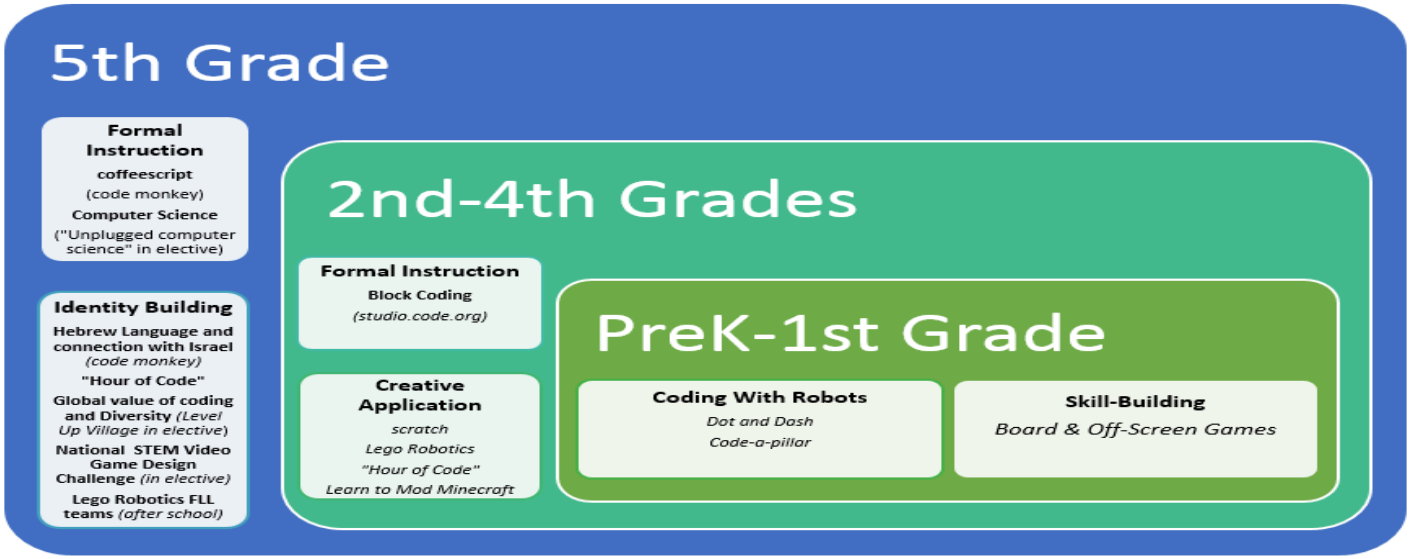
Computer Programming (Coding)

CESJDS Lower School

Curriculum Guide Description: This document outlines the scope and sequence of students as they learn computer programing in grades 1 through 5. It makes transparent the building and application of knowledge and skills at each grade level and through diverse, explicit experiences in both learning and creation. At the end of the elementary experience, students will be proficient with block coding and will have an introduction to coffeescript. They will have also demonstrated extended involvement with 21st Century Skills relating to Critical Thinking and Problem Solving.

The following image describes the goals and tools for each level of learning at the Lower School:



Scope and Sequence

Course Content:
Students will learn the fundamentals of computer programming in developmentally appropriate ways.

By the end of 5th grade, students will:

- Be able to understand and creatively use block coding programs.
- Have a basic understanding of the professional coding language coffeescript.
- Have a grade-level proficiency with 21st Century Skills with a focus on Critical Thinking and Problem Solving (http://www.p21.org/)

These are coded below according to the standard.

Reason Effectively
- Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Use Systems Thinking
- Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions
- Effectively analyze and evaluate evidence, arguments, claims and beliefs
- Analyze and evaluate major alternative points of view
- Synthesize and make connections between information and arguments
- Interpret information and draw conclusions based on the best analysis
- Reflect critically on learning experiences and processes

Solve Problems
- Solve different kinds of non-familiar problems in both conventional and innovative ways
- Identify and ask significant questions that clarify various points of view and lead to better solutions

Students will use the following tutorials to meet proficiency:

- https://code.org/learn (course 4)
- https://www.playcodemonkey.com/

Additional resources:

- Scratch https://scratch.mit.edu/
- Gamestar Mechanic https://gamestarmechanic.com/
- Tinkercad (3D printer design software) https://www.tinkercad.com/
- Minecraft for education: https://minecraftedu.com/
- Dot and Dash Lessons: https://teachers.makewonder.com/lessons
- Lego WeDo and EV3

Additional Instruction Opportunities:

- Electives
- Afterschool Clubs
- 3D Printer Design
- Lego Robotics

Student Activities
To demonstrate learning, students will:

Complete studio.code.org courses to achieve certificate associated with the course. https://studio.code.org/

Use their coding knowledge to code projects in General Studies and Judaic Studies using block coding sandbox programs such as https://scratch.mit.edu/

Complete the Hour of Code

Complete code monkey (using Hebrew language) to the level as determined appropriate by the STEM coordinator and the teacher. https://www.playcodemonkey.com

Assessment Tools

Completion of the coding tutorials to demonstrate skill and content success (certificates issued by the on-line courses)

Program Values

Choices will be made for coding instruction that is challenge-based and game-based

Over the course of the program, instruction is woven with inquiry and creative options

Coding is both a skill to be learned and a tool for expression and reflection and so it will be taught and used in multiple settings

Students need to develop an identity as a Jewish coder with confidence and competence who may move on to middle school coding seamlessly.

Program Content Learning Trajectory

Students will begin coding education with understanding directionality, measurement, and event sequencing. They will move to block coding and graduate to coffeescript (related to javascript). These three steps prime students to bridge to learning javascript at the middle school level.

(We count both of the above as 3 lines of code)

Special Education, ELL, & Girls Accommodations and Strategies

Coding tutorials are self-paced and include videos and multi-media

Code Monkey has screen-less lessons in addition to tutorials where teachers can interact and instruct using classroom methods, supports, and accommodations

Code Monkey can be instructed in Hebrew and English

Students are given flexibility to create their own games, which research shows will interest girls

Grade Level & Main Curriculum, Unit(s) or Activity	**Core Academic and Content Knowledge & Skills**	**21st Century Skills: Critical Thinking and Problem Solving**	**Year End Goals**	**Activities, Programs, & Units** **Math** **Science** **General or Judaic Studies** **Kaleidoscope Project with Crosscutting Concept** **Recess or Recreational**	**Assessment**	**Links**
Grade 1 *Overview: In the first grade year, students are introduced to vocabulary and coding in relationship to robots Dot & Dash. These reduce abstraction of coding and screen-time for young students to meet developmental needs. This year focuses on directionality and measurement as well as generating excitement and engagement.* **Dot & Dash Unit** To be taught in conjunction with measurement in mathematics	Understand directionality Use standard and non-standard units to map a path Gain familiarity with vocabulary- repeat, forward	Students will need to use reason to evaluate their procedure if their robot does not meet the goal in the Dot and Dash Unit. Students will use multiple, sequenced steps to have their robot meet the goal. Students will be working in groups and will be evaluating their ideas and others as they create a path for their Dot and Dash robot. Students will be evaluation the actions of their robots and making changes. Dot and Dash Unit will present challenges without procedures or single solutions, requiring innovative and complex reasoning.	Program a robot to move in a predictable path Use non-screen based resources to map a path (ie- use cards to "walk" through a maze)	Availability of board game "Robot Turtle" during recess and other time "Dot and Dash" Unit co-taught during measurement unit in math	Meeting the goals of the Dot and Dash Unit	

Grade 2 *Overview: In this year, students are introduced to formal coding instruction in tutorial form through learn.code.org. Students will also have a Dot and Dash Unit that focuses on number lines, and addition and subtraction. In this year, students will form a basic foundation of coding.* **Coding Course 2** Completion of course to certificate **Number Line Moves with Dot & Dash** Completion of lesson plan and related assessment of both math understanding and coding to meet learning goal **Hour of Code**	Use proportional, sequenced numbers in mapping moves of Dot and Dash robots on a numberline Combine understanding of coding with mathematics by translating addition and subtraction through paper and pencil and block coding Use block coding to solve problems Coding Course 2 introduces the following skills/concepts: 1.) Sequencing 2.) Loops 3.) Shapes 4.) Mapping 5.) Algorithms 6.) Debugging Coding Course 1 may be used first or substituted if students are not able to access Course 2 due to language or conceptual skills. https://studio.code.org/s/course1	Students will be introduced to "debugging" which requires critical evaluation and reasoning for success. Students will be using deductive reasoning to isolate problems in their code. Students will use multiple, sequenced, and specialized steps to meet their goals in both the Coding Course 1 as well as the Dot and Dash lesson. Students will apply their understanding of mathematics to create programming success in both the Coding Course 1 as well as the Dot and Dash Lesson. Students will be evaluating the actions of their robots and making changes. Students will be persistent, as the Coding Course 1 will present many opportunities for students to try and try again.	Complete Coding Course 2 with a certificate Complete the Number Line Moves with Dot & Dash Lessons	Computer Coding Course 2 (self-paced) offered starting at the beginning of the year and completed as a complement to mathematics Dot & Dash lessons co-taught in conjunction with mathematics lessons on addition using a numberline	Computer Coding Course 2 Certificate (20 Hours) Meet the goals of Dot and Dash lessons	Coding Course 2: https://studio.code.org/s/course2 Number Line Moves Lesson Plan: https://teachers.makewonder.com/lessons/number-line-moves Enrichment: https://scratch.mit.edu/
Grade 3 *Overview: Students will be transitioning this year from exploratory and directed applications to creative possibilities.*	Coding Course 3 introduce the following skills/concepts: 1.) Conditionals 2.) Binary 3.) Functions 4.) Nested Loops Combine understanding of coding and	Students will use inductive and deductive reasoning to solve coding problems in Course 3. Students will use reasoning to connect math	Complete Coding Course 3 with a certificate Complete Lesson Series on Coding for repeated addition and multiplication to satisfactory understanding	Computer Coding 3 (self-paced) offered starting at the beginning of the year and completed as a compliment to mathematics Coding for Repeated addition and multiplication lessons in mathematics Coding a game or tutorial in scratch as part of the Kaleidoscope project	Computer Coding Courses 3 Certificates (20 hours total) Meet the goals of Coding and multiplication lessons Completion of the scratch game or tutorial for both 21st century and coding skills Completion of Lego WeDo Unit	Coding Course 3: https://studio.code.org/s/course3 Scratch: https://scratch.mit.edu/ Hour of Code: https://hourofcode.com/us

Coding Course 3 Completion of course to certificate **Lesson Series on Coding for Repeated Addition and Multiplication** A 3 lesson series to be taught in conjunction with study of repeated addition and multiplication **Coding for Creativity: A Kaleidoscope Project with Cause and Effect** Students use scratch to XXXXXXXX **Hour of Code**	mathematics to solve problems and answer questions that require translation between coding and mathematics understanding Apply coding skills to a creative endeavor, demonstrating a use of coding as a developing tool at the students' disposal	concepts and coding functions/blocks to answer higher-order thinking questions. Students will be using complicated sequences of blocks to solve problems and also create. Students will be analyzing the appropriate uses and reasons behind application of multiplication by exploration of stacked coding blocks and repeat blocks, drawing a high level understanding of both. Students will be reflecting on their Kaleidoscope learning through creative coding. Students will be evaluating their scratch games/tutorials as a reflection of their code and will make necessary changes. In Coding for Creativity, students will explore their own and others' approaches to using coding and their products to demonstrate ideas. They will ask and answer questions related to their choices.	Completion of a game or tutorial using scratch which demonstrated understanding of the Crosscutting Concept Cause and Effect	Lego WeDo Unit		Lesson Plans: XXXXXXXXXXX Enrichment/Support: https://gamestarmechanic.com/

Grade 4 *Overview: In this year, students complete study/introduction of block coding, achieving the first major goal of the program of demonstrating proficiency with block coding. Students will expand and diversify their computer science/coding/robotics experiences by applying their skills to new content areas and projects.* **Coding Course 4** Completion of courses to certificate **Robotics in Science: Coding Lego NXT for Content Goals** Mini- Unit on coding Lego NXT to understand Next Generation Science Standard: 3-5-ETS1 Engineering Design **Coding for Creativity: A Kaleidoscope Project with XXXX using Minecraft** Students use Minecraft to XXXXXXXX **Hour of Code**	Coding Course 4 completes the study of the following skills/concepts: 1.) Binary 2.) Loops 3.) Functions 4.) Parameters Apply coding skills to a range of diverse, creative digital programs. Create a game that shows an understanding of the Crosscutting Concept XXXXXXX	Students will apply their coding understanding to new programs and situations (Minecraft and Lego NXT), working through similarities and differences by understanding the way coding works Students will be connecting coding to actions and systems in Lego NXT robotics. Students will be working in groups to build in minecraft and in doing so will be mentoring each other, evaluating ideas, negotiating outcomes, and using their skills and knowledge creatively. Students will be reflecting on their Kaleidoscope learning through creative programming. Students will be translating their understanding of block coding to novel problems in Lego NXT. Students will be designing using robotics and coding for innovative engineering solutions in response to an open challenge. Students must persist through the engineering design process.	Complete Coding Course 4 with a certificate Complete a project using Minecraft to model ideas in a project with GENERAL OR JUDAIC STUDIES that demonstrated understanding in CROSSCUTTING CONCEPT Complete the mini-unit in science which includes programing Lego NXT robotics	Computer Coding Course 4 (self-paced) offered starting at the beginning of the year and completed as a compliment to mathematics Kaleidoscope Minecraft Project with GENERAL STUDIES OR JUDAICS Lego NXT in Science	Computer Coding Course 4 Certificate Completion of the Minecraft project to satisfactory Completion of the Lego NXT unit to satisfactory	Coding Course 4: https://studio.code.org/s/course4 Minecraft edu: https://minecraftedu.com/ Lego NXT: https://education.lego.com/en-us/lesi/middle-school/mindstorms-education-nxt Hour of Code: https://hourofcode.com/us Enrichment/Support: https://gamestarmechanic.com/

Grade 5 *Overview: In this year, students transition to introduction of a professional coding language- coffeescript. This is done embedded in Judaic studies as part of an initiative to create identity and connect with Israeli innovation. Students continue to program Lego NXT robots in science. Students culminate their experience with a submission of a videogame to the National STEM Video Game Challenge.* **Code Monkey** Work with Judaics teachers and on-line curriculum to complete as much as possible in a year's time **Robotics in Science: Coding Lego NXT for Content Goals** Mini- Unit on coding Lego NXT to understand Next Generation Science Standard: 5-PS2 Motion and Stability: Forces and Interactions **Coding for Creativity: A Kaleidoscope Project with XXXX and the National STEM Video Game Challenge** Students create a game to explore the Crosscutting Concept XXXXXXXX **Hour of Code**	Codemonkey Course introduces the professional language coffeescript Students apply the culmination of their study to apply to the National STEM Video Game Challenge on the Crosscutting Concept of XXXXXXXXXX	Students use reason and logic to imagine and respond to another person completing their video game. Students use logic to write and debug coffeescript code Students build understanding of other people on the topic at hand in their video game, building systems and sequence. Students will connect programing to the actions of robots. Students reflect on their learning through creation of a game. Students connect content learning in science with outcomes creating by programming and robotics. Students will evaluate the actions of their robots and make changes to programming as necessary. Students engage in formal peer review to produce better solutions. Students must demonstrate persistence in the content coursework, videogame creation, and robotics.	Complete Code Monkey to the stage and satisfaction of the program as taught by the JS faculty Submit a student-created video game Lego NXT robotics unit in science	Code Monkey Course National Video Game Challenge Lego NXT Robotics	Assessment embedded in Code Monkey Program Completion and submission of the videogame as demonstrating 21st Century as well as computer coding skills Completion of Lego NXT unit to satisfactory	Code Monkey: https://www.playcodemonkey.com/ Lego NXT: https://education.lego.com/en-us/lesi/middle-school/mindstorms-education-nxt National STEM Video Game Challenge: http://www.stemchallenge.org/stem/#/home Hour of Code: https://hourofcode.com/us Enrichment/Support: https://gamestarmechanic.com/

		In the video game challenge, students will be asking and answering questions in inquiry-based learning.				
5th Grade Elective	Students use Level Up Village Game Designers to understand global value of coding and diversity. http://www.levelupvillage.com/global-video-game-designers/ Students use the National STEM VIdeo Game Challenge to apply new learning creatively http://stemchallenge.org/ Students use "computer science unplugged" to learn the fundamentals of computer science. http://csunplugged.org/	Students will negotiate how multiple perspectives, ideas, components, and requirements work together to make a computer game. Students will work with other students internationally to co-create coded computer games. Students engage in collaborative problem solving.	Complete requirements of Level Up Village Course Enter a submission in the National Video Game Challenge Complete activities and embedded assessments in Computer Science Unplugged	Level Up Village National STEM Video Game Challenge Computer Science Unplugged Scratch Gamestar Mechanic		Level Up Village http://www.levelupvillage.com/global-video-game-designers/ National STEM Video Game Challenge http://stemchallenge.org/ Computer Science Unplugged http://csunplugged.org/

Research and Links:

1.) Harvard's explanation connecting block coding to understanding computer science principals: http://cs.harvard.edu/malan/scratch/printer.php

Ways that this Scope and Sequence will change our current program:

1.) Outlines 21st Century Skills: Critical Thinking and Problem Solving as a driving force in addition to content and skill building
2.) Recognizes coding as a skill and a tool for reflection on learning that is not limited to a single content

3.) Provides clarity in goals and demonstrates and accumulation of knowledge and progressive application of skills and assessment
4.) Provides goals that grade-level teams can work toward with greater independence
5.) Weaves instruction with inquiry opportunities, open-ended projects, and competitions
6.) Builds competence, creativity, and identity.
7.) Provides a plan for fundamental coding learning for all students and enrichment opportunities for interested students to go further.

Discussion Questions and Concerns:

1.) Learn.code.org courses are 20 hours and currently done in “in-between times” (sub days, gap times, etc.). Do we want to set a more formal time? Some grades do short friday math. How do we want to advise on opportunities for these times?
2.) PreK through 1st needs adjustment to their program- arrange “trials” of Code-a-pillar, Dot and Dash, and find more off-screen options.
3.) How can we arrange it so that students are near laptops to be able to code at “in-between times”?
4.) Are we going to include ISTE standards?

5th Grade Elective Description:

VIDEO GAME DESIGN

Blurb: "Who loves video games? In this elective, you won't just play them, you'll make them! We will start out playing board games from the STEM cart to learn how games work, then we will take part in a "Level Up Village" course where we will be paired with students in the developing world and make friends with kids in other countries by exchanging video messages to learn about each other. We will design, code, and hack video games with our global partners using MIT's scratch platform. Once we know how how to make a great video game, we'll make our own new video games and submit them to the contest "The National STEM Video Game Challenge" where you can design any game you want! Finally, we will wrap up with learning how computers work by playing screen-free, hands-on games to find out about things like binary code, pixelation, and how computers store information. If you love video games and you are curious about play, people in other countries, coding, math, and computers- this is where you want to be!"

Part I: Understanding Games

Students use (math and logic oriented) board games on the STEM cart to understand how games operate- how and why rules are created, ways people work together to collaborate or compete, how a visual field and a strategy combine, games that require strategy vs. probability, etc. Playing these games will lead to exposure in math topics included in the games as well as critical evaluation of the social and cognitive attraction of gaming. (5 weeks- approx., free)

Part II: Level Up Village- Video Game Designers

In this course, kids will learn the building blocks of coding for outcomes through MIT’s “Scratch” video game design platform. They’ll get to create all sorts of animations (including a dance party and a farm animal race) while learning sequencing skills.

Like all Level Up Village courses, a Global Partner classroom of students living in developing country will be matched up with our kids. Together, using the same curriculum and technology, these young video game designers from around the world will come to know each other by exchanging personal video messages and participating in a digital show & share of their work every lesson. They will work together exchanging, playing, and co-creating videogames using coding. This comes with all teacher materials, curriculum, and video messaging exchange infrastructure. (10 weekly lessons, $400/10 students)(approx.) http://www.levelupvillage.com/global-video-game-designers

Part III: National STEM Video Game Challenge

Students will use what they have learned about games and coding (both through scratch and through Code Monkey in their Judaics classes) to create a new video game and submit it for competition in the National STEM Video Game Challenge. This allows students a culminating, authentic experience to apply what they have learned and create freely. It also allows students to use computer languages other than scratch to differentiate interests and learning. http://stemchallenge.org/ (5 weeks approx., free)

Part IV: Unplugged Computer Science

Using materials from "Computer Science Unplugged" students learn the mathematics and processing behind the scenes that made their games work. CS Unplugged is a collection of free learning activities that teach Computer Science through engaging games and puzzles that use cards, string, crayons and lots of full body movement. The activities introduce students to Computational Thinking through concepts such as binary numbers, algorithms, pixelation, and data compression. Taking this time to (again) engage in game-like lessons with "hands-on" with non-virtual materials that teach math and computer science in conjunction support a deep and cognitively diverse learning of both content areas.http://csunplugged.org/ (5 weeks approx.,free)