K-12 STEAM
Integrated Component

An Addendum to the
Scarsdale Technology Plan

DRAFT 1.1

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STEAM Offerings in Scarsdale

Overview

This document provides an overview of the Scarsdale STEAM curriculum, which enables students to explore pre-engineering and design. Collectively, this work involves the integration of five core disciplines that are popularly known as STEAM:

Science
Technology
Engineering
Art
Mathematics

Scarsdale's interest in developing these activities is twofold:

1. There has been a lot of conversation in the popular media, as well as among members of the Scarsdale community, that students need to understand the principles of engineering and design due to the increasing need for these skills in a wide range of endeavors..
2. Scarsdale's Education for Tomorrow and the District's latest Strategic Plan focus on fostering the ability of students to engage in activities that promote critical and creative thinking. STEAM activities support this long-term District goal through the application of knowledge and skills in the five STEAM disciplines.

The Scarsdale faculty has identified a core set of activities that augment traditional offerings in science, mathematics, and technology, incorporating all of these disciplines as well as engineering. These activities are encompassed in our STEAM projects that define the core of our program. Students have many opportunities to engage in STEAM learning experiences, and this document highlights the offerings at each level.

This K-12 STEAM articulation was introduced as one of Scarsdale's "Integrated Components" of the 2016-2019 District Technology Plan and has been revised for the 2019-2022 edition of the Plan. These three Integrated Components are designed to showcase specific projects that go beyond the core Technology Plan.

STEAM Activities at Every Level

At the elementary schools, a series of STEAM "anchor units" are incorporated into the curriculum, including . grade-level activities from the Science 21 curriculum, as well as the regular K-6 curriculum. Each of these units incorporate skills outlined in the Next Generation Science Standards.

In the Middle School, STEAM projects are offered via the 6th-grade technology quarterly courses, the three-year technology course sequence, and the science department.

At the High School, three levels of computer science courses are offered, as well as a three-year STEAM sequence that includes elective courses in year two, and a joint STEAM/Computer Science class in App Development.

Scarsdale is committed to ensuring consistent STEAM experiences for all students, as well as providing additional opportunities for students who express an interest in this area. Teachers are provided with professional development experiences to help support this work in their classrooms.

Elementary STEAM

The Elementary Computer Teachers and the Science, Math, and ELA coordinators provide specialized instruction for all students, as well as guidance to classroom and specials teachers in support of STEAM project-based experiences at each grade level.

The following computer science concepts are introduced at the primary level:

- Computing Systems - recognizing that hardware and software have different roles and how understanding those roles can help troubleshoot a system or program that is not working correctly.
- Networks and the Internet - understanding that information is sent and received over networks, and learning to protect personal data, and understanding Internet safety.
- Data and Analysis - collecting, prioritizing and analyzing data in order to understand the world around us.
- Algorithms and Programming - understanding the process of creating instructions and translating them into a language the computer can understand in order to automate actions, or solve problems.
- Impacts of Technology - understanding how technology can be helpful, as well as potentially harmful, and how it connects people and fosters different types of communication, as well as the importance of using technology responsibly.

The following Engineering Skills are incorporated into the common Elementary STEAM Anchor Units mentioned in the introduction:

- Understand the steps of the Engineering Design Process (Ask, Imagine, Plan, Create, Improve).
- Use what students have learned about materials and their properties to make detailed plans for their designs, including labeled models and materials lists.
- Brainstorm ideas for solving problems.
- Create and test designs.
- Observe and analyze solutions to determine strengths and weaknesses based on observations made during testing.
- Imagine ways to improve their designs and implement some of their improvement ideas.

KINDERGARTEN

Kindergarten STEAM Anchor Units

Weather and Climate/Matter and Its Interactions
Students conduct multiple controlled investigations to determine how the sun's energy affects the temperature of different surfaces. Students apply their knowledge to design, build, and test a structure that protects an ice cube from solar energy.

Forces and Interactions: Pushes and Pulls
Through a series of investigations, students explore the nature of force, motion, and cause and effect. Students use this knowledge to design a game with a starting point, an exit point, at least two pushes, two pulls, and one collision. They label their game with arrows to indicate direction and magnitude of forces used in the game. Students play and evaluate one another's games and provide feedback that is used to improve the games.

Interdependent Relationships in Ecosystems: Animals, Plants and Their Environment
Students apply their knowledge of what animals and plants need to survive and thrive to design a zoo/habitat or garden for at least two animals of their choice.

Kindergarten Computer Science STEAM Activities

Beebots
Introduction: Parts, Purposes, Complexities

- For younger students, complexities can be called "Workings" *Link*. Students explore the bots to understand the features and workings before attempting any challenges. They share their discoveries with the group.
- Using a grid on the floor, students work in pairs to make Beebot move forward one square at a time. Ideally one student writes code or puts a series of code cards in order and their partner positions the Beebot and presses the start button. Types of initial challenges include:
    - Move forward and turn
    - Move forward, turn, and move forward
    - Make a square
    - Make a rectangle

Challenge Maps
Using a grid map students work in pairs or threes to program bots around the mat. For instance, students would be given the challenge of getting their bot from the green rectangle to the blue triangle without hitting the red triangle. Students are encouraged to sketch out a plan on paper before actually coding. Beebot Maps As students progress through the various mats they become increasingly challenging. In late Kindergarten, they begin to create their own mazes with blocks/tiles.

Creating Models and Beebots
Kindergarten students also use the bots to demonstrate their understanding of Push and Pull, by using maker materials. They build a “plow” device and then test to see how many small objects it will push, and the next day they design and build a “Pull” mechanism to test, revise and test again.

Creating Stories and Beebots

Kodable
Kodable is a web-based platform, it can be accessed with any web browser from most devices. Students practice Kodable on their school iPad and sometimes on the lab iMacs. Students are introduced to new goals and concepts as a whole group and have guided practice sessions but then also are free to practice independently. Student progress is monitored by teachers and next steps planned based on individual progress.

Below are sequenced benchmark goals and concepts. Kodable is a game-based platform, s ostudents are self-motivated and move through the program sequence at their own pace.

Kodable Computational Thinking and Programming for Kindergarten	
Goal	Identify code as language people use to control machines.
Concepts	--Use numbers and symbols to represent data (e.g., thumbs up/down for yes/no, color by number, arrows for direction). --Identify and describe elements in a pattern. --Deconstruct a model or task into smaller elements.

	--Identify and describe an error (bug) when it is occurring (e.g., “The arrow should be pointing to the right here, not up”). --Select and test the appropriate solution to fix a bug when given multiple options. --Model processes and systems that satisfy “if, then” statements. Students should be completing this at all grade levels, increasing complexity each year.

From the beginning, introducing the Kodable program in Kindergarten, we begin to connect the vocabulary as a common language across all disciplines. Terms discussed include:

Sequence	Functions	Procedure
Code	Variables	Function
Conditions	Debugging	Programmer
Loops	Iteration	Computer Science

GRADE 1

Grade 1 STEAM Anchor Units

Earth's Systems: Patterns and Cycles

Students engage in hands-on investigations to identify what a shadow is, and demonstrate how shadows can change both their shape and location depending on the position of a light source. Students observe, record, and explain the patterns of changes in the sun over the day, how the moon illumination changes each day, how the stars can be seen, and how the amount of daylight changes over the course of a year.

Waves: Light and Sound

This unit is an introduction for young scientists into the physics of sound and light. Students plan and conduct investigations to observe and describe how sound can make matter vibrate and vibrating matter can make something move. Students plan and carry out a fair test and use their understanding of vibrations and sound to design and redesign “phones” to test which one communicates sound the best over a distance.

Structure, Function, and Information Processing
Students discover how plants and animals use unique external body parts to survive, and how engineers use certain strategies from plants and animals as inspiration to design solutions for humans. Students design, create, and wear a device that helps them survive, grow, or meet their needs using inspiration from the external parts of plants and animals.

STEAM Anchor Unit: The Best of Bugs: Designing Hand Pollinators
Students conduct investigations to discover that plants have different parts (roots, stems, leaves, flowers, fruit) that help them survive and grow. They investigate the parts of a flower and the parts of a bee and recognize that a system may fail if a part of it is missing or is not working. Students conduct a fair test to determine which materials and properties of materials are good or poor choices for a design that can mimic a bee's ability to pick up and deposit pollen. They use the Engineering Design Process to engineer their own technologies for pollinating plants by hand.

Grade 1 Computer Science STEAM Activities

Kodable
Below are sequenced benchmark goals and concepts. Kodable is a game-based platform, so students are self-motivated and move through the program at their own pace.

Kodable Computational Thinking and Programming for Grade 1	
Goal	Identify algorithms to complete a task and apply logic statements.
Concepts	--Use numbers or other symbols to make a model representing a set of data. --Define code as a language for computers and recognize there is more than one computer language. --Deconstruct a problem into the variety of possible smaller problems, identifying patterns. --Describe characteristics of the problems in order to understand outcomes and restraints. --Create and arrange sequences of steps to reach a desired outcome. Use appropriate vocabulary (e.g., algorithm) to describe these steps. --Identify and describe an error when it is occurring

	--Select and test the appropriate solution to solve a bug when given multiple options, with more complicated code structures. --Justify decisions by demonstrating an understanding of "if, then" statements. --Model processes and systems that satisfy "if, then" statements.

GRADE 2

Grade 2 STEAM Anchor Units

Structure and Properties of Matter
Students plan and carry out investigations to determine the properties of various materials. They analyze data to choose the best material for creating small-scale 3D models of playground equipment. Finally, they use the Engineering Design Process and knowledge of properties of materials to build a bridge and/or to support a book above a surface.

Earth's Systems: Processes that Shape the Earth
Students plan and carry out an investigation to learn how wind and rain cause erosion. They use this knowledge to help them plan, construct, test, and improve design solutions to slow or prevent erosion.

Interdependent Relationships in Ecosystems
Students engage in hands-on investigations to discover the relationship between the unique structures of plants and animals and their functions. This knowledge coupled with the use of the Engineering Design Process allows students to create a model of a seed that can be carried by wind, water, or an animal.

Grade 2 Computer Science STEAM Activities

Intro to Dash (via Blockly)
Using Dash, students reinforce their knowledge of basic commands and concepts that they experienced with Beebots/Kodable/Tynker/Scratch. Students work with partners to get to know Dash, and command Dash with a familiar basic programming sequence, proceeding to additional challenges, such as creating

shapes, following tiled floor patterns, and reaching a destination. Detailed Dash coding activities HERE.

Kodable

Kodable Computational Thinking and Programming for Grade 2	
Goal	Write, describe, apply and debug multiple coding concepts.
Concepts	--Identify characteristics of code (length, characters, integers, different types). --Determine the best sequence based on a series of outcome restraints. Justify the choice. --Arrange a sequence of code in multiple ways to reach a single outcome. Choose the most efficient and provide rationale. --Predict the outcome of specific scripts, considering errors that may occur. --Automate solutions by using elements in code that increase efficiency, save time, and decrease the likelihood of bugs. --Test and refine automated solutions to determine maximum efficiency. --Justify decisions by demonstrating an understanding of "if, then" statements. Students should be completing this at all grade levels, increasing complexity each year.

Kodable is a game-based platform, so students are self-motivated and move through the program at their own pace. Students have access to levels that for the teacher, are labeled as Grade 3, 4, and 5. The goals for those levels are to write, describe, and apply algorithms using multiple coding concepts; to read and modify scripts to change what happens on the screen; and to read, modify, and write scripts that change what happens on the screen.

Tynker 1B

Students will be able to use sequencing, repetition, conditional logic, keyboard and mouse events, playing sounds, simple motion, and animation to solve problems and create within a block programming environment.

GRADE 3

Grade 3 STEAM Anchor Units

Forces and Interactions

Through a series of inquiry investigations, students discover the cause and effect relationship responsible for magnetic attraction and repulsion and design a magnetic device to solve a real-world problem.

Interdependent Relationships in Ecosystems

Students analyze and interpret data about animals, plants, and habitats to develop a model that shows whether a species is suited for one or more habitats. Balancing the constraints of time, cost, and materials, students evaluate the merit of a solution to a problem caused by an environmental change that may affect the organisms in a habitat.

Weather and Climate

Students gather, graph, and analyze weather and climate data over periods of time in order to predict future patterns. They evaluate the effectiveness of design solutions for various weather hazards and support their claims with evidence.

Inheritance and Variation of Traits

Students develop a model to demonstrate an understanding that plants and animals have traits inherited from parents. They use data to identify environmental factors that can change some traits of organisms and determine if the new trait gives the species a survival advantage. Finally, students develop models to demonstrate the unique and diverse life cycles of plants and animals.

STEAM Anchor Unit: The Attraction is Obvious: Designing Maglev Systems

Innovative “maglev” or magnetic levitation trains move by using magnets instead of wheels. The technological innovation behind these trains comes alive for students in this transportation engineering unit. Students send magnets sailing, help magnets hover, and poke around magnetic fields. With their new insights into the science of magnets, students use the engineering design process to design, test, and improve their own tabletop maglev transportation systems—just like the character in the storybook *Hikaru’s Toy Troubles*.

Grade 3 Computer Science STEAM Activities

Wonder Workshop

Dash Challenge Games using Blockly

Horseshoes: Students program Dash to get closest to or inside the dot, and add obstacles for program challenges.

Bowling: Students program Dash to knock down as many of the ten pins as possible.

Disco Dash: Students program dance moves to the beat of student-selected music.

Maze: Students complete maze challenges with Dash that involve turning angles that are other than 90 degrees.

Kodable

- Students will be able to create functions that include conditional statements.
- Students will be able to include sequence, conditions, and loop concepts in a function.

Tynker 101

Students will be able to use sequencing, repetition, events, conditional logic, animation, pen drawing, drawing shapes and patterns, playing musical notes, sending and receiving messages, handling user input, and color detection to solve problems and create within a block programming environment.

GRADE 4

Grade 4 STEAM Anchor Unit

Land and Water

Students conduct multiple controlled experiments to determine factors affecting rates of erosion and apply this knowledge to design, build, and test a dam. The challenge is to balance aesthetics with protection of the model houses from flooding. Students observe and analyze all class results and imagine ways to improve their designs and apply these ideas when constructing and testing a new, complete landscape.

Grade 4 Computer Science STEAM Activities

Wonder Workshop

Students use Dash and Dot to learn more about area and perimeter. Using physical computing to explore length and width is a fun yet meaningful approach to these math concepts. Students begin with given criteria, then work in pairs to create and solve their own problem. The activity involves describing a rectangle on the floor, creating a program for Dash to travel along its sides and then determine the area and perimeter. Each partnership finds unique solutions.

Tynker 102

- Students will be able to use animation sequences combined with motion, game design basics, built-in animation commands, advanced keyboard and mouse control, sending and receiving messages, Actor layering, advanced events, math operators, and functions to solve problems and create within a block programming environment.
- Students will be able to define and apply foundational coding concepts in isolation.
- Students will be able to define advanced programming concepts.
- Students will be able to connect foundational programming concepts with advanced programming terms.

GRADE 5

Grade 5 STEAM Anchor Units

STEAM Anchor Unit: Water, Water Everywhere: Designing Water Filters
The water you drink is clean and safe thanks to the environmental engineers who design and manage our water supply and water treatment systems. In this unit, the storybook *Saving Salila's Turtle* introduces students to the problem of water pollution—and to some solutions. Students investigate the properties of filter materials, apply their knowledge of water, and think like environmental engineers as they plan, construct, test, and improve their own water filters.

Models and Designs
Drought Stopper Investigation
Students observe a device that produces 500 mL of water when only 100 mL of water is put in. They draw conceptual models to explain how they think the device works. Students brainstorm a list of materials they need and build, test, redesign, and test again until they find success. Students discover that there are multiple methods to achieve the same goal.

Fifth Grade Computer Science STEAM Activities

Tynker Programming 201

- Students will be able to use sequencing, pattern recognition, loops, and conditional logic.
- Students will be able to create scenes, add sounds and music, and program an application for keyboard control.
- Students will be able to add motion, broadcast messages, and special effects to a program.
- Students will be able to define a class.
- Students will be able to group and classify objects.
- Students will be able to connect classifying objects to Object-Oriented Programming.
- Students will be able to define an object as an instance of a class.
- Students will be able to connect classes and objects in programming.
- Students will be able to create their own object from a class.

Elementary Computer Science PILOT Programs

Scratch Jr.

Scratch Jr. is an introductory programming application that enables primary grade students to create their own interactive stories and games. Students connect programming blocks to make characters move and speak. Children can modify characters, add their own voices and sounds - and then use the programming blocks to make their characters come to life. Overall, the focus is not on the product itself, but rather the process generated by critical thinking, problem-solving, and creativity.

Students will be able to:

- develop programs with sequences and simple loops, to express ideas or address a problem.
- model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.
- Deconstruct (break down) the steps needed to solve a problem into a precise sequence of instructions.
- debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.
- Describe the steps taken and choices made during the iterative process of program development.

MicroBit :

Using an online Block-based coding program, students work through a series of physical computing challenges using the Microbit and art materials. Students will: use two Microbits to make a game of Rock, Paper, Scissors; create a reaction timing machine; and make an inchworm robot that crawls using a servo.

Hummingbird:

Students work in teams using the Hummingbird Board to create an interactive story to present to younger students. They choose sensors and outputs such as motors, servos, lights, and buzzers and build an interactive board with detailed artwork to make the story come to life.

Codespark Academy

Codespark Academy features fun little monsters (Foos) navigating city streets, encountering police officers and construction sites as well as obstacles such as boxes and tires. Students drag and drop commands or visual blocks of code from

the Scratch programming language into the correct order to guide the monster (Foo) to his destination. Students must complete one level to advance to the next, and they receive one, two, or three stars based on how efficiently they use the commands. Levels can be replayed for a higher score. The levels get increasingly challenging and the story more complex. By design, students have to figure out what to do and how to do it on their own. Once students master the puzzles, they can create games and stories of their own and share them with the class community so that other students can play.

- Students will be able to create a simple algorithm.
- Students will be able to use trial and error to solve problems.
- Students will be able to model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.
- Students will be able to develop programs with sequences and simple loops, to express ideas or address a problem.
- Students will be able to deconstruct the steps needed to solve a problem into a precise sequence of instructions.
- Students will be able to develop plans that describe a program's sequence of events, goals, and expected outcomes.
- Students will be able to debug errors in an algorithm or program that includes sequences and simple loops.
- Students will be able to describe the steps taken and choices made during the iterative process of program development.
- Students will be able to compare how people live and work before and after the implementation or adoption of new computing technology.
- Students will be able to create programs that include sequences, events, loops, and conditionals.
- Students will be able to collect and present the same data in various visual formats.
- Students will be able to identify and describe patterns in data visualizations, such as charts or graphs, to make predictions.
- Students will be able to organize and present collected data visually to highlight relationships and support a claim.
- Students will be able to take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development

Middle School

The Art, Tech, and Design department (formerly known as Related Arts) provides courses for all students at every grade level, as follows:

Sixth Grade Computer Technology
The Middle School's quarterly program introduces all students to computational skills, problem-solving, and project design skills through introductory coding activities using the Scratch programming platform and Swift Playgrounds, as well as basic spreadsheet instruction using Google Sheets.

- Coding concepts include
    - Sequences
    - Iteration
    - Conditionals
    - Variables
    - Lists
    - Random numbers
    - Boolean logic
    - User interface design
- Spreadsheet concepts include
    - The basic layout of a spreadsheet
    - Formatting of cells
    - Sorting spreadsheets
    - Writing simple formulas
    - Using simple functions
    - Filtering spreadsheets
    - Creating charts

Sixth Grade Technology Quarterly

- Electrons and their relationship to electricity
- Voltage, current, circuits, and breadboards (jigsaw, hand tools, breadboards, pliers)
- Introduction to the design thinking process
- Using vector-based graphic design tools to design and iterate concepts
- Measuring, cutting, manipulating, and soldering wire to create jewelry (measurement, assorted pliers, mandrels, soldering)
- Introduction to drafting (drafting boards, triangles, and T-squares)
- Building from a student-made diagram and successfully integrating a soldered circuit (saws, drill press, soldering, measurement)

- Introduction to mechanical movement using cams and gears designed on vector-based software and cut with the laser cutter (digital plotting, laser cutter, measurement, iteration)

Seventh Grade Technology Quarterly

- technology safety protocols
- review of design process
- continuation of drafting (drafting boards, triangles, T-squares)
- using vector-based graphic design tools to design and produce
- introduction to woodworking materials, tools, and techniques
- measuring, cutting, assembling and finishing wood (box project)
- introduction to plastics in manufacturing
- introduction to metals in manufacturing

Eighth Grade Technology Quarterly

- Technology: using tools, materials and knowledge to solve problems
- Focus on problem-solving
- The computer as a tool: How does a computer work? (processors, RAM, ROM etc.)
- Hands-on problem-solving using a tape measure and model cars (simulation with budget, variables, etc.).
- Providing students with opportunities to fail, as a key step in learning
- Seven steps of problem-solving, documented through the bridge-building project
- Bridge project: research, working with librarian, reports, building a prototype
- Using Excel to budget for materials (line item budget) built from scratch
- Using a digital video camera and how to download clips.
- Video yearbook (iMovie, Photoshop, and iApps)
- Yearbook (Photoshop, iPhoto, graphic design), in conjunction with the Art program (Photoshop)
- Using DSL cameras and downloading images.

Sixth Grade Exploring Music

Every 6th Grade Exploring Music student participates in a project using a microprocessor and capacitive sensors. The project takes the students through creating a story based on artwork, choosing sound effects that will enhance the story, sampling the sounds live, editing the sounds, and putting them on the microprocessor. Then, the students build a device using capacitive sensors and conductive materials that will trigger the sounds while they present their story.

Middle School students also have the opportunity to participate in the *Science Olympiad* and the *Math Counts* competitions, and to join the school's *Vex Robotics Team,* and 3D modelling club for making three dimensional miniature models.

7th and 8th grade STEAM projects hosted by the Science Department

Grade 7

Early in the school year, seventh grade students are given the opportunity to design their own experiments to reinforce the elements of the scientific method. Students either design an experiment to test the strength of wet paper towels, or create an experiment to test various variables associated with balls and ramps.

Paper Towel Activity
In this activity students are asked to design an experiment to test the strength of various brands of paper towels. They are given three different brands of paper towels. They need to determine how much water to apply to the paper towel and how best to apply weights to the paper towel to determine its strength.

Ball and Ramp Activity
In this activity students are asked to design an experiment in which they test to see if they could make a ball roll farther or faster depending on the materials used and the height of the ramp.

In both activities, students are engaging in the scientific process by creating hypotheses and procedures, collecting data, and making inferences that will lead to a conclusion. Grade 7 students have the opportunity to use the Internet to research their problem before designing the experiment. They are responsible for determining the dependent and independent variables and designing an experiment with enough controlled variables to accurately perform the experiment. As students engage in their experiment, they are encouraged to use iPads to photograph or videotape their results. While conducting the experiment students are asked to graph results, interpret data, identify scientific error, and explain sound scientific reasoning. The end product is a lab report that summarizes their results. In order to draw a conclusion, students will need to use math skills such as determining averages and graphing their results.

Grade 8

In Grade 8 science, students research, design, and build passive solar homes. The science concepts that are reinforced in this project are energy transfer, radiation, insolation (the amount of solar radiation reaching a given area), and transfer of heat. To begin the project, students use Internet resources such as library databases to prepare background research.

Based on their research students then design and construct a passive solar home. Math skills are used as students build a scale model and calculate the angle of insolation for the current season in order to calculate roof angle. There is an opportunity for students to redesign their home for improvement. Students are encouraged to construct and paint their house using artistic skills, and using only recycled materials.

Students use cloud-based software to create a lab report. This lab report can include a visual procedure made using iPads. In addition, the lab report provides an opportunity for students to apply their graphing skills.

CHOICE

In the extended Leaf Pack Experiment that is the foundation for the CHOICE "stream science loop" activity, students design an actual experiment using leaf packs as a measuring device, to arrive at a water quality rating for the length of the Catherine Road stream that runs behind the Middle School.

1. Student groups develop background information through a series of teacher-planned trips to the stream, observations, and classroom discussions. Background information includes information about stream flow, macroinvertebrates and their preferred environments, land use in the surrounding area, and mapping. This includes conversation about possible contaminants that may enter the waters and their possible effects on stream life.
2. Student groups identify controls and variables, and set/map the location of the leaf packs. Student groups set time periods for retrieving leaf packs to conduct data collection and tallies. Students make predictions about results.
3. Students conduct several data collection and tally sessions throughout the year, spanning different seasonal conditions.
4. Students create graphs to show relationships among different data points such as dissolved oxygen levels versus species diversity.
5. Students use simple mathematics and spreadsheet formulas to tally species types/numbers and determine water quality rating.
6. Data is reported to the Stroud Water Research Center.
7. Throughout the course of the year, students create presentations that allow them to form/demonstrate their knowledge of different aspects of the experiment. For example, in the fall students ask a researchable question and read through several reliable sources to determine the answer; presentations are made with an iPad App called *Explain Everything.* These "questions" form the basis of mini-experiments throughout the year, especially in the winter months. In the winter, students also collect and tally data. We store this data in a spreadsheet and examine changes as the year progresses. In the spring, students determine relationships based on data collected, and create Infographics to present their understanding of the data.
8. Classes end the year with an examination of geologic history and forces that have shaped the land that our stream cuts through, as well as how that land could appear in the future; they also tie the idea of resources, renewable and nonrenewable, into this ending unit; students create a movie poster advertising agents of erosion that help to shape the land.

High School Computer Science and STEAM Opportunities

The High School STEAM sequence includes several courses in Design and Engineering, as well as three Coding courses. In addition, a new course on mobile app design and development is offered in collaboration with the High School Design and Engineering department.

COMPUTER SCIENCE 912 Grades 9 through 12
This course provides students with a knowledge base and basic programming skills that are both applicable in the classroom and marketable. After becoming familiar with the functionality of spreadsheets and learning how to construct and apply the formulas that drive them, students create their own macros/programs to address a variety of tasks and a range of programming challenges.

COMPUTER SCIENCE 913 Grades 9 through 12
This course provides an introduction to a wide range of topics in computer science, including database development and SQL, computer-relevant number systems and information encoding, computing hardware and digital logic and circuit design, physical computing, and web development. Core computing concepts, such as problem solving, computational thinking, and algorithm development, are stressed in each unit of the course.

COMPUTER SCIENCE 925 Grades 10 through 12
This Advanced Topics offering is comparable to an introductory college-level computer science course. Topics include program design, principles of object-oriented programming, programming constructs, testing and debugging programs, analysis of algorithms, standard data structures, standard algorithms, recursion, and responsible use of computer systems. Most work is done using the Java programming language. Much of this course's challenging, project-based work takes place outside of class. Prerequisites: Computer Science 912 or Computer Science 913 or a math class at least as challenging as Math 433, as well as permission from the department

INTRODUCTION TO DESIGN & FABRICATION 912 Grades 10 through 12
This course engages students in design thinking, effective documentation, and engineering processes. Through design challenges, students learn safety protocols and become certified in using the tools of the Design Lab, including 3-D printers and laser cutters.

INTRODUCTION TO ENGINEERING 912 Grades 10 through 12
This course introduces students to general principles and methods that shape the practice of engineering. Participants explore various fields of engineering, such as mechanical, civil, electrical, and environmental, through individual and team projects.

DESIGN FOR MODERN PRODUCTION Grades 10 through 12
In this course, students will design meaningful products by mastering the tools and techniques of digital fabrication and pre-production design. As they learn industrial standards of digital drafting, 3D modeling with CAD software, and 3D printing, they will apply creative solutions to real world problems to gain a deeper understanding of engineering. Prerequisite: Design and Fabrication or Introduction to Engineering

MOBILE APP DESIGN & DEVELOPMENT Grades 10 through 12
This course provides an introduction to mobile app development and design thinking. Students will learn the basics of app development and then use design thinking to identify a real need that an app could solve. Following the design thinking process, students will prototype, test and reiterate their designs, culminating in the production of their app for iOS. Prerequisite: Introduction to Design and Fabrication, Introduction to Engineering, OR any Computer Science course.

PHYSICAL COMPUTING/WEARABLES Grades 10 through 12
This course is an introduction to wearable technology. Students will learn the rudiments of physical interaction design and the programming of microcontrollers, starting with observation of what a user does physically and then planning the best ways to sense and respond to that action. Students will apply what they learn about circuits and electrical engineering to create physical devices that are embedded with electronics, software, and sensors. Prerequisite: Design and Fabrication or Introduction to Engineering

ROBOTICS I Grades 10 through 12
In this course, students will acquire a foundational understanding of how to integrate the physical, mechanical, and electrical worlds to create systems that improve human life. They will engage in real-world problems and gain skills as they build robots, apply mechanical concepts by using sensors, motors, and mechanisms, and learn to code with Robot-C, a program based on C++ programming language. Prerequisite: Design and Fabrication or Introduction to Engineering

DESIGN/BUILD Grades 10 through 12
In Design/Build, students will generate ideas for handmade products and products that can be mass produced, take them through the design process, and build them at full scale. Sustainable design will also be covered through a consideration of materials and production methods. Prerequisite: Design and Fabrication or Introduction to Engineering

AT ENTREPRENEURSHIP Grades 11 and 12
Entrepreneurship is the capstone experience for the STEAM sequence. By practicing human-centered design, participants in this project-based course develop the skills, creative confidence, and teamwork abilities necessary to successfully research, conceive, prototype, test, refine, and ultimately present in a public forum a product that appropriately meets the needs of those for whom it has been designed. Students will compose a design notebook (both physical and digital) of concept sketches, ideas pertaining to their project, and reflections on their readings about the human-centered design theoretical framework. Prerequisites: completion of introductory and second-level STEAM courses as well as permission of the program coordinator

Several technology-rich art courses incorporate STEAM concepts, including: Computer Animation I, Computer Animation II, Digital Photography I, Digital Photography II, Digital Video I, Digital Video II, Architecture I, and Architecture II.

COMPUTER ANIMATION I
Students work with both cartoon-based and realistic images to create 3-D characters and virtual environments that seem real. Students become visual storytellers by using Cinema 4D and Adobe Premier software applications to create a 3-D animated movie.

COMPUTER ANIMATION II
Participants will create realistic models, work with typography, and use camera, lights, and animation to explore ways of applying three-dimensional modeling and animation techniques to the creation of motion graphics and visual effects. Computer Animation II investigates the creative capacity of digital technology to improve communication, develop creative self-expression, and explore perception and interaction among people, objects, and ideas.

DIGITAL PHOTOGRAPHY
In this introductory course, students examine the world through the lens of a 35mm, digital, SLR camera. Studies in the history of film and digital photography combine with instruction in camera basics (shutter speed, aperture, and ISO) to facilitate the composition of artful, personally meaningful photographs. Students develop skill and

confidence as they investigate and apply Adobe Photoshop's tools and filters for refining, transforming, and printing finished images.

DIGITAL VIDEO I
This course introduces students to the basics of cinematography, screenwriting, storyboarding, and editing. The study of film and video history inspires individual and collaborative efforts to translate ideas from paper to the screen. Students work with Adobe Premiere to capture, edit, and export video.

The Music department also offers a course on Digital Music production and composition.

Resources

As we move forward with implementing the new units, courses, and projects described in this document, we hope to engage the community in conversations about the importance of STEAM and also offer educational programming and events that educate our parents and showcase the work of our students. To learn more about STEAM, please visit the following resources:

The Next Generation Science Standards website
http://www.nextgenscience.org/

The International Society for Technology and Education's website
http://www.iste.org/standards

The International Society for Technology and Education's STEAM Resources
https://www.iste.org/explore/topic/stem-steam

The International Technology and Engineering Educators Association STEM Center
http://www.iteea.org/STEMCenter.aspx

The Rhode Island School of Design's STEM to STEAM website
http://stemtosteam.org/

STEM Resources at the U.S. Department of Education
http://www.ed.gov/stem