

Main Criteria: Forward Education
Secondary Criteria: Iowa Student Standards
Subjects: Mathematics, Science, Technology Education
Grades: 11, 12, Key Stage 4

Forward Education

Autonomous Electric Vehicles of the Future

Iowa Student Standards
Mathematics
Grade 11 - Adopted: 2012

STRAND / COURSE		Mathematical Practices
ESSENTIAL CONCEPT AND/OR SKILL	1	Make sense of problems and persevere in solving them.
ESSENTIAL CONCEPT AND/OR SKILL	2	Reason abstractly and quantitatively.
ESSENTIAL CONCEPT AND/OR SKILL	3	Construct viable arguments and critique the reasoning of others.
ESSENTIAL CONCEPT AND/OR SKILL	4	Model with mathematics.
ESSENTIAL CONCEPT AND/OR SKILL	8	Look for and express regularity in repeated reasoning.

STRAND / COURSE	HS.A.	High School—Algebra
ESSENTIAL CONCEPT AND/OR SKILL	A-CED.	Creating Equations A-CED
DETAILED DESCRIPTOR	A-CED.A.	Create equations that describe numbers or relationships (A-CED.A)

GRADE LEVEL EXPECTATION A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (A-CED.A.2) (DOK 1,2)

STRAND / COURSE	HS.A.	High School—Algebra
ESSENTIAL CONCEPT AND/OR SKILL	A-REI.	Reasoning with Equations and Inequalities A-REI
DETAILED DESCRIPTOR	A-REI.A.	Understand solving equations as a process of reasoning and explain the reasoning (A-REI.A)

GRADE LEVEL EXPECTATION A-REI.A.1. Explain each step in solving a simple equation as following from the 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. (A-REI.A.1) (DOK 1,2,3)

STRAND / COURSE	HS.F.	High School—Functions
ESSENTIAL CONCEPT AND/OR SKILL	F-IF.	Interpreting Functions F-IF
DETAILED DESCRIPTOR	F-IF.C.	Analyze functions using different representations (F-IF.C)
GRADE LEVEL EXPECTATION	F-IF.C.7.	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

EXAMPLE F-IF.C.7.a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

STRAND / COURSE	HS.F.	High School—Functions
ESSENTIAL CONCEPT AND/OR SKILL	F-LE.	Linear, Quadratic, and Exponential Models F-LE
DETAILED DESCRIPTOR	F-LE.A.	Construct and compare linear, quadratic, and exponential models and solve problems (F-LE.A)
GRADE LEVEL EXPECTATION	F-LE.A.1.	Distinguish between situations that can be modeled with linear functions and with exponential functions.

EXAMPLE F-LE.A.1.a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

STRAND / COURSE	HS.G.	High School—Geometry
ESSENTIAL CONCEPT AND/OR SKILL	G-GPE.	Expressing Geometric Properties with Equations G-GPE
DETAILED DESCRIPTOR	G-GPE.B.	Use coordinates to prove simple geometric theorems algebraically (G-GPE.B)

GRADE LEVEL EXPECTATION G-GPE.B.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). (G-GPE.B.5) (DOK 1,2)

**Iowa Student Standards
Mathematics
Grade 12 - Adopted: 2012**

STRAND / COURSE		Mathematical Practices
ESSENTIAL CONCEPT AND/OR SKILL	1	Make sense of problems and persevere in solving them.
ESSENTIAL CONCEPT AND/OR SKILL	2	Reason abstractly and quantitatively.
ESSENTIAL CONCEPT AND/OR SKILL	3	Construct viable arguments and critique the reasoning of others.

ESSENTIAL CONCEPT AND/OR SKILL	4	Model with mathematics.
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ESSENTIAL CONCEPT AND/OR SKILL	8	Look for and express regularity in repeated reasoning.
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STRAND / COURSE	HS.A.	High School—Algebra
ESSENTIAL CONCEPT AND/OR SKILL	A-CED.	Creating Equations A-CED
DETAILED DESCRIPTOR	A-CED.A.	Create equations that describe numbers or relationships (A-CED.A)

GRADE LEVEL EXPECTATION A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (A-CED.A.2) (DOK 1,2)

STRAND / COURSE	HS.A.	High School—Algebra
ESSENTIAL CONCEPT AND/OR SKILL	A-REI.	Reasoning with Equations and Inequalities A-REI
DETAILED DESCRIPTOR	A-REI.A.	Understand solving equations as a process of reasoning and explain the reasoning (A-REI.A)

GRADE LEVEL EXPECTATION A-REI.A.1. Explain each step in solving a simple equation as following from the 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. (A-REI.A.1) (DOK 1,2,3)

STRAND / COURSE	HS.F.	High School—Functions
ESSENTIAL CONCEPT AND/OR SKILL	F-IF.	Interpreting Functions F-IF
DETAILED DESCRIPTOR	F-IF.C.	Analyze functions using different representations (F-IF.C)

GRADE LEVEL EXPECTATION F-IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

EXAMPLE F-IF.C.7.a. Graph linear and quadratic functions and show intercepts, maxima, and minima.

STRAND / COURSE	HS.F.	High School—Functions
ESSENTIAL CONCEPT AND/OR SKILL	F-LE.	Linear, Quadratic, and Exponential Models F-LE
DETAILED DESCRIPTOR	F-LE.A.	Construct and compare linear, quadratic, and exponential models and solve problems (F-LE.A)

GRADE LEVEL EXPECTATION F-LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.

EXAMPLE	F- LE.A.1.a.	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
STRAND / COURSE	HS.G.	High School—Geometry
ESSENTIAL CONCEPT AND/OR SKILL	G-GPE.	Expressing Geometric Properties with Equations G-GPE
DETAILED DESCRIPTOR	G-GPE.B.	Use coordinates to prove simple geometric theorems algebraically (G-GPE.B)

GRADE LEVEL EXPECTATION G-GPE.B.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). (G-GPE.B.5) (DOK 1,2)

**Iowa Student Standards
Science
Grade 11 - Adopted: 2015**

STRAND / COURSE	IA.HS-PS1.	Matter and Its Interactions
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

STRAND / COURSE	IA.HS-PS3.	Energy
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR 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.

STRAND / COURSE	IA.HS-PS4.	Waves and Their Applications in Technologies for Information Transfer
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.

STRAND / COURSE	IA.HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

STRAND / COURSE	IA.HS-ESS2.	Earth's Systems
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ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:
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DETAILED DESCRIPTOR	HS-ESS2-4.	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
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STRAND / COURSE	IA.HS-ESS3.	Earth and Human Activity
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ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:
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DETAILED DESCRIPTOR	HS-ESS3-1.	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
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DETAILED DESCRIPTOR	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
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DETAILED DESCRIPTOR	HS-ESS3-3.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
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DETAILED DESCRIPTOR	HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
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DETAILED DESCRIPTOR	HS-ESS3-6.	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
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STRAND / COURSE	IA.HS-ETS1.	Engineering Design
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ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:
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DETAILED DESCRIPTOR	HS-ETS1-1.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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DETAILED DESCRIPTOR	HS-ETS1-2.	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
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DETAILED DESCRIPTOR	HS-ETS1-3.	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
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Grade 11 - Adopted: 2016

STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
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ESSENTIAL CONCEPT AND/OR SKILL		Key Ideas and Details
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DETAILED DESCRIPTOR	RST.11-12.2.	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (RST.11-12.2.)
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DETAILED DESCRIPTOR	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. (RST.11-12.3.)
STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Craft and Structure
DETAILED DESCRIPTOR	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. (RST.11-12.4.)
DETAILED DESCRIPTOR	RST.11-12.5.	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. (RST.11-12.5.)
DETAILED DESCRIPTOR	RST.11-12.6.	Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. (RST.11-12.6.)
STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Integration of Knowledge and Ideas
DETAILED DESCRIPTOR	RST.11-12.9.	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (RST.11-12.9.)
STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Range of Reading and Level of Text Complexity
DETAILED DESCRIPTOR	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. (RST.11-12.10.)
STRAND / COURSE	IA.CC.WHST.11-12.	Writing Standards for Literacy Science, and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Text Types and Purposes
DETAILED DESCRIPTOR	WHST.11-12.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
GRADE LEVEL EXPECTATION	WHST.11-12.2.d.	Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. (WHST.11-12.2.)
STRAND / COURSE	IA.CC.WHST.11-12.	Writing Standards for Literacy Science, and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Production and Distribution of Writing
DETAILED DESCRIPTOR	WHST.11-12.4.	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4.)

DETAILED DESCRIPTOR	WHST.11-12.6.	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6.)
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**Iowa Student Standards
Science
Grade 12 - Adopted: 2015**

STRAND / COURSE	IA.HS-PS1.	Matter and Its Interactions
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-PS1-4.	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
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STRAND / COURSE	IA.HS-PS3.	Energy
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	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.
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STRAND / COURSE	IA.HS-PS4.	Waves and Their Applications in Technologies for Information Transfer
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
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STRAND / COURSE	IA.HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-LS2-7.	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
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STRAND / COURSE	IA.HS-ESS2.	Earth's Systems
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-ESS2-4.	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
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STRAND / COURSE	IA.HS-ESS3.	Earth and Human Activity
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-ESS3-1.	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
DETAILED DESCRIPTOR	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
DETAILED DESCRIPTOR	HS-ESS3-3.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
DETAILED DESCRIPTOR	HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
DETAILED DESCRIPTOR	HS-ESS3-6.	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

STRAND / COURSE	IA.HS-ETS1.	Engineering Design
ESSENTIAL CONCEPT AND/OR SKILL		Students who demonstrate understanding can:

DETAILED DESCRIPTOR	HS-ETS1-1.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
DETAILED DESCRIPTOR	HS-ETS1-2.	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
DETAILED DESCRIPTOR	HS-ETS1-3.	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Grade 12 - Adopted: 2016

STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Key Ideas and Details

DETAILED DESCRIPTOR	RST.11-12.2.	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (RST.11-12.2.)
DETAILED DESCRIPTOR	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. (RST.11-12.3.)

STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Craft and Structure

DETAILED DESCRIPTOR	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. (RST.11-12.4.)
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DETAILED DESCRIPTOR	RST.11-12.5.	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. (RST.11-12.5.)
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STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Integration of Knowledge and Ideas

DETAILED DESCRIPTOR	RST.11-12.9.	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (RST.11-12.9.)
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STRAND / COURSE	IA.CC.RST.11-12.	Reading Standards for Literacy in Science and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Range of Reading and Level of Text Complexity

DETAILED DESCRIPTOR	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. (RST.11-12.10.)
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STRAND / COURSE	IA.CC.WHST.11-12.	Writing Standards for Literacy Science, and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Text Types and Purposes
DETAILED DESCRIPTOR	WHST.11-12.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

GRADE LEVEL EXPECTATION	WHST.11-12.2.d.	Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. (WHST.11-12.2.)
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STRAND / COURSE	IA.CC.WHST.11-12.	Writing Standards for Literacy Science, and Technical Subjects
ESSENTIAL CONCEPT AND/OR SKILL		Production and Distribution of Writing

DETAILED DESCRIPTOR	WHST.11-12.4.	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4.)
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DETAILED DESCRIPTOR	WHST.11-12.6.	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6.)
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**Iowa Student Standards
Technology Education
Grade 11 - Adopted: 2018**

STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming

GRADE LEVEL EXPECTATION		Algorithms
EXAMPLE	3B-AP-09.	Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem. (P5.3)

EXAMPLE	3B-AP-10.	Use and adapt classic algorithms to solve computational problems. (P4.2)
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STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3 B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming
GRADE LEVEL EXPECTATION		Modularity

EXAMPLE	3B-AP-14.	Construct solutions to problems using student-created components, such as procedures, modules and/or objects. (P5.2)
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STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3 B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming
GRADE LEVEL EXPECTATION		Program Development

EXAMPLE	3B-AP-17.	Plan and develop programs for broad audiences using a software life cycle process. (P5.1)
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**Iowa Student Standards
Technology Education
Grade 12 - Adopted: 2018**

STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3 B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming
GRADE LEVEL EXPECTATION		Algorithms

EXAMPLE	3B-AP-09.	Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem. (P5.3)
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EXAMPLE	3B-AP-10.	Use and adapt classic algorithms to solve computational problems. (P4.2)
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STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3 B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming
GRADE LEVEL EXPECTATION		Modularity

EXAMPLE 3B-AP-14. Construct solutions to problems using student-created components, such as procedures, modules and/or objects. (P5.2)

STRAND / COURSE		CSTA K-12 Computer Science Standards
ESSENTIAL CONCEPT AND/OR SKILL	CSTA.3 B.	Level 3B (Ages 17-18)
DETAILED DESCRIPTOR	3B-AP.	Algorithms & Programming
GRADE LEVEL EXPECTATION		Program Development

EXAMPLE 3B-AP-17. Plan and develop programs for broad audiences using a software life cycle process. (P5.1)