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

Forward Education

Autonomous Electric Vehicles of the Future

Michigan Academic Standards
Mathematics
Grade **11** - Adopted: **2010**

STRAND / STANDARD CATEGORY	MI.CC.MP.	Mathematical Practices
STANDARD	MP-1.	Make sense of problems and persevere in solving them.
STANDARD	MP-2.	Reason abstractly and quantitatively.
STANDARD	MP-3.	Construct viable arguments and critique the reasoning of others.
STANDARD	MP-4.	Model with mathematics.
STANDARD	MP-8.	Look for and express regularity in repeated reasoning.

STRAND / STANDARD CATEGORY	MI.CC.A.	Algebra
STANDARD	**A-CED.**	**Creating Equations**
GRADE LEVEL EXPECTATION		**Create equations that describe numbers or relationships.**
EXPECTATION	A-CED.2.	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

STRAND / STANDARD CATEGORY	MI.CC.A.	Algebra
STANDARD	**A-REI.**	**Reasoning with Equations and Inequalities**
GRADE LEVEL EXPECTATION		**Understand solving equations as a process of reasoning and explain the reasoning.**
EXPECTATION	A-REI.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.

STRAND / STANDARD CATEGORY	MI.CC.F.	Functions
STANDARD	**F-IF.**	**Interpreting Functions**
GRADE LEVEL EXPECTATION		**Analyze functions using different representations.**
EXPECTATION	**F-IF.7.**	**Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.**

INDICATOR	F-IF.7(a)	Graph linear and quadratic functions and show intercepts, maxima, and minima.

STRAND / STANDARD CATEGORY	**MI.CC.F.**	**Functions**
STANDARD	**F-LE.**	**Linear and Exponential Models**
GRADE LEVEL EXPECTATION		**Construct and compare linear and exponential models and solve problems.**
EXPECTATION	**F-LE.1.**	**Distinguish between situations that can be modeled with linear functions and with exponential functions.**
INDICATOR	F-LE.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 / STANDARD CATEGORY	**MI.CC.G.**	**Geometry**
STANDARD	**G-GPE.**	**Expressing Geometric Properties with Equations**
GRADE LEVEL EXPECTATION		**Use coordinates to prove simple geometric theorems algebraically**
EXPECTATION	G-GPE.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).

Michigan Academic Standards

Mathematics

Grade **12** - Adopted: **2010**

STRAND / STANDARD CATEGORY	**MI.CC.MP.**	**Mathematical Practices**
STANDARD	MP-1.	Make sense of problems and persevere in solving them.
STANDARD	MP-2.	Reason abstractly and quantitatively.
STANDARD	MP-3.	Construct viable arguments and critique the reasoning of others.
STANDARD	MP-4.	Model with mathematics.
STANDARD	MP-8.	Look for and express regularity in repeated reasoning.

STRAND / STANDARD CATEGORY	**MI.CC.A.**	**Algebra**
STANDARD	**A-CED.**	**Creating Equations**
GRADE LEVEL EXPECTATION		**Create equations that describe numbers or relationships.**
EXPECTATION	A-CED.2.	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

STRAND / STANDARD CATEGORY	**MI.CC.A.**	**Algebra**
STANDARD	**A-REI.**	**Reasoning with Equations and Inequalities**
GRADE LEVEL EXPECTATION		**Understand solving equations as a process of reasoning and explain the reasoning.**
EXPECTATION	A-REI.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.

STRAND / STANDARD CATEGORY	**MI.CC.F.**	**Functions**
STANDARD	**F-IF.**	**Interpreting Functions**
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EXPECTATION	**F-IF.7.**	**Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.**
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GRADE LEVEL EXPECTATION		**Use coordinates to prove simple geometric theorems algebraically**
EXPECTATION	G-GPE.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).

Michigan Academic Standards

Science

Grade **11** - Adopted: **2015**

STRAND / STANDARD CATEGORY	**MI.SC.2.**	**Chemical Reactions**
STANDARD	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 / STANDARD CATEGORY	**MI.SC.4.**	**Energy**
STANDARD	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 / STANDARD CATEGORY	**MI.SC.5.**	**Waves and Electromagnetic Radiation**
STANDARD	HS-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
STRAND / STANDARD CATEGORY	**MI.SC.9.**	**Interdependent Relationships in Ecosystems**
STANDARD	HS-LS2-7.	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
STRAND / STANDARD CATEGORY	**MI.SC.16.**	**Weather and Climate**
STANDARD	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.
STRAND / STANDARD CATEGORY	**MI.SC.17.**	**Human Sustainability**
STANDARD	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.
STANDARD	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
STANDARD	HS-ESS3-3.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
STANDARD	HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
STANDARD	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 / STANDARD CATEGORY	**MI.SC.18.**	**Engineering Design**
STANDARD	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.
STANDARD	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.

STANDARD	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 **11** - Adopted: **2010**

STRAND / STANDARD CATEGORY	**MI.RST.11-12.**	**Reading Standards for Literacy in Science and Technical Subjects**
STANDARD		**Key Ideas and Details**
GRADE LEVEL EXPECTATION	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.
GRADE LEVEL EXPECTATION	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.
STRAND / STANDARD CATEGORY	**MI.RST.11-12.**	**Reading Standards for Literacy in Science and Technical Subjects**
STANDARD		**Craft and Structure**
GRADE LEVEL EXPECTATION	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.
GRADE LEVEL EXPECTATION	RST.11-12.5.	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
GRADE LEVEL EXPECTATION	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.
STRAND / STANDARD CATEGORY	**MI.RST.11-12.**	**Reading Standards for Literacy in Science and Technical Subjects**
STANDARD		**Integration of Knowledge and Ideas**
GRADE LEVEL EXPECTATION	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.
STRAND / STANDARD CATEGORY	**MI.RST.11-12.**	**Reading Standards for Literacy in Science and Technical Subjects**
STANDARD		**Range of Reading and Level of Text Complexity**
GRADE LEVEL EXPECTATION	RST.11-12.10.	By the end of grade 12, read and comprehend science/technical texts in the grades 11-12 text complexity band independently and proficiently.
STRAND / STANDARD CATEGORY	**MI.WHST.11-12.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD		**Text Types and Purposes**
GRADE LEVEL EXPECTATION	**WHST.11-12.2.**	**Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.**

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.
STRAND / STANDARD CATEGORY	**MI.WHST.11-12.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD		**Production and Distribution of Writing**
GRADE LEVEL EXPECTATION	WHST.11-12.4.	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
GRADE LEVEL EXPECTATION	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.

Michigan Academic Standards

Science

Grade **12** - Adopted: **2015**

STRAND / STANDARD CATEGORY	**MI.SC.2.**	**Chemical Reactions**
STANDARD	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 / STANDARD CATEGORY	**MI.SC.4.**	**Energy**
STANDARD	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 / STANDARD CATEGORY	**MI.SC.5.**	**Waves and Electromagnetic Radiation**
STANDARD	HS-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
STRAND / STANDARD CATEGORY	**MI.SC.9.**	**Interdependent Relationships in Ecosystems**
STANDARD	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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STANDARD	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.
STRAND / STANDARD CATEGORY	**MI.SC.17.**	**Human Sustainability**

STANDARD	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.
STANDARD	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
STANDARD	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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STANDARD	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.
STANDARD	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.
STANDARD	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: **2010**

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GRADE LEVEL EXPECTATION	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.
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GRADE LEVEL EXPECTATION	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.
GRADE LEVEL EXPECTATION	RST.11-12.5.	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

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STANDARD		**Integration of Knowledge and Ideas**
GRADE LEVEL EXPECTATION	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.

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STRAND / STANDARD CATEGORY	**MI.WHST.11-12.**	**Writing Standards for Literacy in Science and Technical Subjects**
STANDARD		**Production and Distribution of Writing**
GRADE LEVEL EXPECTATION	WHST.11-12.4.	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
GRADE LEVEL EXPECTATION	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.

Michigan Academic Standards

Technology Education

Grade **11** - Adopted: **2017**

STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**
STANDARD	**MITECS.3.**	**Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.**
GRADE LEVEL EXPECTATION	MITECS.3.d.	Build knowledge by actively exploring realworld issues and problems, developing ideas and theories, and pursuing answers and solutions.

STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**

STANDARD	**MITECS .4.**	**Innovative Designer - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.**
GRADE LEVEL EXPECTATION	MITECS. 4.b.	Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
GRADE LEVEL EXPECTATION	MITECS. 4.c.	Develop, test, and refine prototypes as part of a cyclical design process.
GRADE LEVEL EXPECTATION	MITECS. 4.d.	Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.
STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**
STANDARD	**MITECS .5.**	**Computational Thinker - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.**
GRADE LEVEL EXPECTATION	MITECS. 5.a.	Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
GRADE LEVEL EXPECTATION	MITECS. 5.d.	Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

Grade **11** - Adopted: **2019**

STRAND / STANDARD CATEGORY		**Michigan Computer Science Standards**
STANDARD		**LEVEL 3B: HIGH SCHOOL - SPECIALIZING (GRADES 11-12)**
GRADE LEVEL EXPECTATION		**ALGORITHMS AND PROGRAMMING**
EXPECTATION	3B-AP-09.	Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem. Subconcept: Algorithms; Practice 5.3
EXPECTATION	3B-AP-10.	Use and adapt classic algorithms to solve computational problems. Subconcept: Algorithms; Practice 4.2

Michigan Academic Standards

Technology Education

Grade **12** - Adopted: **2017**

STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**
STANDARD	**MITECS .3.**	**Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.**
GRADE LEVEL EXPECTATION	MITECS. 3.d.	Build knowledge by actively exploring realworld issues and problems, developing ideas and theories, and pursuing answers and solutions.
STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**
STANDARD	**MITECS .4.**	**Innovative Designer - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.**

GRADE LEVEL EXPECTATION	MITECS.4.b.	Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
GRADE LEVEL EXPECTATION	MITECS.4.c.	Develop, test, and refine prototypes as part of a cyclical design process.
GRADE LEVEL EXPECTATION	MITECS.4.d.	Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.
STRAND / STANDARD CATEGORY	**MI.MITECS.**	**Michigan Integrated Technology Competencies for Students**
STANDARD	**MITECS.5.**	**Computational Thinker - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.**
GRADE LEVEL EXPECTATION	MITECS.5.a.	Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
GRADE LEVEL EXPECTATION	MITECS.5.d.	Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

Grade **12** - Adopted: **2019**

STRAND / STANDARD CATEGORY		**Michigan Computer Science Standards**
STANDARD		**LEVEL 3B: HIGH SCHOOL - SPECIALIZING (GRADES 11-12)**
GRADE LEVEL EXPECTATION		**ALGORITHMS AND PROGRAMMING**
EXPECTATION	3B-AP-09.	Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem. Subconcept: Algorithms; Practice 5.3
EXPECTATION	3B-AP-10.	Use and adapt classic algorithms to solve computational problems. Subconcept: Algorithms; Practice 4.2