

address real world problems. (IT-PRG) Programming & Software Dev.

6. Program a computer application using the appropriate programming language.

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.10

CCSS.ELA-LITERACY.RST.9-10.10
By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.1

By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity

Concepts

To 12. Computing Systems: Devices
Computing devices are often integrated
with other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

To 12. Algorithms and Programming: Variables

Data structures are used to manage program complexity. Programmers choose data structures based on functionality, storage, and performance tradeoffs.

To 12. Algorithms and Programming: Control

band independently and	Programmers consider tradeoffs related to
proficiently.	implementations, readability, and program
	performance when selecting and combining
	control structures.
	To 12. Impacts of Computing: Modularity
	Complex programs are designed as systems
	of interacting modules, each with a specific
	role, coordinating for a common overall
	purpose. These procedures; or independent,
	but interrelated, programs. Modules allow
	for better management of complex tasks.
	To 12. Impacts of Computing: Program
	Development
	Diverse teams can develop programs with a
	broad impact through careful review and by
	drawing on the strengths of members in
	different roles. Design decisions often
	involve tradeoffs. The development of
	complex programs is aided by resources
	such as libraries and tools to edit and
	manage parts of the program. Systematic
	analysis is critical for identifying the effects
	of lingering bugs.

Cyber:bot Roaming with the Ping)))

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
Ping))) ultrasonic sensor Speed of sound Sub-system	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and	CCSS.MATH.PRACTICE.M P2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.M P4 Model with mathematics. CCSS.MATH.PRACTICE.M P6 Attend to precision. CCSS.MATH.CONTENT.H SN.Q.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	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	(CRP) Career Ready Practices 2. Apply appropriate academic skills 6. Demonstrate creativity and innovation 7. Employ valid and reliable research strategies 8. Utilize critical thinking to make sense of problems and persevere in solving them. 11. Use technology to enhance productivity. (ST) Stem Careers	Self-direction Technology Use Critical-thinking Reflection Revision Design-thinking Innovation

figurative meanings, and
analyze how specific word
choices shape meaning or
tone.

CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

CCSS.ELA-LITERACY.CCRA.R.10
Read and comprehend
complex literary and
informational texts
independently and
proficiently.

CCSS.ELA-LITERACY.RST.9-10.1
Cite specific textual evidence
to support analysis of science
and technical texts, attending
to the precise details of
explanations or descriptions.

CCSS.ELA-LITERACY.RST.9-10.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS.ELA-LITERACY.RST.9-10.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades
9-10 texts and topics.

CCSS.ELA-LITERACY.RST.9-10.5
Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

CCSS.ELA-LITERACY.RST.9-10.7

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.

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.

Evaluate whether it is 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 Evaluate existing technological functionalities and incorporate them into new designs.
- 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

 Modify an existing artifact to improve or customize it.
- 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, 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.

- 2. Use technology to acquire, manipulate, analyze and report data.
- 6. Demonstrate technical skills needed in a chosen STEM field.
- (ST-ET) Engineering & Technology
- 1. Use STEM concepts and processes to solve problems involving design and/or production.
- 2. Display and communicate STEM information.
- 3. Apply processes and concepts for the use of technological tools in STEM.
- 4. Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.
- 5. Apply the elements of the design process.
- 6. Apply the knowledge learned in STEM to solve problems.
- (ST-SM) Science & Math
- 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-PRG) Programming & Software Dev.
- 6. Program a computer application using the appropriate programming language.

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.10

CCSS.ELA-LITERACY.RST.9-10.10
By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.1

By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity

Concepts

To 12. Computing Systems: Devices
Computing devices are often integrated
with other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

To 12. Algorithms and Programming: Variables

Data structures are used to manage program complexity. Programmers choose data structures based on functionality, storage, and performance tradeoffs.

To 12. Algorithms and Programming: Control

band independently and	Programmers consider tradeoffs related to	
proficiently.	implementations, readability, and program	
p. 2	performance when selecting and combining	
	control structures.	
	To 12. Impacts of Computing: Modularity	
	Complex programs are designed as systems	
	' ' - - - - - - - -	
	of interacting modules, each with a specific	
	role, coordinating for a common overall	
	purpose. These procedures; or independent,	
	but interrelated, programs. Modules allow	
	for better management of complex tasks.	
	To 12. Impacts of Computing: Program	
	Development	
	Diverse teams can develop programs with a	
	broad impact through careful review and by	
	drawing on the strengths of members in	
	different roles. Design decisions often	
	involve tradeoffs. The development of	
	complex programs is aided by resources	
	such as libraries and tools to edit and	
	manage parts of the program. Systematic	
	analysis is critical for identifying the effects	
	of lingering bugs.	
	oj ililgerilig bugs.	

Control Your cyber:bot with an Infrared TV Remote

Concepts Vocabulary	Common Core State Standards (ELA) ²	Common Core State Standards (Math) ²	Next Generation Science Standards (NGSS) ⁴	K-12 Computer Science Framework ¹	Career Technical Education Standards (CTE) ³	21st Century Competencies
Syntax error	CCSS.ELA-LITERACY.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. CCSS.ELA-LITERACY.CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and	CCSS.MATH.PRACTICE.M P6 Attend to precision.	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	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	(CRP) Career Ready Practices 2. Apply appropriate academic skills 6. Demonstrate creativity and innovation 7. Employ valid and reliable research strategies 8. Utilize critical thinking to make sense of problems and persevere in solving them. 11. Use technology to enhance productivity. (ST) Stem Careers	Self-direction Technology Use Critical-thinking Reflection Revision Design-thinking

figurative meanings, and analyze how specific word choices shape meaning or tone.

CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

CCSS.ELA-LITERACY.CCRA.R.10
Read and comprehend
complex literary and
informational texts
independently and
proficiently.

CCSS.ELA-LITERACY.RST.9-10.1
Cite specific textual evidence
to support analysis of science
and technical texts, attending
to the precise details of
explanations or descriptions.

CCSS.ELA-LITERACY.RST.9-10.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS.ELA-LITERACY.RST.9-10.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

CCSS.ELA-LITERACY.RST.9-10.7

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.

Evaluate whether it is 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

 Evaluate existing technological
 functionalities and incorporate them into
 new designs.
- 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

 Modify an existing artifact to improve or customize it.
- 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, 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.

- 2. Use technology to acquire, manipulate, analyze and report data.
- 3. Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
- 6. Demonstrate technical skills needed in a chosen STEM field.
- (ST-ET) Engineering & Technology
- 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 knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.
- 5. Apply the elements of the design process.
- 6. Apply the knowledge learned in STEM to solve problems.
- (ST-SM) Science & Math
- 2. Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. (IT-PRG) Programming &
- Software Dev.
- 6. Program a computer application using the appropriate programming language.

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.RST.9-10.10

CCSS.ELA-LITERACY.RST.9-10.10
By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.1

By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity

Concepts

To 12. Computing Systems: Devices
Computing devices are often integrated
with other systems, including biological,
mechanical, and social systems. These
devices can share data with one another.
The usability, dependability, security, and
accessibility of these devices, and the
systems they are integrated with, are
important considerations in their design as
they evolve.

To 12. Computing Systems: Hardware and Software

Levels of interaction exist between the hardware, software, and user of a computing system. The most common levels of software that a user interacts with include system software and applications. System software controls the flow of information between hardware components used for input, output, storage, and processing.

To 12. Computing Systems: Troubleshooting Troubleshooting complex problems involves the use of multiple sources when researching, evaluating, and implementing potential solutions. Troubleshooting also relies on experience, such as when people recognize that a problem is similar to one they have seen before or adapt solutions that have worked in the past.

To 12. Algorithms and Programming: Algorithms

People evaluate and select algorithms based on performance, reusability, and ease of implementation. Knowledge of common algorithms improves how people develop software, secure data, and store information.

To 12. Algorithms and Programming: Variables

Data structures are used to manage program complexity. Programmers choose data structures based on functionality, storage, and performance tradeoffs.

To 12. Algorithms and Programming: Control

nd independently and	Programmers consider tradeoffs related to	
oficiently.		
,		
	·	
	, , , , , , , , , , , , , , , , , , , ,	
	· ·	
	1 · · · · ·	
	drawing on the strengths of members in	
	different roles. Design decisions often	
	involve tradeoffs. The development of	
	complex programs is aided by resources	
	such as libraries and tools to edit and	
	manage parts of the program. Systematic	
		implementations, readability, and program performance when selecting and combining control structures. To 12. Impacts of Computing: Modularity Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. These procedures; or independent, but interrelated, programs. Modules allow for better management of complex tasks. To 12. Impacts of Computing: Program Development Diverse teams can develop programs with a broad impact through careful review and by drawing on the strengths of members in different roles. Design decisions often involve tradeoffs. The development of complex programs is aided by resources such as libraries and tools to edit and

- 1. K-12 Computer Science Framework. https://k12cs.org/
- 2. Common Core State Standards Initiative. (2019). www.corestandards.org
- 3. Advance CTE: State Leaders Connecting Learning to Work. (2019). https://careertech.org
- 4. Next Generation Science Standards. https://www.nextgenscience.org/