Innovators in STEM

Grades 5-8 Scope & Sequence

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The Innovators in STEM course engages students from fifth through eighth grades in authentic problems to discuss complex topics and develop their communication, collaboration, creativity, and critical thinking skills. Students will gain a wide range of knowledge about real-world issues and careers by exploring academic, local, and global topics. This trimester course will provide students with opportunities to engage in research, collaboration, and solution design with a variety of technologies. Students' designs are published for members of the school community to view and interact with, extending STEM learning beyond the classroom and cultivating a learning community.

Innovators in STEM develops students' 21st-century skills and curiosity by engaging them in creative thinking and inquiry to solve problems and address topics relevant to today's society. Through their learning experiences, students unlock their passions, develop empathy, and practice skills necessary to solve known and unknown problems.

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STEM Program Goals

Throughout the course, students develop their competencies of communication, collaboration, creativity, and critical thinking. For each competency, there is an anchor learning target or goal of what the competency means and performance indicators for students. Each grade level's unit learning targets are aligned with the anchor learning target. The below sequence illustrates student expectations and how educators support skill development of the 4 C's in each grade level. Students are to demonstrate mastery of these learning targets by the end of the year.

Competency	Anchor Learning Target	Grade 5	Grade 6	Grade 7	Grade 8
Communication	Students will be able to **communicate their reasoning and solutions**, actively listen to others, and evaluate messages.	Students will be able to **ask, listen, and respond to questions**, allowing for the **equitable flow of ideas**.	Students will be able to **determine the mediums** best suited for communicating their solutions and reaching an audience.	Students will be able to **analyze the main idea** of a piece of work(s) and determine how the point of view(s) **impacts their solutions**.	Students will be able to communicate their solutions by **following the conventions of written, technological, and verbal communication** to reach their audiences.
Collaboration	Students will be able to **collaborate to solve a problem** with people of varying roles, points of view, and strengths.	Students will be able to **utilize group roles** to manage time, resources, and tasks.	Students will be able to **solicit and provide ideas and feedback** through brainstorming and problem-solving processes.	Students will be able to work together to **build consensus** on an approach or solution by determining a goal and considering design constraints and possibilities.	Students will be able to ensure **all group members** have a **meaningful and valued role** and navigate conflicts to ensure the group reaches its desired outcomes.
Creativity	Students will be able to **regularly consider possibilities** to **determine solutions** that are new, different, and resourceful.	Students will be able to **brainstorm answers or solutions** to questions or problems and **create something** that **serves a particular purpose**.	Students will be able to **consider answers or solutions** that are **both unknown, or considered impossible** while **presenting information in concrete steps** to support others' understanding.	Students will be able to **provide a new or different perspective** on how to solve a problem by rethinking the constraints, materials, approach, or desired outcome.	Students will be able to **problem-solve multiple approaches** through questioning and researching to act on one approach and **realize a solution**.
Critical Thinking	Students will be able to **analyze** problems, situations, ideas, questions, and concepts **objectively** and determine a point of view, noting strengths, limitations, and other points of view.	Students will be able to **break down the parts** of a problem, question, or task and determine **which information is relevant** to determining a solution and **explain how the evidence supports** their approach.	Students will be able to **explain how ideas are logically connected**, and **supported by evidence**, to reach a conclusion and **ensure that others can understand** their analysis.	Students will be able to **use data to analyze** the **cause and effect** of a problem to determine **ways in which the problem can be addressed** or solved.	Students will be able to **compare and contrast points of view**, ideas, data, concepts, solutions, etc. to **evaluate the value** of information **to an objective conclusion**.

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Grade 5 Curriculum Overview

(Science discipline focus = general science aligned to NJSLS)

Unit Title	**Standards** *What students will master by the end of the year.*	**Unit Learning Targets** *Standards-aligned objects students will master by the end of the unit. Daily learning objects are aligned with learning targets and standards.*	**Essential Questions (EQ) and Enduring Understandings (EU)**	**Assessment**	**Discipline & Real-World Connections**	**Technology Integration** *Identified in phases to suggest how technology could be integrated over time.*
Unit 1: Empathetic Engineering *15 Periods*	Science: 3-5.EST1.1 3-5.ETS1.2 3-5.ETS1.3 ELA: NJSLSA.W.4 NJSLSA.SL.5 NJSLSA.L.6 Computer Science and Design Thinking: 8.2.5.ED.2 8.2.5.ITH.1 8.2.5.EC.1 Technology (ISTE): 1.4.a: Innovative Designer	***Communication***: Students will be able to explain how their design addresses a need(s) and promotes access and equity, as well as the limitations of the design. ***Collaboration***: Students will be able to work collaboratively, utilizing group roles, to determine a design and justify their design according to variables and constraints. ***Creativity***: Students will be able to use information from academic subjects, and global discourse to brainstorm approaches and test their designs. Students will utilize feedback and data to iterate their design. ***Critical Thinking***: Students will be able to use the steps of the Engineering Design Process to break down the parts problem and determine which information is relevant to their design and explain how the evidence supports their	**EQ:** ***How do engineers design innovative solutions that consider the needs of individuals and society such as sustainability, employment, and inclusivity?*** EU: *Engineers can use design processes, data, and empathy to design solutions that meet the needs of individuals and societies. Engineers should use human-centered design practices and work to create greater access and equity in their designs.*	***Empathetic Engineering*** Students engineer a solution to support someone's everyday use of an object or to complete a task, such as designing a utensil for someone with limited mobility or a water filtration system. Students will unpack how the design relates to their audience, the impact on the global society, the training that is needed to implement the design effectively, and the financial impact of producing the design. Students will utilize their knowledge and skills from science as they consider variables, and data, and conduct experiments and utilize the design process. ***Learning Process:*** *Engineering Design Process*	**General Science:** • Variables • Data • Experiments • Design process and constraints **UN Sustainable Development Goals:** *Goal 8: Decent work and economic growth* • Sustainable economic growth • Full and productive employment and decent work for all *Goal 9: Industry, innovation, and infrastructure* • Promote inclusive and sustainable industrialization • Foster innovation	Makerspace building materials Hummingbird Kits with Micro:bit

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		approach.				
Unit 2: ***Engineering with Coding and Robotics*** *15 Periods*	Science: *Science and Engineering Practices:* 5.ESS3.1: Obtaining, Evaluating, and Communicating Information ELA: NJSLSA.R.10 NJSLSA.W.6 NJSLSA.SL.5 NJSLSA.L.6 Computer Science and Design Thinking: 8.1.5.CS.3 8.1.5.IC.1 8.1.5.AP.3 8.1.5.AP.6 Technology (ISTE): 1.4.c: Innovative Designer 1.5.d: Computational Thinker 1.7.c: Global Collaborator	***Communication***: Students will be able to share their ideas and ask for the ideas of others to determine a task that can be automated using coding and robotics. ***Collaboration***: Students will be able to define roles in a team and act on the roles to create a cohesive coding program. ***Creativity***: Students will be able to determine how to automate a task that considers multiple perspectives, needs, and approaches. ***Critical Thinking***: Students will be able to determine how to design an attachment that is coded to automate a task by breaking down the problem, considering different solutions, and debugging their designs.	**EQ:** ***How can coding and robotics help us do things more efficiently or effectively or enable us to do things we wouldn't have been able to do without them?*** EU: *We can build our knowledge of coding and robotics in order to automate tasks, make things safer, be more productive, and accomplish things we couldn't previously imagine possible.*	***Engineering with Coding and Robotics*** Students design attachments to a robot and code it to automate a task, such as feeding a pet on a schedule or deploying and retracting a sunshade to protect a garden. Students will utilize three different difficulty levels of coding (badge, block, and code) to create a cohesive program that utilizes loops, conditionals, and variables to command the robot. Students will work collaboratively to simulate a design team, ensuring they are properly ideating, testing, and debugging. ***Learning Process:*** *Engineering Design Process*	**Discipline Connections:** ● History: History of automation, Industrial Revolution, industry's impact on societies ● Math: variables, measurements, distance, calculations, ratio, fractions ● English: the structure of coding language (ie. code, algorithm, program) and how it relates to English (ie. words, sentences, paragraphs, etc.) ● Science: The impact of automation on the environment, variables, data, experiments, design process and constraints **UN Sustainable Development Goals:** *Goal 8: Decent Work and Economic Growth* ● Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all *Goal 9: Industry, innovation, and infrastructure* ● Promote inclusive and sustainable industrialization *Goal 12: Responsible Consumption and Production* ● Ensure sustainable consumption and production patterns *Goal 14: Life below water* ● Conserve and sustainably	Photon robot Photon EDU application Photon Code application Magic Bridge Dongle Hummingbird Kits with Micro:bit

					use the oceans, seas and marine resources for sustainable development *Goal 15: Life on land* • Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	

Grade 6 Curriculum Overview

(Science discipline focus = earth science)

Unit Title	**Standards** *What students will master by the end of the year.*	**Unit Learning Targets** *Standards-aligned objects students will master by the end of the unit. Daily learning objects are aligned with learning targets and standards.*	**Essential Questions (EQ) and Enduring Understandings (EU)**	**Assessment**	**Discipline & Real-World Connections** *Topics of inquiry related to science curriculum and the UN SDGs.*	**Technology Integration** *Identified in phases to suggest how technology could be integrated over time.*
Unit 1: **A Place to Call Home** *15 Periods*	Science: MS.LS2.5 MS.ESS3.3 MS.ETS1.2: ELA: NJSLSA.W.7 NJSLSA.SL.5 NJSLSA.L.6 Computer Science and Design Thinking: 8.2.8.ED.3 8.2.8.ITH.3 Technology (ISTE): 1.4.b: Innovative Designer 1.5.a: Computational Thinker	***Communication***: Students will be able to utilize technology to communicate their community design solutions. ***Collaboration***: Students will use feedback to work through the brainstorming process without stifling ideas. ***Creativity***: Students will be able to develop answers to inquiry questions that might be considered unknown or impossible. ***Critical Thinking***: Students will be able to justify their	**EQ:** ***How can housing be designed to ensure a limited impact on the environment, affordability for all, and withstand natural phenomena?*** EU: *Housing of the future will need to have a low impact on the environment, withstand the elements, and be accessible and affordable for humans. Science and technology can help us create sustainable and affordable housing.*	***A Place to Call Home*** Students survey the impact of human infrastructure and design on animal habitats and migration locally or around the world. Students utilize technology to survey the land, analyze the potential impacts on animals, and create wildlife corridors to provide a solution for how humans and animals can sustainably coexist, allowing for expansion and quality of life for all. ***Learning Process:*** *Problem-Based Learning*	**Earth Science:** • Human impact • Global warming • Natural disasters • Geology • Water movement • Limited resources **UN Sustainable Development Goals:** *Goal 11: Sustainable cities and communities* • Make cities and human settlements inclusive, safe, resilient and sustainable *Goal 12: Responsible Consumption and Production* • Sustainable consumption and production patterns	Drone CoSpaces

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		community solutions with scientific information and theories.			*Goal 13: Climate action* • Combat climate change and its impacts	
Unit 2: **The Innovator's Exchange** *15 Periods*	Science: MS.ESS3.3 MS.ESS3.5 ELA: NJSLSA.W.6 NJSLSA.SL.6 NJSLSA.L.3 Computer Science and Design Thinking: 8.1.8.CS.1 8.1.8.CS.3 8.2.8.ED.7 Technology (ISTE): 1.3.b: Knowledge Constructor 1.6.b: Creative Communicator 1.7.b: Global Collaborator	***Communication***: Students will be able to create a tutorial using the appropriate medium for teaching a skill or concept. ***Collaboration***: Students will be able to provide feedback to peers on the efficacy of their tutorials. ***Creativity***: Students will be able to convey complex concepts concretely in ways that develop others' understanding of the topic. ***Critical Thinking***: Students will be able to determine how to logically convey information and support their teachings with evidence.	**EQ:** ***How can we make learning accessible to all and promote life-long learning to tackle poverty, inequality, and sustainability?*** EU: *Equitable and inclusive education can address issues of poverty, inequality, and sustainability.*	***The Innovator's Exchange*** Students work together to design an application that aims to teach others on a topic of climate change and guide learning through a digital medium. The application will feature an interactive learning experience that guides people through three learning steps: Learn, Discuss, Try. Students will make decisions in the content, user experience, and user interface for their custom apps that best apply to the learning modalities and learning goals. ***Learning Process:*** *Problem-Based Learning*	**Discipline Connections:** • History: Research, expository writing, speaking and listening skills, and the historical context of the inquiry question. • Math: Mathematical calculations or practices related to their topic of inquiry. • English: Research, expository writing, speaking, and listening skills. • Earth Science: Weather and climate; Earth's crust, oceans, and atmosphere; Earth's rotation and heating; Earth's history; Sun, moon, and stars; Seasons; Eclipses; Universe formation **UN Sustainable Development Goals:** *Goal 4: Quality Education* • Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all *Goal 11: Sustainable cities and communities* • Make cities and human settlements inclusive, safe, resilient and sustainable *Goal 13: Climate action* • Combat climate change and its impacts	Lumavate

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(Science discipline focus = life science)

Unit Title	Standards *What students will master by the end of the year.*	Unit Learning Targets *Standards-aligned objects students will master by the end of the unit. Daily learning objects are aligned with learning targets and standards.*	Essential Questions (EQ) and Enduring Understandings (EU)	Assessment	Discipline & Real-World Connections	Technology Integration *Identified in phases to suggest how technology could be integrated over time.*
Unit 1: Healthcare Innovations *15 Periods*	Science: *Disciplinary Core Idea:* MS.LS2.A: Interdependent Relationships in Ecosystems MS.LS1.B: Growth and Development of Organisms *Crosscutting Concepts:* MS.LS4.5: Interdependence of Science, Engineering, and Technology MS.LS4.5: Science Addresses Questions about the Natural and Material World *Science and Engineering Practices:* MS.LS1.5: Constructing Explanations and Designing Solutions MS.LS4.5: Obtaining, Evaluating, and Communicating Information ELA: NJSLSA.R.10 NJSLSA.W.6 NJSLSA.SL.4 NJSLSA.L.6 Computer Science and Design Thinking: 8.2.8.ED.2 8.2.8.ED.7	***Communication***: Students will be able to comprehend and analyze challenges impacting the health and well-being of humans. ***Collaboration***: Students will be able to determine how their solution relates to the solutions of others to create a collective approach or meet a common goal. ***Creativity***: Students will be able to consider the relationship between science, nature, and health in a new or different way to address issues of healthcare. ***Critical Thinking***: Students will be able to determine the potential cause and effect between nature, industry, and human well-being by using data.	**EQ:** ***How can science and nature inform our collective understanding of health and well-being for all?*** EU: *We can utilize inquiry to develop an understanding of the relationship between science, nature, and healthcare to determine how we can promote long and healthy lives for all.*	***Healthcare Innovations*** Through problem-based learning, students develop an understanding of an issue related to medicine and health in order to design a solution to support equitable wellbeing for all. Students articulate their solutions by creating a VR experience that others can learn about through a VR headset such as walking through the sections of an organ or a vegetable garden that highlights the benefits of food on the body and illness. ***Learning Process:*** *Problem-Based Learning*	**Life Science:** ● Cell structure and function ● Body systems ● Transformation of matter and energy ● Organisms in an ecosystem ● Photosynthesis ● Limited resources ● Genetics ● Environments' influence on organisms **UN Sustainable Development Goals:** *Goal 2: Zero Hunger* ● End hunger, achieve food security and improved nutrition and promote sustainable agriculture *Goal 3: Good Health and Wellbeing* ● Ensure healthy lives and promote well-being for all at all ages *Goal 4: Quality Education* ● Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all *Goal 12: Responsible Consumption and Production* ● Ensure sustainable consumption and production patterns	Veative headsets VR Create software 360° Cameras

	Technology (ISTE): 1.3.c: Knowledge Constructor 1.6.c: Creative Communicator					
Unit 2: **The Innovator's School** *15 Periods*	Science: *Science and Engineering Practices:* MS.LS4.1: Analyzing and Interpreting Data MS.LS4.5: Obtaining, Evaluating, and Communicating Information MS.LS4.6: Using Mathematics and Computational Thinking ELA: NJSLSA.R.6 NJSLSA.W.9 NJSLSA.SL.4 NJSLSA.L.3 Computer Science and Design Thinking: 8.1.8.DA.1 8.2.8.ED.7 Technology (ISTE): 1.4.c: Innovative Designer 1.5.b: Computational Thinker 1.7.c: Global Collaborator	***Communication***: Students will be able to ask and listen to students' perspectives on what they need from their school and determine the extent to which the points of view impact their school solutions. ***Collaboration***: Through the Design Thinking Process, students will be able to build consensus on what will be incorporated into their design based on the challenge, goal, and design constraints. ***Creativity***: Students will be able to rethink the use of resources, space, and time to meet the desired outcome in their design of a school. ***Critical Thinking***: Students will be able to collect and analyze data to determine what the best use of school space is and how to allocate resources to achieve their design.	**EQ:** ***How can we peacefully and effectively advocate for change while addressing realistic constraints and being inclusive of all?*** EU: *Using problem-solving processes, we can develop a solution, supported by data, to present our solution so it meets the needs of varying stakeholders.*	***The Innovator's School*** Students work together to reimagine a specific physical space in their actual school environment. In their designs, students work to address a question and meet a need such as how to design a space that provides access to physical activities all students enjoy, a place to utilize innovative technologies, or a space to study efficiently. Students survey the school community and utilize the data to justify their designs. Students will work within a budget and demonstrate their understanding of how to manage the budget. ***Learning Process:*** *Design Thinking Process*	**Discipline Connections:** ● History: Investigation of the history of the school and how the space has been used; argumentative and expository writing opportunities. ● Math: Operations, area, space, volume, data collection, and analysis. ● English: Expository and persuasive writing; research; citation of evidence. ● Science: Sustainable building materials, impact on the environment. **UN Sustainable Development Goals:** *Goal 4: Quality Education* ● Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all *Goal 5: Gender Equality* ● Achieve gender equality and empower all women and girls *Goal 8: Decent Work and Economic Growth* ● Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all *Goal 16: Peace, Justice, and Strong Institutions*	CoSpaces 3D Printer

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					• Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	

Grade 8 Curriculum Overview

(Science discipline focus = physical science)

Unit Title	**Standards** *What students will master by the end of the year.*	**Unit Learning Targets** *Standards-aligned objects students will master by the end of the unit. Daily learning objects are aligned with learning targets and standards.*	**Essential Questions (EQ) and Enduring Understandings (EU)**	**Assessment**	**Discipline & Real-World Connections**	**Technology Integration** *Identified in phases to suggest how the technology could be integrated over time.*
Unit 1: Transportation of the Future *15 Periods*	Science: MS-ETS1.1 MS.ETS.3 MS.ESS3.3 ELA: NJSLSA.W.7 NJSLSA.SL.5 NJSLSA.L.6 Computer Science and Design Thinking: 8.2.8.ED.3 8.2.8.NT.4 Technology (ISTE): 1.3.d: Knowledge Constructor 1.5.c: Computational Thinker	***Communication***: Students will be able to prototype their solutions and communicate their ideas using the appropriate written, verbal, and technical communication tools. ***Collaboration***: Students will be able to collaborate to develop collective knowledge on a topic and utilize the information to design independent solutions. ***Creativity***: Students will be able to consider multiple approaches to solving sustainable or autonomous transportation designs and prototype at least one solution. ***Critical Thinking***: Students will be able to reflect on the approaches of others and	**EQ:** ***How can sustainable and autonomous transportation address issues of affordable clean energy, and inclusive and sustainable industrialization?*** EU: *We can consider the role of transportation in developing communities that are inclusive, safe, sustainable, and affordable and how science and technology may help us design sustainable solutions.*	***Transportation of the Future*** Students explore the topic of sustainable and autonomous transportation in supporting the expansion of human settlement and quality of life. Through the Design Thinking Process, students prototype a solution to how transportation can be sustainable and what it entails to integrate automation into our society safely and ethically. Students design the body of a car and code it using Arduino code, to automatically follow another path and create an autonomous city as a class. ***Learning Process:*** *Design Thinking Process*	**Physical Science:** • Atomic and molecular interactions • Periodic table of elements • Molecules • Energy transfer • Motion • Newton's laws • Potential/Kinetic Energy • Light and sound waves **UN Sustainable Development Goals:** *Goal 7: Affordable and Clean Energy* • Access to affordable, reliable, sustainable and modern energy for all *Goal 9: Industry, innovation, and infrastructure* • Promote inclusive and sustainable industrialization *Goal 11: Sustainable cities and communities*	Soap Box Derby DigiRacer

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		determine the extent to which others' designs influence their solutions.			• Make cities and human settlements inclusive, safe, resilient and sustainable	
Unit 2: Mission-Driven Entrepreneurs *15 Periods*	Science: MS.ETS1.2 MS.ETS1.4 ELA: NJSLSA.W.4 NJSLSA.SL.4 NJSLSA.L.3 Computer Science and Design Thinking: 8.2.8.ED.7 8.2.8.EC.1 8.2.8.EC.2 Technology (ISTE): 1.4.d: Innovative Designer 1.6.d: Creative Communicator 1.7.d: Global Collaborator	***Communication***: Students will be able to communicate their multifaceted solutions by choosing the appropriate tools to communicate with an audience. ***Collaboration***: Students will be able to work collaboratively to design a solution while ensuring all team members are included, valued, and contributing authentically. ***Creativity***: Students will be able to consider multiple solutions and determine which is the best solution based on the needs of the challenge and team. ***Critical Thinking***: Students will be able to justify how their approach considers and addresses the needs of diverse people and perspectives to create an inclusive community.	**EQ:** ***How can we use innovation to create products or processes that support a local or global community need?*** EU: *We can use our passions surrounding societal needs to fuel creativity and inspire the development of new solutions and business ideas.*	**Mission-Driven Entrepreneurs** In the capstone project of their Middle School STEM experience, students design a business that aims at accomplishing a specific goal or mission related to the UN Sustainable Development Goals to serve their communities (local or global). Through the Design Thinking Process, students define their passions and develop a mission statement, a business plan, and a prototype of their product or service. Students will present their plans to a group of their peers and/or school staff in order to explain how this idea is a capstone of their learning experience and relates to global issues. Students utilize technologies of their choosing (new or previously utilized) to prototype their solutions and communicate their business plan. ***Learning Process:*** *Design Thinking Process*	**Discipline Connections:** • Social Studies: sociology, communities, human behavior and community needs • Math: calculations related to materials, scaled proportions in a model • English: expository or persuasive writing of the mission statement • Science: designing solutions using the design cycle **UN Sustainable Development Goals:** *Goals 1-17*: Student Choice	Students will choose any of the available tools.