

Middle School Programming

Course Syllabus



Developed by:
Kelly Strick
strickkr@gmail.com
Summer 2016

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1. INTRODUCTION

The intent of this syllabus is to provide a logical progression educators can follow for middle school STEM classes with programming as a part of the regular curriculum. This syllabus is a work in progress and will be updated as the courses are taught this school year.

This material was created by a teacher new to programming and can easily be taught by the same. It is not necessary to have any programming experience, but would be helpful to work through the lessons prior to teaching the material. Any resources mentioned in this syllabus are free or have a free version. Purchasing licenses is not necessary to teach the material.

This course material was originally designed for a three-class progression: Introduction to STEM, STEM 1, and STEM 2. These are semester-long courses, with one quarter devoted to, or at least including, programming. The Intro class would provide an introduction to programming using Tynker™ material. While Tynker™ is not a free resource; it does provide six free-play lessons. STEM 1, the second course in the sequence, first uses Lego Mindstorms NXT kits, providing an opportunity for students to build and program robots to move in particular ways. This would then progress into lessons on Scratch programming, similar to building with Lego blocks because it uses “blocks” of code. Finally, STEM 2, the last course, would introduce programming in Python and experience programming with Arduino for electronics and microcontrollers. If desired, the three units could be grouped together for use as a programming class rather than part of a STEM class curriculum. The daily plans in this syllabus are projected completion times; some may need adjusted based on students. This will be updated after the courses are taught this school year.

Differentiation will be highly necessary in these courses as students will enter with varying degrees of exposure and experience with programming. Assignments based on each student’s level of skills, is recommended. It is also recommended that a pre-assessment be given to evaluate the students’ relative abilities.

Throughout the syllabus, some instruction will be individualized, as needed, which means that instruction should be geared to the individual students’ needs. Due to varying degrees of computer experience, some students may need more instruction than others. Beginning with a pretest and utilizing the formative assessments should give the instructor an idea of who will need more guidance. This individualized instruction may include one-on-one or small group assistance.

Formative assessments can include student submissions of sample programs as well as interviews between student and teacher at certain check points for projects. Summative assessments may include quizzes, tests, and projects. Quizzes would be short, in-class activities

which demonstrate knowledge of coding vocabulary, functions, etc. Students may be asked to write code, interpret code, or debug code. Sample assessments are provided with these materials. It would be particularly helpful to print assessment materials in color as students read code and errors. Sample solutions may not include all possible correct solutions. Students may represent their solutions in various ways. Final projects may be completed over several weeks and presented to the class upon completion. Logbooks should be used by students as a personal reference for the projects they are completing, strategies they are learning, and reflections over the process. Logbooks, ideally, will be routinely monitored by instructors. Providing feedback to students about their progress, problem-solving ideas, and providing additional resources is important.

Assessments and Quick Reference Guide are available to print from the Middle School Programming Teacher Resource document. These documents are also works in progress. Teacher resources will be added as the course is taught during the 2016-2017 school year. These documents are available for unlimited teacher use and may be altered as needed.

Logbook entries should contain the following:

- Date for each entry
- Response to daily question, if necessary
- Log of personal activity, completed tasks, communications, team activity
- Research and analysis
- Sketches, pictures, screen shots, class notes, calculations, design process, rationale for decisions, links to helpful resources, videos, and /or tutorials
- Everything should be included whether or not tasks are successful.

While writing programs, students will often generate errors. A good practice would be for students to copy/paste the code and error message into their log book for future reference. They should include a description of how they resolved the error. Educators can also save their error messages to use as examples for students or to include as assessment items.

1.1. MATERIALS

- Computers with internet access
- Lego Simple & Powered Machines Base set #9686
- Lego Mindstorms Education kits (NXT or EV3 versions)
- Scratch Hot Sheets (created by SparkFun)
 - <https://learn.sparkfun.com/resources/78>
- Arduino kits (such as SparkFun Tinker Kit product #13930)
- *Invent Your Own Computer Games with Python 3rd Edition* by Al Sweigart

- <https://inventwithpython.com/>
- *Think Python 2nd Edition* by Allen Downey
 - <http://greenteapress.com/thinkpython2/thinkpython2.pdf>
- *Python-for-Kids* by Jason R. Briggs
 - http://raspbian.serveblog.net/wp-content/uploads/2016/02/python_for_kids.pdf

2. INTRODUCTION TO STEM

Day 1 **Class Activity** – Introduction to the Art of Computer Science (code.org); Binary Strips activity

Instruction – Expectations and learning targets; logbook usage; What is computer science? Vocabulary; Binary

Resource – [Intro to the Art of Computer Science](#)

Day 2 **Class Activity** – Count the Dots Activity: Binary Numbers Follow Up

Instruction – Review binary numbers

Resource – csunplugged.org Activity 1: [Binary Numbers](#)

Day 3 **Class Activity** – Treasure Hunt Activity – Finite State Automata

Instruction – Finite State Automata (simplified)

Resource – csunplugged.org Activity 11: [Treasure Hunt](#)

Day 4 **Class Activity** – Color By Numbers: Image Representation

Instruction – image representation (pixels; compression)

Resource – csunplugged.org Activity 2: [Color by Numbers](#); info-study.net Unplugged Flash Activity: [Unplugged Flash Activity](#)

Day 5 **Class Activity** – Graphics: Bits and Points

Instruction – vocabulary, scale, task scheduling

Resource – TryEngineering.org Graphics: Bits and Points Lesson: [Bits and Points](#)

Day 6 **Class Activity** – Bits and Points continued

Instruction – individualized, as needed

Day 7 **Class Activity** – Introduction to Programming

Instruction – Programming vocabulary

Resource – videos: [What Most Schools Don't Teach](#) and [What is Programming? or Programming](#)

Day 8 **Class Activity** – Marching Orders Activity

Instruction – programming languages

Resource – csunplugged.org Activity 12: [Marching Orders](#)

Day 9 **Class Activity** – BrainPop movie

Instruction – vocabulary, graphic organizer

Resource – movie: [BrainPop Computer Programming Movie](#), vocabulary: [BrainPop Vocabulary](#)

Day 10 **Class Activity** – Explore games: Lost in Space and Puppy Adventure

Instruction – Demo Lost In Space game; Demo Puppy Adventure – reinforce correct vocabulary; Compare/contrast two games

Resource – Tynker Lost in Space game: [Lost in Space](#), Tynker Puppy Adventure game: [Puppy Adventure](#)

Day 11 **Class Activity** – Sketch Racer

Assessment – Computer Programming BrainPop quiz

Instruction – Discussion of 3 games and their strategies

Resource – Tynker Sketch Racer game: [Sketch Racer](#)

Day 12 **Class Activity** – BrainPop Chain Diagram; “Identify It”

Instruction – coding concepts

Resource – BrainPop Computer Programming activities: [Chain Diagram](#), [Identify It](#)

Day 13 **Class Activity** – CodeMonkey game

Instruction – individualized, as needed

Resource – playcodemonkey.com Code Monkey game: [CodeMonkey](#)

Day 14 **Class Activity** – Hour of Code

Assessment – Pre-assessment

Resource – www.code.org

Day 15 **Class Activity** – Hour of Code continued

Resource – www.code.org

Day 16 **Class Activity** – Hour of Code continued

Resource – www.code.org

Day 17 **Class Activity** – Welcome to Tynker

Instruction – Introduce Tynker and show demonstrations (Candy Quest and Code Monster)

Resource – [Tynker](#) and student cards (www.tynker.com)

Day 18 **Class Activity** – Tynker Candy Quest Lesson

Instruction – individualized as needed

Resource – Tynker Hour of Code: Candy Quest: [Tynker](#)

Day 19 **Class Activity** – Tynker Dragon Dash Lesson

Assessment – Formative

Instruction – individualized as needed

Resource – Tynker Hour of Code: Dragon Dash: [Tynker](#)

Day 20 **Class Activity** – Tynker Comic Creator Lesson

Instruction – individualized as needed

Resource – Tynker Comic Creator Lesson: [Tynker](#)

Day 21 **Class Activity** – Tynker Pattern Maker Lesson

Instruction – individualized as needed

Resource – Tynker Pattern Maker Lesson: <https://www.tynker.com/hour-of-code/puzzle?c=setup&dirctx=school>

Day 22 **Class Activity** – Tynker continued

Assessment – Summative

Instruction – individualized as needed

3. STEM 1

Day 1 **Class Activity** – Legos Mindstorms inventory

Instruction – Expectations for logbooks; Introduction of Mindstorms and NXT “brains”

Resource – Legos Mindstorms Education kits (NXT or EV3)

Day 2 **Class Activity** – Lego NXT

Assessment – What is a Program? Worksheet

Instruction – TeachEngineering.org PowerPoint

Resource – TeachEngineering.org worksheet: [What Is a Program?](#); TeachEngineering.org PowerPoint: [What is a Program?](#)

Day 3 **Class Activity** – Build robots; learn to program

Instruction – Programming of robots

Resource – [Lego Mindstorms Learn To Program](#) and [Mindstorms User Guide](#) (lego.com)

Day 3 **Class Activity** – Investigating Distance

Instruction – individualized, as needed

Resource – communityeducation.lego.com: [Investigating Distance](#)

Day 4 **Class Activity** – Moving Straight

Instruction – individualized, as needed

Resource – communityeducation.lego.com: [Moving Straight](#)

Day 5 **Class Activity** – Work/”Catch-Up” Day

Assessment – logbook checks

Instruction – individualized, as needed

Day 6 **Class Activity** – Move Straight: A Dicey Situation

Instruction – individualized, as needed

Resource – communityeducation.lego.com: [Move Straight: A Dicey Situation](#)

Day 7 **Class Activity** – Dancing Robots

Assessment – informal and formative: Can students design and build a robot that will dance to music for 20 seconds? The dance must include at least 3 different dance moves.

Instruction – individualized, as needed

Resource – dance music

Day 8 **Class Activity** – Move until Touch (using touch sensors)

Instruction – Sensors: what are they and how do they work?

Resource – [www.education.rec.ri.cmu.edu](#): [Move Until Touch](#)

Day 9 **Class Activity** – Challenge: Move until Touch Vacuum Challenge

Instruction – individualized, as needed

Resource – [www.education.rec.ri.cmu.edu](#): [Vacuum Challenge](#)

Day 10 **Class Activity** – Catch Up Day

Assessment – Vacuum Challenge; logbook check

Instruction – individualized, as needed

Day 11 **Class Activity** – Repeating Behaviors

Instruction – Loops

Resource – www.education.rec.ri.cmu.edu: [Repeating Behaviors](#)

Day 12 **Class Activity** – Buried Treasure Challenge

Assessment – Buried Treasure Challenge

Instruction – individualized, as needed

Resource – www.education.rec.ri.cmu.edu: [Buried Treasure Challenge](#)

Day 13 **Class Activity** – Scratch Overview and exploration

Instruction – Scratch introduction and sample projects

Resource – **video**: [Scratch Overview YouTube](#) or [Scratch Overview Video](#)

Day 14 **Class Activity** – Log: “What are 3 aspects of yourself that you could represent through images or sound?”; About Me project

Instruction – explanation of project requirements

Resource – Scratch Curriculum Guide: <https://drive.google.com/file/d/0B4qIZ8hFgev8STdXNW03Rmtabjg/view> ; Scratch About Me example project: [About Me](#)

Day 15 **Class Activity** – “About Me” work

Instruction – individualized, as needed

Day 16 **Class Activity** – Log: “What are 5 situations where you use instructions?, What are instructions good for?”; Programmed to Dance: “Bossy” vs. “Bosserd”

Resource – Vimeo Dance videos: [Dance Moves 4](#), [Dance Moves 1](#), [Dance Moves 2](#), [Dance Moves 3](#)

Day 17 **Class Activity** – “Create” with Scratch

Instruction – Getting Started with Scratch

Resource – Scratch.mit.edu: [Scratch](#)

Day 18 **Class Activity** – Scratcher Hot Sheet

Assessment – Formative Assessment #1 (see Teacher Resource Documents)

Instruction – individualized, as needed

Resource – cdn.sparkfun.com: [Scratcher Hot Sheet](#)

Day 19 **Class Activity** – Log: “What are two strategies that you could use when you get stuck while designing?”; Dance Party

Instruction – Difference between a sprite and a costume

Resource – Dance Party handout from Scratch Curriculum Guide:
<https://drive.google.com/file/d/0B4qIZ8hFgev8STdXNW03Rmtabjg/view>;
Scratch.mit.edu: [Dance Party](#)

Day 20 **Class Activity** – Project Work

Instruction – individualized, as needed

Day 21 **Class Activity** – Six Word Stories

Instruction – Reset and parallel events

Resource – Post-its

Day 22 **Class Activity** – Remixing; Pass-it-on story

Assessment – logbook check

Resource – copy paper

Day 23 **Class Activity** – Log: “How was working with someone else different from your prior experiences of Designing your Scratch projects?”; Debug it!

Instruction – What does “debug” mean?

Resource – Debug it! Handouts from Scratch Curriculum Guide:

<https://drive.google.com/file/d/0B4qIZ8hFgev8STdXNW03Rmtabjg/view>; [Debug it! 1](#), [Debug it! 2](#), [Debug it! 3](#), [Debug it! 4](#), [Debug it! 5](#)

Day 24 **Class Activity** – Log: “What is a game?”; Brainstorm for Maze creating

Instruction – How to be a brainstorm productively

Resource – Maze Handout from Scratch Curriculum Guide:

<https://drive.google.com/file/d/0B4qIZ8hFgev8STdXNW03Rmtabjg/view>; [Maze-creating](#)

Day 25 **Class Activity** – Buffalo Cart Hot Sheet Challenge

Assessment – Formative Assessment #2 (see Teacher Resource Document); logbook check

Instruction – individualized, as needed

Resource – cdn.sparkfun.com: [Buffalo Cart Hot Sheet](#)

Day 26 **Class Activity** – Log: “What did you like about the Maze project? How might you want to change it?”; Maze extension projects; Students teach

Instruction – student led

Resource – Scratch Curriculum Guide [Maze Extensions](#), Score: [Score Extension](#), Timer: [Timer Extension](#), Enemies: [Enemies Extension](#), Levels: [Levels Extension](#), Rewards: [Rewards Extension](#)

Day 27 **Class Activity** – Log: “What is a variable? What is it good for?”; Game project

Instruction – individualized, as needed

Resource – Games starter projects handouts

Day 28 **Class Activity** – Crab Defender Hot Sheet Challenge

Assessment – formative

Instruction – individualized, as needed

Resource – cdn.sparkfun.com: [Crab Defender](#)

Day 29 **Class Activity** – Doughboy Adventure Hot Sheet Challenge

Assessment – formative

Instruction – individualized, as needed

Resource – cdn.sparkfun.com: [Doughboy Adventure](#)

Day 30 **Class Activity** – Log: “What has been your favorite Scratch project to work on so far? What are 3 ideas for something you could work on next?”; Brainstorm for Final project; project planner

Instruction – Project planner

Resource – planner handout

Day 31 **Class Activity** – Log: “What part of your project will you be working on today? What might you need help with in order to make progress?”; project work

Assessment – logbook check

Instruction – special interest group explanation and sign-up

Day 32 **Class Activity** – project work

Instruction – individualized, as needed

Resource – additional project resources: [Scratch Resources](#)

Day 33 **Class Activity** – Log: “On what aspects of your project could someone give you feedback?”; critique groups; project work

Instruction – How to give constructive criticism with examples

Day 34 **Class Activity** – project work

Instruction – individualized, as needed

Day 35 **Class Activity** – project work; reflection

Resource – “My final project reflections” handout

Day 36 **Class Activity** – project work

Instruction – individualized, as needed

Day 37 **Class Activity** – Project presentations

Assessment – summative, with rubric

4. STEM 2

Day 1 **Class Activity** – Open Python; TechRocket Chapter 1

Instruction – What is Python and why we’re learning it.

Assessment – pre-assessment

Resource – Python-for-Kids chapter 1 ([python-for-kids](#))

Day 2 **Class Activity** – Print command in Python; TechRocket Chapter 2

Instruction – Using the print command in Python

Resource – [python-for-kids](#); [TechRocket](#)

Day 3 **Class Activity** – Tech Rocket Chapter 3: Variables; Python-for-kids Chapter 2: Calculations and Variables

Instruction – via TechRocket

Resource – [TechRocket](#); [python-for-kids](#)

Day 4 **Class Activity** – Tech Rocket chapter 3.2 and 3.3: All about variables

Assessment – Formative Assessment #1 (see Teacher Resource Document)

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 5 **Class Activity** – Tech Rocket chapter 3.4: Concatenation

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 6 **Class Activity** – Tech Rocket chapter 4.1: String and Numeric Data Types; 5.1 – 5.3: Operators

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 7 **Class Activity** – Python-for-kids chapter 3: Strings, Lists, Tuples, and Maps

Assessment – Greetings! Program Puzzle

Instruction – individualized, as needed

Resource – [python-for-kids](#)

Day 8 **Class Activity** – Python-for-kids chapter 4: Drawing with Turtles

Assessment – Rectangle Puzzle (bronze level), Triangle Puzzle (silver level), or Box without Corners (gold level)

Instruction – individualized, as needed

Resource – [python-for-kids](#)

Day 9 **Class Activity** – TechRocket 6.1-6.2: Commenting

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 10 **Class Activity** – Tech Rocket chapter 6.3: Debugging/Quarantining

Assessment – Formative Assessment #2 (see Teacher Resource Document)

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 11 **Class Activity** – Assessment/ Catch-Up Day

Instruction – individualized, as needed

Resource – [TechRocket](#)

Day 12 **Class Activity** – Python-for-kids chapter 5: Asking Questions with If and Else (conditionals)

Assessment – Are You Rich Puzzle

Instruction – conditionals

Resource – [python-for-kids](#)

Day 13 **Class Activity** – Python-for-kids chapter 6: Going Loopy (Loops)

Assessment – The Hello Loop Puzzle

Instruction – Loops

Resource – [python-for-kids](#)

Day 14 **Class Activity** – Catch-Up/Extension Day

Instruction – individualized, as needed

Day 15 **Class Activity** – Tech Rocket chapter 7.1 and 7.2: Organizing Projects and Declaring Variables

Assessment – Formative Assessment #3 (see Teacher Resource Document)

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 16 **Class Activity** – Tech Rocket chapter 7.3 and 7.4: Random Values; Import; Modules; Random Range

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 17 **Class Activity** – Tech Rocket chapter 8.1: User Input

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 18 **Class Activity** – Tech Rocket chapter 8.2: Casting Input

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 19 **Class Activity** – Tech Rocket chapter 9.1

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 20 **Class Activity** – Tech Rocket chapter 9.2: Recap

Instruction – via TechRocket

Resource – [TechRocket](#)

Day 21 **Class Activity** –Python-for-kids chapter 12: Using Tkinter for Better Graphics

Instruction – Tkinter usage

Resource – [python-for-kids](#)

Day 22 **Class Activity** –Bounce! Python-for-kids chapter 13: Beginning Your First Game

Instruction – individualized, as needed

Resource – [python-for-kids](#)

Day 23 **Class Activity** – Bounce! Python-for-kids chapter 14: Finishing Your First Game

Instruction – individualized, as needed

Resource – [python-for-kids](#)

Day 24 **Class Activity** – Final Assessment/Project

Instruction – individualized, as needed

Resource – [TechRocket](#) and [python-for-kids](#)

Day 25 **Class Activity** – Arduino Introduction

Assessment – pre-assessment

Instruction – circuit boards, microcontrollers, sensors, etc.

Resource – [What is Arduino?](#)

Day 26 **Class Activity** – Fundamentals of Electronics

Instruction – Circuits, voltage, current, resistance

Day 27 **Class Activity** – Vocabulary

Instruction – electronics vocabulary

Day 28 **Class Activity** – Blink an LED

Instruction – individualized as needed

Resource – learn.sparkfun.com: [Experiment 1](#)

Day 29 **Class Activity** – Reading a Potentiometer

Assessment – logbook check

Instruction – individualized as needed

Resource – learn.sparkfun.com: [Experiment 2](#)

Day 30 **Class Activity** – Driving an RGB LED

Instruction – individualized as needed

Resource – learn.sparkfun.com: [Experiment 3](#)

Day 31 **Class Activity** – Driving Multiple LEDs

Instruction – individualized as needed

Resource – learn.sparkfun.com: [Experiment 4](#)

Day 32 **Class Activity** – Reading a Button Press

Instruction – individualized as needed

Resource – learn.sparkfun.com: [Experiment 5](#)

Day 33 **Class Activity** – Reading a Photoresistor

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 6](#)

Day 34 **Class Activity** – Reading a Temperature Sensor

Assessment – logbook check

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 7](#)

Day 35 **Class Activity** – Using a Servo Motor

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 8](#)

Day 36 **Class Activity** – Driving a Motor with an H-Bridge

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 9](#)

Day 37 **Class Activity** – Controlling a Motor with Inputs

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 10](#)

Day 38 **Class Activity** – Reading Serial Data

Instruction – individualized, as needed

Resource – learn.sparkfun.com: [Experiment 11](#)