STEM Education Works®

Scope & Sequence

Coding with Build Smart EV Micro-Kart

BUILD SMART EV MICRO KART

	Grade Band	Unit	Overview
BUILD SMART EV MICRO CART	9-12	**Unit 1 Lesson 1:** The Engineering Design Process	Students learn about the Engineering Design Process. They take on the role of bicycle designer to solve a problem and create sketches of chassis they might want to use for their EV Micro-Kart.
	9-12	**Unit 1 Lesson 2:** Engineering Tolerances and Dimensions	Students explore the basics of engineering tolerances and dimensions. They make adjustments to their EV Micro-Kart prototypes based on tolerances and to ensure accuracy. Using a checklist of final functional requirements for the EV Micro-Kart chassis, students assess their updated prototypes' accuracy and effectiveness in meeting design requirements.
	9-12	**Unit 1 Lesson 3:** Prototyping with 3D Printers	Students use CAD software to replicate (in 1:1 scale) their final EV Micro-Kart chassis design. In preparation for CAD drawing, students learn about orthographic projections and isometric views and review parametric modeling principles. Also, students learn about the use of 3D printers in the prototyping process in industry. Finally, students draw and then 3D-print their chassis.
	9-12	**Unit 2 Lesson 1:** Power Transmission	This lesson introduces students to the topic of power transmission, including sources of power in karting and transportation systems. Students learn about losses in powertrain systems and the means of mitigating those losses.
	9-12	**Unit 2 Lesson 2:** Acceleration and Braking	Students explore the concept of acceleration (both positive and negative) and its relation to both speed and torque. Hydraulic, pneumatic, and electrical braking systems are discussed, and students engage in hands-on activities that model two types of braking systems.
	9-12	**Unit 2 Lesson 3:** Steering	Students explore the effects of geometry on a steering system. They learn the common components of a steering system and how they are used to manipulate steering geometry. Students explore caster, camber, toe, scrub angle, steering inclination angle (SIA), and Ackermann angle.
	9-12	**Unit 3 Lesson 1:** Headlights, Taillights, and Variable-Speed Motor	Students make data-driven decisions by programming a microcontroller to gather performance data. Analysis of the data prepares students for making critical decisions at the race. Students learn how to program headlights and taillights for their karts and understand how direct current (DC) motor control can be achieved through pulse width modulation and how to vary motor speed based on potentiometer input.

NGSS Standards Alignment	NGSS Discipline	Connected Subjects	Time Required
HS-ETS1-2	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours
HS-ETS1-2	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours
HS-ETS1-2	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	7 hours
HS-PS3-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	7 hours
HS-PS3-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	8 hours
HS-PS3-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	7 hours
HS-PS3-3 HS-ETS1-2 HS-ETS1-4 SEPS.4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours

	Grade Band	Unit	Overview
BUILD SMART EV MICRO CART	9-12	**Unit 3 Lesson 2:** Voltage, Current, and Power	Students program a microcontroller to control motor speed and gather performance data. They analyze data and make adjustments to prepare for the EV Grand Prix. Students gather measurements of voltage and current to calculate power using a multimeter.
	9-12	**Unit 3 Lesson 3:** Data Collection	Students program their Micro-Karts to automatically collect performance data like voltage, current, power, and wheel revolutions.
	9-12	**Unit 3 Lesson 4:** Data Visualization	Students mount their programmed microcontroller on an EV Micro-Kart and remotely gather performance data. Students hypothesize and experimentally measure impacts on power consumption based on changing gear ratios and other variables.

NGSS Standards Alignment	NGSS Discipline	Connected Subjects	Time Required
HS-PS3-3 HS-ETS1-2 HS-ETS1-4 SEPS.4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours
HS-PS3-3 HS-ETS1-2 HS-ETS1-4 SEPS.4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours
HS-PS3-3 HS-ETS1-2 HS-ETS1-4 SEPS.4	Engineering, technology, and applications of science	ELA, science, math, social studies, art, SEL, movement	6 hours