KANE AREA
SCHOOL DISTRICT

Middle School STEM Curriculum (Science, Technology, Engineering, Math)

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STEM 6

Statement of Organization:
This course was designed to teach students to code Mini Sphero through drawing, block, and text coding. Students will explore various types of communication and relate them to the ways they can communicate with Mini Sphero. As students start to learn coding, they will discover how to relate block coding to text code. In addition to coding and communication, students will expand their knowledge of geometry and physics concepts.

This course will introduce students to animation creation using the Stop Motion Studio Pro application. Students will deepen their understanding of animation by creating flipbook, stop motion, Claymation, and pixilation animation projects. Students will practice communication and presentation skills.

Expected Levels of Achievement:
Students are expected to achieve mastery of concepts and skills presented by obtaining an eight percent (80%) or better on all graded materials and projects.

Methods of Evaluation:
Student competence will be assessed through the use of one or more of the following methods:

- Exit Ticket
- Project
- Demonstration
- Journal
- Rubric
- Presentation

Estimated Instructional Time:
22 hours

Technology Integration:
Students will use technology as a core requirement of the course.

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
Communication and Coding	***NGSS – Next Generation Science Standards*** *MS-ETS1-1* *MS-ETS1-2* *MS-ETS1-3* *MS-ETS1-4* *MS-ETS2-2* *MS-ETS4-3* ***ISTE – International Society for Technology Education*** *4 - Innovative Designer 4a, 4b, 4c, 4d* *5 – Computational Thinker 5c, 5d* *6 - Creative Communicator 6a, 6b, 6c, 6d* ***CSTA - Computer Science Teachers Association*** *Algorithms and Programming 2-AP-12, 2-AP-13, 2-AP-16*	Identify forms of communication including Morse code and robotics code. Students will • Compare coding to other forms of communication. • Understand the process of digitized signals with Bluetooth robotics. • Utilize basic coding skills with the Mini robot.	Coding Bluetooth Robot Communication Block Code Javascript
		Communicate with geometry and color Students will • Work with geometric shapes within nautical flags. • Explore block coding with Sphero Edu and Mini. • Develop block code that Mini can carry out for representing nautical flags.	
		Communicate with text coding Students will • Explore the difference between block and text coding in the Sphero Edu app. • Work to communicate coordinate movements for Mini.	
		Communicate forces and motion with reference Students will • Extend and practice their use of text coding in the Sphero Edu app. • Share the motion (speed and direction) of Mini using reference points with arrows.	
		Communicate, code, and challenge Students will • Use their understanding of coding to share a newly developed communication system with Mini. • Design and build a communication mat game board that Mini can roll on for communication. • Share the newly created communication system in a 3-minute presentation.	
Animation	***NGSS – Next Generation Science Standards*** *Waves and their Applications in Technologies for Information Transfer • MS-PS4-3* ***ISTE – International Society for Technology Education*** *1 - Empowered Learner 1a, 1b, 1c, 1d* *4 - Innovative Designer 4b* *6 - Creative Communicator 6c*	Create flipbook animation Students will • Discover what animation is and how it is produced. • Learn about the history of animation. • Determine how to give an object the illusion of movement using drawings in sequence. • Create their own animated flipbook animation using traditional materials. • Share their animated flipbook with peers, teachers, and	Animation Persistence of Vision Claymation Stop Motion Green Screen FPS

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
	7 - Global Collaborator 7c ***CSTA - Computer Science Teachers Association*** *Algorithms and Programming 2-AP-13, 2-AP-16* *Impacts of Computing 2-IC-22* ***Common Core*** *English Language Arts Standards » Science & Technical Subjects Key Ideas and Details CCSS.ELA-LITERACY.RST.6-8.3* *Craft and Structure* *CCSS.ELA-LITERACY.RST.6-8.4* *English Language Arts Standards » Writing Research to Build and Present Knowledge CCSS.ELA-LITERACY.WHST.6-8.8*	family members. Create stop motion animation Students will • Investigate the meaning of animation and how it is produced. • Explore what it means to give an object the illusion of movement using animation techniques and a combination of digital and traditional tools. • Create their own stop motion animation using Stop Motion Studio Pro, an electronic device, and everyday materials. • Share their stop motion animations with peers, teachers, and family members Create Claymation Students will • Research how Claymation animation is produced. • Create the illusion of movement using animation techniques and a combination of digital and traditional tools. • Create a clay character and bring it to life using Stop Motion Studio Pro. • Tell a story about their character using Claymation. • Share their Claymation with peers, teachers, and family members. Create human animation Students will • Explore how animation can be produced. • Create the illusion of movement using animation techniques and a combination of digital and traditional tools. • Apply stop-motion animation skills to create a pixilation. • Share their pixilation with peers, teachers, family members, and the broader school community. Present knowledge Students will • Showcase one animation that they created. • Share knowledge with others about what it means to give an object the illusion of movement using animation techniques.	

STEM 7

Statement of Organization:
This course is designed to introduce students to the process, potential, and products of 3D printing. Beginning with a conceptual understanding and moving towards 3D printing with purpose, these lessons will support both instructor and student as they make their way into this exciting realm.

This course prepares young pilots for true success in flight. Working with safety and drone regulations, students will acquire the knowledge and appreciation needed to fly safely in and out of the classroom. This kit supports students in improving piloting skills while also exploring the science behind flight and drones. Allowing for research and hands-on application, the modules build into challenges and tasks to give plenty of flight time with support.

Expected Levels of Achievement:
Students are expected to achieve mastery of concepts and skills presented by obtaining an eight percent (80%) or better on all graded materials and projects.

Methods of Evaluation:
Student competence will be assessed through the use of one or more of the following methods:

- Exit Ticket
- Checklist
- Project
- Demonstration
- Journal
- Rubric
- Presentation
- Self-assessment

Estimated Instructional Time:
22 hours

Technology Integration:
Students will use technology as a core requirement of the course.

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
3d Printing	*NGSS* *1-1, MS-ETS1-3, MS ETS1-4* *ISTE* *Knowledge Constructor 3a-3c,* *Innovative Designer 4a4d,* *Creative Communicator 6a-6c* *CSTA* *2-AP-15, 2-CS-02, 2-IC-20*	3-D Printing Students will • Exercise research skills as they build an understanding of 3D printing. • Get an introduction to the class 3D printer. • Gain an understanding of the history, current possibilities, and future potential of 3D printing. • Develop an appreciation for how 3D printing can benefit life. • Build vocabulary and workflow awareness of 3D printing.	3d Printing CAD Engineering Design Manufacturing Additive Manufacturing
		Layers and Beginning Designs Students will • Develop an understanding of additive manufacturing. • Design and build a class 3D model. • Explore the basics of creating a 3D file through a design challenge. • Begin brainstorming a future 3D print project	
		Design Thinking Model Framework Students will • Gain an understanding of the Design Thinking Process. • Work together to create a math manipulatives kit for a younger grade level. • Utilize a 3D modeling software to create objects for print. • Continue brainstorming a future 3D print object	
		3-D Printing and the Design Thinking Model Students will • Recognize the purpose of modeling in the ideation and problem-solving process in science. • Revisit the Design Thinking Model in a hands-on design challenge. • Work collaboratively to imagine, design, and build a 3D model of future space travel.	
		Purposeful Engagement with 3-D Printing Students will • Utilize the Design Thinking Model to bring their own ideas to print.	
Deploying a Drone	*NGSS* *MS-ETS1-1* *ISTE* *Emp. Learner 1a, 1c-d,* *Knowledge Constructor 3a-3c,*	Becoming a Drone Builder and Pilot Students will • Explore the Federal Aviation Administration's classifications and requirements for public use of drone technology, and take notes for sharing in their drone teams.	Drone UAV Elevation Pilot Speed

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
	Innovative Designer 4a4d *Computer Thinker 5a-5d;* *Creative Communicator 6a-6c* *CSTA* *2-DA-08*	• Research, identify, and share online current event articles regarding drone use in the public sector, and take notes for sharing in their drone teams. • Discover how to assemble, connect, and lift/land their drones. • Complete a checklist rubric of "I Can" statements to apply for pilot status with the drone	
		Science of Flight Students will • Learn basic vocabulary associated with drone flight. • Practice movements that connect to the vocabulary learned. • Develop piloting skills that allow them to safely pilot a drone within a defined area in a controlled manner	
		Stability and Control Students will • Practice piloting. • Support teammates with safety and directions. • Continue to build confidence with terminology regarding drone flight.	
		Speed and Variables Students will • Make predictions regarding the speed of the DIY drone. • Design and conduct an investigation in which they use the formula for speed to calculate the drone's speed. • Compare their results to the company's estimation of the speed of the drone. • Assess what variables could make the drone's speed vary	
		Teamwork and Demonstration Students will • Demonstrate control and maneuverability in piloting a drone. • Work together in a team to accomplish a goal. • Share understanding of drone terminology	

STEM 8

Statement of Organization:
This course is designed to support students in gaining an understanding of robots as programmable machines with interconnected parts and systems. Throughout the modules, students explore the attributes of robots and discover how roboticists design, engineer, and program robots with the features and functionality to behave a certain way, accomplish a specific task, and/or solve a problem.

This course is designed to support students in gaining valuable experience in piloting small, aerial vehicles. Students will gain hands-on experience piloting and spotting for drone missions. This course is designed to go beyond basic operations and will challenge students to explore complex maneuvers, rules for flying outdoors, as well as legal and social issues regarding public and private use of drones

Expected Levels of Achievement:
Students are expected to achieve mastery of concepts and skills presented by obtaining an eight percent (80%) or better on all graded materials and projects.

Methods of Evaluation:
Student competence will be assessed through the use of one or more of the following methods:

- Checklist
- Project
- Demonstration
- Journal
- Rubric
- Self-assessment
- Worksheet

Estimated Instructional Time:
22 hours

Technology Integration:
Students will use technology as a core requirement of the course.

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
Robotics	*NGSS* *MS-ETS1-1, 1-2, 103, 1-4* *ISTE* *1—Empowered Learner 1a, 1b, 1c, 1d* *4—Innovative Designer 4a, 4b, 4c, 4d* *5—Computational Thinker 5a, 5c* *6—Creative Communicator 6c* *7—Global Collaborator 7c* *CSTA* *Algorithms and Programming 1A-AP-10, 3A-AP-18, 3B-AP-09* *Computing Systems 1B-CS-01* *Data and Analysis 1B-DA-07* *Impacts of Computing 1B-IC-18* *Common Core* *English Language Arts Standards »* *Science & Technical Subjects* *Key Ideas and Details* *CCSS.ELA-LITERACY.RST.6-8.3* *Craft and Structure* *CCSS.ELA-LITERACY.RST.6-8.4*	Teamwork, Collaboration, and Problem Solving Students will • Discuss how robots are machines that mimic living creatures in actions, movements, and decisions. • Discuss why robots do not always look human-like and may look more like a machine. • Identify robots as machines designed, programmed, and controlled by humans. • Engage with the interconnected systems and infrastructure of a robot. • Collaborate with peers to build a working, programmable robotic vehicle. Robotics – Sensing and Programming Students will • Discuss how robots are machines that mimic living creatures in senses, actions, movements, and decisions. • Discuss why robots do not always look human-like and may look more like a machine. • Identify robots as machines designed, programmed, and controlled by humans. • Engage with the interconnected systems and infrastructure of a robot. • Examine how robots sense their surroundings and program a robot using a choice of coding languages. Robotics – Space Exploration Students will • Discover how robots are used for space exploration at NASA through the Mars Rover program. • Analyze how cameras and sensors on a robotic vehicle allow it to understand and collect images and data about its environment. • Practice camera programming on a mini robotic vehicle. • Collaborate with peers to accomplish tasks with the GoPiGo3 robot. Robotic Teams Students will • Discuss how robots are machines that mimic living creatures in senses, actions, movements, and decisions. • Discuss why robots do not always look human-like and may look more like a machine. • Identify robots as machines designed, programmed, and controlled by humans. • Engage with the interconnected systems and infrastructure of a robot.	Robot Coding Block Code Python Sensor Rover Swarm Robotics

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
		• Demonstrate how robots sense their surroundings and program a robot using code. • Analyze concepts such as swarm robotics and how robots can work together to mimic and accomplish tasks normally done by humans or other living creatures	
		Robotic Vehicle Students will • Discuss how robots are machines that mimic living creatures in senses, actions, movements, and decisions. • Discuss why robots do not always look human-like and may look more like a machine. • Identify robots as machines designed, programmed, and controlled by humans. • Engage with the interconnected systems and infrastructure of a robot. • Examine how robots sense their surroundings and program a robot using code. • Experiment with robotics	
Drone Flight	*NGSS* *MS-ETS1-1* *MS-ETS1-4* *ISTE* *Emp. Learner 1a, 1c-d* *Digital Citizen 2b* *Knowledge Constructor 3a-3c* *Innovative Designer 4a4d* *Computer Thinker 5a-5d* *Creative Communicator 6a-6c* *Global Coll. 7c* *CSTA* *2-CS-03* *2-AP-15*	Introduction to Drones Students will • Explore the concept of an Unmanned Aerial Vehicle (UAV). • View and explain basic uses for UAVs and drones. • Articulate basic vocabulary relating to parts of drones, flight, and safety.	Drone UAV Pilot in Command Visual Observer Pitch Yaw Thrust Vertical Horizontal Rotational
		Introduction to Flight Students will • Perform preflight checklist steps to assess weather quality, battery charging level (state of charge – SOC), propeller conditions, and more. • Visually inspect the aircraft and flight area to determine flight safety. • Perform a flight challenge involving three maneuvers. • Master the power-up and power-down sequence controls.	
		Basic Drone Maneuvers Students will • Complete a proper preflight checklist. • Form a flight plan that matches the mission objectives. • Perform their assigned role of pilot, observer, or recorder. • Perform a series of basic maneuvers to take off from the starting position, move several directions, and then land on a finishing target.	

Big Idea/Reporting Category	Concepts/Standards	Competencies/Eligible Content	Vocabulary
		• Communicate directions during the mission to properly orient the aircraft and move it toward the landing target. • Record mission details, communication challenges, and any other successes or failures experienced.	
		Advanced Drone Maneuvers Students will • Analyze objects to be moved. • Design how the drone will pick up and carry the objects. • Build a mechanism by which the drone will pick up and deliver objects. • Calculate weights and determine what objects can be safely transported by the drone.	
		Collaborate to Construct a Flyway Students will • Work together to set up a challenging drone obstacle course. • Communicate effectively to navigate the drone obstacle course.	
		Collaborate to Pilot a Mission Students will • Demonstrate mission planning, communication, and proper use of vocabulary/action words to effectively complete a challenge. • Design a flight plan that has a clear path. • Identify best role for each team member to assign correct skill sets to unique challenges of each role. • Safely pilot the mission from start to finish avoiding obstacles and working together to articulate directions, elevation changes, and power-up/power-down sequences.	