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

Forward Education

Autonomous Electric Vehicles of the Future

Kentucky Academic Standards
Mathematics
Grade **11** - Adopted: **2019**

STRAND		Standards for Mathematical Practices
CATEGORY / GOAL	MP.1.	Make sense of problems and persevere in solving them.
CATEGORY / GOAL	MP.2.	Reason abstractly and quantitatively.
CATEGORY / GOAL	MP.3.	Construct viable arguments and critique the reasoning of others.
CATEGORY / GOAL	MP.4.	Model with mathematics.
CATEGORY / GOAL	MP.7.	Look for and make use of structure.
CATEGORY / GOAL	MP.8.	Look for and express regularity in repeated reasoning.

STRAND		Conceptual Category Algebra
CATEGORY / GOAL		Algebra—Creating Equations
STANDARD / ORGANIZER		Cluster: Create equations that describe numbers or relationships.
EXPECTATION	KY.HS.A.13.	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (MP.2, MP.5)

STRAND		Conceptual Category Algebra
CATEGORY / GOAL		Algebra—Reasoning with Equations and Inequalities
STANDARD / ORGANIZER		Cluster: Understand solving equations as a process of reasoning and explain the reasoning.
EXPECTATION	KY.HS.A.16.	Understand 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. (MP.1, MP.3)

STRAND		Conceptual Category Functions
CATEGORY / GOAL		Functions—Interpreting Functions

STANDARD / ORGANIZER		**Cluster: Analyze functions using different representations.**
EXPECTATION	**KY.HS.F.4.**	**Graph functions expressed symbolically and show key features of the graph, with and without using technology (computer, graphing calculator). (MP.4, MP.5)**
INDICATOR	KY.HS.F.4.a.	Graph linear and quadratic functions and show intercepts, maxima and minima.

STRAND		**Conceptual Category Functions**
CATEGORY / GOAL		**Functions—Linear, Quadratic and Exponential Functions**
STANDARD / ORGANIZER		**Cluster: Construct and compare linear, quadratic and exponential models and solve problems.**
EXPECTATION	**KY.HS.F.11.**	**Distinguish between situations that can be modeled with linear functions and with exponential functions. (MP.3, MP.8)**
INDICATOR	KY.HS.F.11.a.	Recognize and justify that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

Kentucky Academic Standards

Mathematics

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

STRAND		**Standards for Mathematical Practices**
CATEGORY / GOAL	MP.1.	Make sense of problems and persevere in solving them.
CATEGORY / GOAL	MP.2.	Reason abstractly and quantitatively.
CATEGORY / GOAL	MP.3.	Construct viable arguments and critique the reasoning of others.
CATEGORY / GOAL	MP.4.	Model with mathematics.
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STRAND		**Conceptual Category Algebra**
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STRAND		**Conceptual Category Algebra**

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Kentucky Academic Standards

Science

Grade **11** - Adopted: **2022**

STRAND		**High School**
CATEGORY / GOAL	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.
CATEGORY / GOAL	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.
CATEGORY / GOAL	HS-PS4-2.	Evaluate questions about the advantages of using digital transmission and storage of information.
CATEGORY / GOAL	HS-LS2-7.	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
CATEGORY / GOAL	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.
CATEGORY / GOAL	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost[1]benefit ratios.

CATEGORY / GOAL	HS-ESS3-3.	Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.
CATEGORY / GOAL	HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
CATEGORY / GOAL	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.
CATEGORY / GOAL	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.
CATEGORY / GOAL	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.
CATEGORY / GOAL	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.

Kentucky Academic Standards

Science

Grade **12** - Adopted: **2022**

STRAND		High School
CATEGORY / GOAL	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.
CATEGORY / GOAL	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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Kentucky Academic Standards

Technology Education

Grade **11** - Adopted: **2018**

STRAND		Kentucky Academic Standards (KAS) for Computer Science
CATEGORY / GOAL		Algorithms & Programming
STANDARD / ORGANIZER		Algorithms
EXPECTATION	H-AP-07.	Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests. A prototype is a computational artifact that demonstrates the core functionality of a product or process. Prototypes are useful for getting early feedback in the design process, and can yield insight into the feasibility of a product. The process of developing computational artifacts embraces both creative expression and the exploration of ideas to create prototypes and solve computational problems. Students create artifacts that are personally relevant or beneficial to their community and beyond. Students should develop artifacts in response to a task or a computational problem that demonstrate the performance, re-usability, and ease of implementation of an algorithm.

STRAND		Kentucky Academic Standards (KAS) for Computer Science
CATEGORY / GOAL		Algorithms & Programming
STANDARD / ORGANIZER		Program Development
EXPECTATION	H-AP-08.	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. Computational artifacts can be created by combining and modifying existing artifacts or by developing new artifacts. Examples of computational artifacts include programs, simulations, visualizations, digital animations, robotic systems, and apps. Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks. The focus at this level is understanding a program as a system with relationships between modules. The choice of implementation, such as programming language or paradigm, may vary. Students could incorporate computer vision libraries to increase the capabilities of a robot or leverage open-source JavaScript libraries to expand the functionality of a web application.

STRAND		Kentucky Academic Standards (KAS) for Computer Science
CATEGORY / GOAL		Algorithms & Programming
STANDARD / ORGANIZER		Algorithms
EXPECTATION	H-AP-13.	Use and adapt classic algorithms to solve computational problems. Students should be able to identify and use well-known algorithms in sorting (e.g., bubble sort, quicksort, merge sort, insertion sort), searching (e.g., linear search, binary search), and shortest-path (e.g., Dijkstra's algorithm) problems. Students will also be able to adapt and combine such well-known algorithms to add features that address more complex computational tasks.

EXPECTATION	H-AP-14.	Evaluate algorithms in terms of their efficiency, correctness, and clarity. Students should be able to calculate the total number times a loop will be executed given a code snippet, will be able to state whether an algorithm is correct for solving a given problem, and compare/contrast algorithms for clarity and the number of executed operations.

STRAND		**Kentucky Academic Standards (KAS) for Computer Science**
CATEGORY / GOAL		**Algorithms & Programming**
STANDARD / ORGANIZER		**Program Development**

EXPECTATION	H-AP-24.	Compare multiple programming languages and discuss how their features make them suitable for solving different types of problems. Students should be able to explain the difference between a compiled and scripted programming language, defend a choice of a programming language for a certain computing device and defend a choice of a language (3rd generation versus 4th generation) for solving different types of problems.

STRAND		**Kentucky Academic Standards (KAS) for Computer Science**
CATEGORY / GOAL		**Impacts of Computing**
STANDARD / ORGANIZER		**Culture**

EXPECTATION	H-IC-07.	Demonstrate ways computational design (i.e. algorithms, abstractions and analysis) can apply to problems across disciplines. Computational design can share features across disciplines (i.e. art, music etc.) by translating human intention into an artifact through algorithmic development and the need to solve a problem. Students should be able to demonstrate how these features are shared across disciplines and how real-world problems can be solved using computational methods.

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

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Information, Communication and Productivity – Students demonstrate a sound understanding of the nature and operations of technology systems. Students use technology to learn, to communicate, increase productivity and become competent users of technology. Students manage and create effective oral, written and multimedia communication in a variety of forms and contexts.**
STANDARD / ORGANIZER		**Academic Expectations**

EXPECTATION	H.BI1.AE. 6.1.	Students connect knowledge and experiences from different subject areas.

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**Academic Expectations**

EXPECTATION	H.BI3.AE. 5.5.	Students use problem-solving processes to develop solutions to relatively complex problems.

EXPECTATION	H.BI3.AE. 6.1.	Students connect knowledge and experiences from different subject areas.

STRAND		**Technology – High**

CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Enduring Knowledge – Understandings**
EXPECTATION	H.BI3.EK.1.	Technology supports critical thinking skills used in inquiry/problem solving to make informed decisions for independent learning.

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Skills and Concepts – Research**
EXPECTATION	H.BI3.SC 1.6.	Express and synthesize digital information collected in research effectively and accurately to produce original work (e.g., desktop-published or word-processed report, multimedia presentation, engineering design).

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Skills and Concepts – Inquiry/Problem-solving**
EXPECTATION	H.BI3.SC 2.3.	Explain how technology can be used for problem solving and creativity (e.g., simulation software, environmental probes, computer-aided design, geographic information systems, dynamic geometric software, graphing calculators, art and music composition software).

Kentucky Academic Standards

Technology Education

Grade **12** - Adopted: **2018**

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STANDARD / ORGANIZER		**Algorithms**
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STRAND		**Kentucky Academic Standards (KAS) for Computer Science**
CATEGORY / GOAL		**Algorithms & Programming**
STANDARD / ORGANIZER		**Program Development**

EXPECTATION	H-AP-08.	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. Computational artifacts can be created by combining and modifying existing artifacts or by developing new artifacts. Examples of computational artifacts include programs, simulations, visualizations, digital animations, robotic systems, and apps. Complex programs are designed as systems of interacting modules, each with a specific role, coordinating for a common overall purpose. Modules allow for better management of complex tasks. The focus at this level is understanding a program as a system with relationships between modules. The choice of implementation, such as programming language or paradigm, may vary. Students could incorporate computer vision libraries to increase the capabilities of a robot or leverage open-source JavaScript libraries to expand the functionality of a web application.

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EXPECTATION	H-AP-14.	Evaluate algorithms in terms of their efficiency, correctness, and clarity. Students should be able to calculate the total number times a loop will be executed given a code snippet, will be able to state whether an algorithm is correct for solving a given problem, and compare/contrast algorithms for clarity and the number of executed operations.

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STRAND		**Kentucky Academic Standards (KAS) for Computer Science**
CATEGORY / GOAL		**Impacts of Computing**
STANDARD / ORGANIZER		**Culture**
EXPECTATION	H-IC-07.	Demonstrate ways computational design (i.e. algorithms, abstractions and analysis) can apply to problems across disciplines. Computational design can share features across disciplines (i.e. art, music etc.) by translating human intention into an artifact through algorithmic development and the need to solve a problem. Students should be able to demonstrate how these features are shared across disciplines and how real-world problems can be solved using computational methods.

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

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CATEGORY / GOAL		**Big Idea: Information, Communication and Productivity – Students demonstrate a sound understanding of the nature and operations of technology systems. Students use technology to learn, to communicate, increase productivity and become competent users of technology. Students manage and create effective oral, written and multimedia communication in a variety of forms and contexts.**
STANDARD / ORGANIZER		**Academic Expectations**

EXPECTATION	H.BI1.AE.6.1.	Students connect knowledge and experiences from different subject areas.

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**Academic Expectations**

EXPECTATION	H.BI3.AE.5.5.	Students use problem-solving processes to develop solutions to relatively complex problems.

EXPECTATION	H.BI3.AE.6.1.	Students connect knowledge and experiences from different subject areas.

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Enduring Knowledge – Understandings**

EXPECTATION	H.BI3.EK.1.	Technology supports critical thinking skills used in inquiry/problem solving to make informed decisions for independent learning.

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Skills and Concepts – Research**

EXPECTATION	H.BI3.SC1.6.	Express and synthesize digital information collected in research effectively and accurately to produce original work (e.g., desktop-published or word-processed report, multimedia presentation, engineering design).

STRAND		**Technology – High**
CATEGORY / GOAL		**Big Idea: Research, Inquiry/Problem-Solving and Innovation – Students understand the role of technology in research and experimentation. Students engage technology in developing solutions for solving problems in the real world. Students will use technology for original creation and innovation.**
STANDARD / ORGANIZER		**High Skills and Concepts – Inquiry/Problem-solving**

EXPECTATION	H.BI3.SC2.3.	Explain how technology can be used for problem solving and creativity (e.g., simulation software, environmental probes, computer-aided design, geographic information systems, dynamic geometric software, graphing calculators, art and music composition software).