Coding in the Middle School Mathematics Classroom

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Lesson 1: Communicating with the Computer - Introduction to the Binary Language

Big Idea:
To communicate in a variety of languages
To understand how computer process information using a series of digits and patterns

Curriculum Expectations:
Grade 6, 7 & 8: Mathematical Process Expectations
-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Number Sense & Numeration
-solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 1 000 000
-represent, compare, and order equivalent representations of numbers

Patterning & Algebra
-Determine the solution to a simple equation with one variable, through investigation using a variety of tools and strategies
-Demonstrate an understanding of different ways in which variables are used
-Solve problems that use two or three symbols or letters as variables to represent different unknown quantities

Objectives:
-Understand how computers comprehend and process information
-All computer information is processed through binary digits (1 and 0).
-Demonstrate how sequences of 0 and 1 can be used to represent any number or letter.
-Understand how computers store information.
-Encode and decode binary to letters and numbers

Vocabulary:

- binary	- bit	- code	- coding
- decoding	- encoding	- hexadecimal	- nibble

- bytes (B) - gigabytes (GB) - megabyte (MB) - terabytes (TB)
- ASCII

Minds On

Vocabulary matching game - Put students into small groups or pairs to match vocabulary words to their meanings.
Review definitions and pronunciation of key vocabulary words as a whole group. Ask a few students to post the definitions on a Padlet wall for future reference.

Action

-Write a message on the board in english and the same (or opposite) message in binary right below it. e.g. “Open the door”
-Ask the students if they know what to do or what both messages mean?
-Discuss how can we communicate with a computer? Or how do computers communicate with each other?
-Computer use a language called binary to communicate. It is a base-2 number system, such that it only has 2 numbers 0 and 1.
-Watch the video; How to write Decimal Number in Binary: https://www.youtube.com/watch?v=XdZqk8BXPwg
-Using the information from Kid’s Math: Binary Math **(** http://www.ducksters.com/kidsmath/binary_numbers_basics.php), discuss how the base 2 system works.
-Watch the video “Binary in 60 seconds” https://www.youtube.com/watch?v=qdFmSlFojlw to explain how to read the base 2 system.
-Explain that letters can also be converted to binary. Handout the Binary Decoder https://code.org/curriculum/course2/14/Activity14-BinaryBracelets.pdf from Code.org. This decoder key represents capital letters.
-Write a few examples of words on the board and convert the back and forth.
-When students are ready hand out the Binary bracelets activity https://code.org/curriculum/course2/14/Activity14-BinaryBracelets.pdf from Code.org.
-See if some of the kids can translate the message on the board.

Consolidation

-Binary Assessment https://code.org/curriculum/course2/14/Assessment14-BinaryBracelets.pdf
-Students can review the definitions and their meanings using a quiz written on Kahoot.

Novice	Learning	Master	Expert
-Using binary to write their name and simple message -Crack simple letter codes to find the English and use the decoder to convert simple commands to binary.	-Convert numbers to binary or base 2 -Use to convert simple sentences to binary.	-Using binary and base 2 system add and subtract numbers.	-Discuss the hardware components of the computer and how they work -Using Tiny Baubles Lessons by Thinkersmith -How to convert images and music to binary -Convert more complicated sentences and symbols into binary.

Multimedia Resources

MathCrazyTutoring. (2007). *Binary Numbers in 60 Seconds*. Available at: https://www.youtube.com/watch?v=qdFmSlFojlw. (Last Access: May 1, 2017).

MindYourDecisions. (2014). *Convert Numbers into Binary*. Available: https://www.youtube.com/watch?v=XdZqk8BXPwg. (Last Access: April 28, 2017)

Khan Academy Videos *Introduction to Binary*. Available at: http://www.crazygames.com/game/binary-game (Last Access: April 28, 2017)

National Council of Teachers of Mathematics. (Unknown). *Birthdays and the Binary System*. Available at: https://code.org/curriculum/course2/14/Assessment14-BinaryBracelets.pdf. (Last Access: May 15, 2017)

Assessment (for, as and of) : The Green Machine Activity: http://illuminations.nctm.org/Lesson.aspx?id=937 from the National Council of Teachers of Mathematics.

Assessment for Learning (Diagnostic):
-Kahoot Vocabulary Quiz
-Decode the Binary message: https://code.org/curriculum/course2/14/Assessment14-BinaryBracelets.pdf
- Using Google Classroom (or another blogging site such as Edmodo or Edublogs) to create a blog post for each day's lesson, embedded images and videos, and all the necessary links to help students and their families.
-Additional suggestions by Wisestamp (2017) in the article "*A Simple "Algorithm" for Bringing Coding to Your School"* are*:*

- create a category for each class or group of students.
- Write posts in "pseudocode" so children can get used to seeing common coding symbols and formatting.
- Besides lesson plans, include pages with information for parents, rules, and photos (which can be password protected). Having a page of links students can visit if they're waiting for help keeps kids from getting antsy and frustrated.
- Adding a "project gallery" page is a fun way for students to show off their projects.
- Include widgets with vocabulary words, links the students need often, etc.
- Create bookmarks, or better yet, set browsers to open directly to the blog.
- Encourage families to visit the blog regularly.

Assessment as Learning (Formative):
-Oral conferencing and observation
-Descriptive Feedback
-Exit Ticket

Assessment of Learning (Summative):
-Demonstration
-Rubric/Checkbric for Final Product and Task
-Peer and Self Evaluation Reflection

References & Supporting Resources

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Heeren, C., Magliery, T. & Pitt, L.(1998). *Math Maniacs: Lesson 1: Binary Numbers.* Available at: http://www.mathmaniacs.org/lessons/01-binary/. (Last Access: May 1, 2017).

Science Friday Initiative. (2015). *Write Your Name in Binary Code*. Available at: http://www.sciencefriday.com/educational-resources/write-your-name-in-binary-code/. (Last Access: May 5, 2017).

Technological Solutions, Inc. (2017). *Kid's Math: Binary Numbers.* Available at: http://www.ducksters.com/kidsmath/binary_numbers_basics.php . (Last Access: May 5, 2017).

Thinkersmith. (2013). *Traveling Circuits: Lesson 1 Binary Baubles*. Creative Commons. Available at: https://code.org/files/CSEDbinary.pdf. (Last Access: April 28, 2017)

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Lesson 2: Points of View or Reference Points

Big Idea:
To effectively communicate with technology to perform a variety of commands and tasks.

Curriculum Expectations:
Grade 6, 7 & 8: Mathematical Process Expectations
-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Measurement
-Estimate, measure, and record quantities, using the metric measurement system
-Solve problems requiring conversion from larger to smaller metric units

Geometry & Spatial Sense
-Explain how a coordinate system represents location, and plot points in a Cartesian coordinate plane
-Identify, through investigation, real-world movements that are translations, reflections, and rotations

Data Management & Probability
-collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements
– read, interpret, and draw conclusions from primary data and from secondary data presented in charts, tables, and graphs

Objective:

- To understand that there are different reference points or points of view when describing actions and locations
-To provide directions and to communicate a variety of instructions to complete a simple task
-To be able to communicate with the technology using simple code and commands
-To find multiple ways to solve a problem with a common solution

Vocabulary:

-input	- output	- reference point
-translation (slides)	- rotations (turns)	- reflection (flip)
-point of rotation	- mirror lines	- x and y coordinates
-plane	- revolutions	- perimeter
-circumference	- diameter	- radius
-Cartesian Plane	- angles	- distance

Minds On

-Review geometric vocabulary for transforming shapes
-Using the Hot Dog Activity from http://igamemom.com/5-crucial-computer-coding-skills-teach-kids-at-home/ , have students find different ways to move the bun to the hot dog,
-Try to get the students to look at the board from either side, so the “up”, “right”, “left” commands are leading to different moves depending on the side from which they are referencing.
- It is important to draw students’ attention to “Which side is UP, which side is DOWN?” “What if I am looking at the board from a different side? Will your code work?” to get them thinking about other reference points.

Action

-Place a grid on the classroom floor. This can be done with tape on the floor or use an old shower curtain with grid lines taped on it.
-Make a starting point and a finish point. Initially have students write instructions of how to get another student to and from each point.
-Talk about how to get from one point to another. What do we need to know?
-Making sure they include directions and measurements (how many steps).. Discuss why measurement and direction are important? Where else do we need measurements and directions in math (transformations). Would coordinate reference points help?
-Next make improvements. What can be done to make the process more efficient.
-If students are progressing well, have them include angle measurements in their turns.

Consolidation

Mission: In groups of 2-3, you are to create a maze. To test the intelligence of a lab mouse. See the lesson plan from CPALMS (2017) *Transform The Maze* for more explanation and the rubric file:///C:/Users/Jennifer/Google%20Drive/Teaching%20Resources%202017/Coding/Resource_71317.pdf. Making sure to discuss in their groups and the teacher the algorithm to solve their maze. Is there more than one way to complete it? Which method is more efficient? How do you know?

Novice	Learning	Master	Expert
-Create a simple 2D maze with 3-5 transformations to complete in quadrant 1 of the Cartesian Plane. Similar to the example on lesson plan from CPALMS (2017) *Transform The Maze*	-Create a simple 2D or 3D maze with 5-10 transformations to complete in quadrant 1 & 2 of the Cartesian Plane.	-Create a 3D maze with at least 10 or more transformations in all 4 quadrants of the Cartesian Plane.	-Create a 3D maze with 10 or more transformations, and multiple solutions, to complete in all 4 quadrants of the Cartesian Plane.

Multimedia Resources

iGameMom. (Unknown). *5 Crucial Computer Coding Skills You Can Teach Kids at Home*. Available: http://igamemom.com/5-crucial-computer-coding-skills-teach-kids-at-home/ . (Last Access: May 5, 2017).

Scratch (Unknown). *Scratch*. Available at: https://scratch.mit.edu/ . (Last Access: May 14, 2017).

Tickle, Lightning Lab apps on the iPad

Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Conferencing, Demonstrations, Descriptive Feedback
-Self-Evaluations
-Padlet postings
-Kahoot Vocabulary Quiz
-Think/Pair/Share
-Using Google Classroom Blog posts

Assessment as Learning (Formative):
-Oral conferencing and observations
-Experiments
-Descriptive Feedback
-Reflection sheet
-Exit tickets asking to describe their solutions to the problem with use of appropriate vocabulary

Assessment of Learning (Summative):
Rubric/Checkbric for Final Product and Task
Peer and Self Evaluation Reflection

References & Supporting Resources

Carrara, B. & Guiot-Guillain, P. (Unknown). *Introduction to Educational Robotics - EV3 in the Classroom*. Brault & Bouthillier Education.

CPALMS. (2017). *Transform through the Maze*. Available at: file:///C:/Users/Jennifer/Google%20Drive/Teaching%20Resources%202017/Coding/Resource_71317.pdf. (Last Access: May 15, 2017).

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Technology Enabled Learning Ontario.(Unknown). Coding in Elementary A Professional Learning Resource for Ontario Educators. Available at: http://www.edugains.ca/resourcesTELO/CE/CodingInterface/interface.html (Last Access: May 16, 2017).

Lesson 3: Introduction to Computer Languages

Big Idea: to be able to communicate with technology to complete a variety of tasks

Curriculum Expectations:

Grade 6, 7 & 8: Mathematical Process Expectations

-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Measurement

-Estimate, measure, and record quantities, using the metric measurement system
-Solve problems requiring conversion from larger to smaller metric units

Geometry & Spatial Sense

-Explain how a coordinate system represents location, and plot points in a Cartesian coordinate plane;
-Identify, through investigation, real-world movements that are translations, reflections, and rotations.

Patterning & Algebra

- determine the solution to a simple equation with one variable, through investigation using a variety of tools and strategies
- demonstrate an understanding of different ways in which variables are used
- solve problems that use two or three symbols or letters as variables to represent different unknown quantities

Objective

To communicate in a variety of languages in order to perform a computer task.
To understand that there are a variety of ways to communicate with a computer for different purposes

Vocabulary:

-Scratch	-Python	- C++	- Block Code
-Ruby	- HMTL HyperText Markup Language	- Javascript	

Minds On
- Using the “Marching Orders” activity (http://csunplugged.org/wp-content/uploads/2014/12/unplugged-12-programming_languages.pdf) from CS Unplugged, talk about the difference between how people and computers process information and instructions.
-As a whole group, have the students draw the box example following the teachers instructions.
-Compare with a neighbour to see if their drawings are similar. The the teacher can show the example in the lesson plan
-In partners, have students choose one of the examples in the lesson and describe how to draw the picture.
-Have one student choose an image, and have them describe the picture for the class to reproduce. The other students can ask questions to help them.
-Repeat this activity, with a simple image, but no questions are to be asked, so the students can only hear the instructions.
-This is how computers follow instructions, which creates a program.
-Programs are written in languages that have been specially designed to tell computers what to do, and each language is used for a particular purpose.

Action
-Depending on the capabilities of your students the computer languages introduced to the students can vary. For younger or more inexperienced students, simple block coding software can be used to create programs.
-Students can work through the tutorials on how to code from Swift Playgrounds, Scratch, Python and Javascript, as well as the Hour of Code lessons on Code.org.

Consolidation
Students can choose the performance task to show their understanding which will depend on their levels. In the blog post (http://www.lookwerelearning.com/2016/02/middle-school-coding-projects/) offers a few simple project ideas for students to show their understanding.

Novice	Learning	Master	Expert
Image or Picture Languages — -Turtle Art is a great example.	Block or Bubble Languages — -Scratch, Tynker, Swift	Programming Languages — Python, Ruby, HTML, XCode, JavaScript, Swift	Programming Languages — Python, Ruby, HTML, Noobs, Raspbian, XCode, JavaScript.

Multimedia Resources

Apple Inc. (2017). *Start Developing iOS Apps (Swift) Xcode.* Available at: https://developer.apple.com/library/content/referencelibrary/GettingStarted/DevelopiOSAppsSwift/index.html#//apple_ref/doc/uid/TP40015214-CH2-SW1. (Last Access: May 14, 2017).

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SoloLearn, Inc. (2017). *Java Tutorial*. Available at: https://www.sololearn.com/Course/Java/. (Last Access: May 8, 2017).

SoloLearn, Inc. (2017). *Python 3 Tutorial*. Available at: https://www.sololearn.com/Course/Python/. (Last Access: May 8, 2017).

TurtleArt. (Unknown). *TurtleArt*. Available at: http://turtleart.org/. (Last Access: May 8, 2017).

Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Think/Pair/Share
-Turn & Talk
- Using Google Classroom for blog posts

Assessment as Learning (Formative):
-Oral conferencing and observation
- Exit Tickets
-Descriptive Feedback
-Checklists

Assessment of Learning (Summative):
-Tests/Quizzes
-Demonstrations

References & Supporting Resources

Apple Inc. (2016). *Hour of Code with Swift Playgrounds - Facilitator's Guide*. Avaiable at: https://www.apple.com/education/docs/hourofcode_guide.pdf?CID=mkts-edu-ecc-appleedutwt-hoc. Last Access: May 14, 2017).

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Micro:bit Educational Foundation. (Unknown). Start Coding with the JavaScript Blocks Editor. Available at: http://microbit.org/en/2017-03-07-javascript-block-resources/. (Last Access: May 5, 2017).

Raspberry Pi Foundation. (Unknown). *Resources*. Available: https://www.raspberrypi.org/. (Last Access: May 12, 2017).

Robinson, S. (2016). *10 Middle School Coding Projects for Beginners*. Available at: http://www.lookwerelearning.com/2016/02/middle-school-coding-projects/. (Last Access: May 16, 2017).

Slavin, T. (August 2013). How to Choose Your First Programming Language. Available at: https://www.kidscodecs.com/how-to-pick-a-programming-language/. (Last Access: May 5, 2017).

The LEGO Group. (2017). Lego Mindstorms EV3. Available at: https://www.lego.com/en-us/mindstorms. (Last Access: May 15, 2017).

Lesson 4: Introduction to Coding

Big Idea:
- To communicate in a variety of languages in order to perform a computer task.
- To find the steps to solving a problem knowing the final outcome

Curriculum Expectations:

Grade 6, 7 & 8: Mathematical Process Expectations
-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Number Sense & Numeration
-Solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools and strategies
-Use estimation when solving problems involving operations with whole numbers, decimals, percents, integers, and fractions, to help judge the reasonableness of a solution

Measurement
-Solve problems that require conversion between metric units of measure

Geometry & Spatial Sense
-Graph the image of a point, or set of points, on the Cartesian coordinate plane after applying a transformation to the original point(s)
-Identify, through investigation, real-world movements that are translations, reflections, and rotations

Patterning & Algebra
-Compare pattern rules that generate a pattern by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term
-Evaluate algebraic expressions by substituting natural numbers for the variables
-Translate statements describing mathematical relationships into algebraic expressions and equations

Data Management & Probability
-collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements

– read, interpret, and draw conclusions from primary data and from secondary data presented in charts, tables, and graphs

Objective

-Identify key computer science and coding vocabulary
-Make connections between computer science concepts and the real world
-A simple program to get students accustomed to math operations and variables
-create a program that encompasses many computer science concepts – random numbers, loops, decision structures (if… then…), variables

Vocabulary:

- Computer science	- Bug	- Debugging	-Program	- Input
- Output	- Algorithm	- Variables	- Block Coding	- Blocks
- Code	- X & Y positions	- If/then/else statements,	- Loops	- Hex
- String	-Sequence	-Branches	- Nested Loops	- Parameters
- Go-To Commands	-Conditions	- Run	-Decompose	- Event
- Data	-Functions			

Minds On

-Discuss with students what an algorithm is? An algorithm is a detailed step-by-step set of instruction set or formula for solving or completing a task.
-How are they used to solve a problem?
-watch the following video on algorithms from Khan Academy: https://www.khanacademy.org/computing/computer-science/algorithms/intro-to-algorithms/v/what-are-algorithms.
-In groups of 2-3, use an example of a problem that would require an algorithm e.g. how to brush your teeth
-Create an algorithm flow chart to explain how to solve this problem.
-Trade with another group.
-Is their algorithm feasible? Did they miss anything? Add any additional steps you feel the group is missing.
-Think/Pair/Share - Look at vocabulary words and create definitions for each
-Create a Padlet or word wall for the classroom listing all the key vocabulary and their definitions.
-Each student can be assigned one word and post the definition to the Padlet wall for others to view.
-Any new vocabulary words can be added as students move along in their understanding.

Action

-Students can work through the various lessons on the different computer languages.
-Google, Apple have guided tutorials on how to use Scratch and Swift to create algorithms in which the students can work on at school or from home.
-As students progress through the tutorials, they can move on to creating more complicated algorithms in other computer languages.

Consolidation

https://codinginmathclass.wordpress.com/2015/02/19/algorithms-teaching-coding-structures-to-6th-grade/

Novice	Learning	Master	Expert
Scratch For Kids Scratch Blockly BB-8 Ollie Dash & Dot iPad apps - Code Spark Academy, Code School, Hopscotch, Minecraft -Students new to coding can continue to practice building simple algorithms using several programs and simple robots. -Using Scratch create a small string in which the character from one point to another on the screen. Some of the students can share their program with the class. Improvements	Scratch Tynker Hour of Code Code.org Spheros mBot Google CS First, Swift Playgrounds iPad apps - Code School, Hopscotch, Minecraft, Tynker, Twinkle, Lightning Lab -Use Spheros and the Tickle or Lightning Lab apps to follow a grid path to reach one point to another. The level of difficulty can be in the number of turns in the program. -There are accessories (e.g. chariot) for the Sphero that can be used to find a solution to the problem. -Other robots that be used are Dash & Dot, Osmo, BB-8	Hour of Code Lego Mindstorm EV3 Makey Makey Micro:bit iPad apps - Code School, Hopscotch, Minecraft, Learn Python Pro, Tynker, Twinkle, Lightning Lab -After constructing their robot, students can use the EV3 robots to create a program to follow a grid. -Stronger students can use the sensors available on the EV3 to assist them in creating their program.	Hour of Code Arduino, Raspberry Pi Micro:bit Makey Makey iPad apps - Code School, Hopscotch, Minecraft, Learn Python Pro -Using Arduino robots or robots using Raspberry Pi to navigate a course -Students can design an effective robot that would best be able to complete this course accurately. -They can also add additional features to enhance their robots functionality.

Multimedia Resources

Apple, Inc. (Unknown). Swift Playgrounds. Available at: https://www.apple.com/ca/swift/playgrounds/. . (Last Access: May 5, 2017).

Code.org. (2017). *Learn Computer Science*. Available at: https://code.org/student. (Last Access: May 5, 2017).

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Tynker. (2017). *Tynker Coding For Kids.* Available at: https://www.tynker.com/. (Last Access: May 5, 2017).

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Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Padlet Organizer
-Kahoot Vocabulary Quiz
-Think/Pair/Share
-Google Classroom Blog Post

Assessment as Learning (Formative):
-Exit tickets asking to describe their solutions to the problem with use of appropriate vocabulary
-Oral conferencing and observation
-Experiments
-Descriptive Feedback

Assessment of Learning (Summative):
-Demonstrations
-Rubric/Checkbric for Final Product
-Peer and Self Evaluation Reflection

References & Supporting Resources

Apple Inc. (2017). Get Started With Code 1: Teacher's Guide. Available at: https://itunes.apple.com/us/book/get-started-with-code-1/id1226776727?mt=11. (Last Access: May 12, 2017).

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Lesson 5: Drawings, Animations and Game Design

Big Idea: to use mathematical understandings to create a drawings, animation and video games for a particular purpose.

Curriculum Expectations:

Grade 6, 7 & 8: Mathematical Process Expectations

-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Number Sense & Numeration

-Solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools and strategies
-Use estimation when solving problems involving operations with whole numbers, decimals, percents, integers, and fractions, to help judge the reasonableness of a solution

Measurement

-Solve problems that require conversion between metric units of measure

Geometry & Spatial Sense

-Graph the image of a point, or set of points, on the Cartesian coordinate plane after applying a transformation to the original point(s)
-Identify, through investigation, real-world movements that are translations, reflections, and rotations

Patterning & Algebra

-Compare pattern rules that generate a pattern by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term
-Evaluate algebraic expressions by substituting natural numbers for the variables
-Translate statements describing mathematical relationships into algebraic expressions and equations

Objective: to create a functioning game using a written program including graphics and animations to solve a problem.

Vocabulary:

-will depend on coding language used

Minds On
-Discuss with students about how they were able to draw the images from the Making Orders activity. What had to be done to make sure the pictures were drawn accurately.
-How could you solve a math problem? What would your algorithm be for these

a) Adding three two-digit numbers
b) Finding the outcome of a coin toss with three rounds
c) find the area of a parallelogram

In an Think/Pair/Share, come up with the algorithms to solve these math problems.
As a whole group, discuss the feasibility of the algorithms.

Action
-Using the lessons on Khan Academy for Computer Animation https://www.khanacademy.org/computing/computer-programming/programming to introduce how to create graphics.
-Depending on skill levels of students there are several programs that will assist students in creating animations or game building.
-In small groups of 3-4, find a word problem that needs to be solved or a skill that needs to be learned. Create an animation or a game that teaches the concept or solves the problem.

Consolidation
Students in small groups can create their own game using Scratch. The Learning Partnership in their Coding Quest course (https://elearn.thelearningpartnership.ca/course/view.php?id=2) has a Game Design Booklet, the students can work through in the Game project.

Novice	Learning	Master	Expert
Sketch Nation http://sketchnation.com/ -used to create simple games for Android, iOS **Stencyl** http://stencyl.com/ Can publish iPhone, iPad, Android, Windows, Mac, Linux & Flash games without code **Sploder** http://www.sploder.com/ -very simple site for making video games	**Scratch** https://scratch.mit.edu/ -can be used to create simple animations -has tutorials for student learn to animate **Google Made With Code** https://www.madewithcode.com/ -more aimed at girls, can create pictures, music and animations **Tech Rockets** https://www.techrocket.com/code -game and graphic design	**Trinket** https://trinket.io/ -can create their own code using Python - needs their Google Account to access **Construct 2** https://www.scirra.com/ -can create a game with blocks -download to computer	**EarSketch** https://earsketch.gatech.edu/landing/#/ -can create music using Python or Javascript **Codecademy** https://www.codecademy.com/courses/web-beginner-en-X7bpO/0/1 -create a video game using HTML & Javascript

Multimedia Resources

Codecademy. (2017). *Make a Video Game*. Available at: https://www.codecademy.com/courses/web-beginner-en-X7bpO/0/1. (Last Access: May 14, 2017).

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Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Think/Pair/Share
-Turn & Talk
- Using Google Classroom to create a post describing the group's plan and reasoning for their app choice.

Assessment as Learning (Formative):
-Oral conferencing and observation
- Exit Tickets
-Descriptive Feedback

- Experimenting

Assessment of Learning (Summative):
-Demonstration
-Rubric/Checkbric for Final Product
-Peer and Self Evaluation Reflection

References & Supporting Resources

Autodesk, Inc. (2017). *Tinkercad*. Available at: https://www.tinkercad.com/ (Last Access: May 12, 2017).

Khan Academy. (2017). *Computer Programming*. https://www.khanacademy.org/computing/computer-programming. (Last Access: May 12, 2017).

Open Middle. (Unknown). *Challenging math problems worth solving*. Available at: http://www.openmiddle.com/. (Last Access: May 14, 2017).

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Lesson 6: App Development

Big Idea: To create a functioning app that teaches a skill.

Curriculum Expectations:

Grade 6, 7 & 8: Mathematical Process Expectations
-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Objective: to be able to create a functioning app that helps to reinforce a math skills for other students.

Vocabulary:
-will depend on coding language used

Minds On
-As a whole group, discuss what makes a good app?
-When making a new app, what things do you need to keep in mind?.

- What exactly do you want your app to do?
- How are you going to make it appeal to users?
- What problem is it going to solve?
- How will it simplify life for people?
- How will you market (sell) your app?

During a Turn and Talk activity, students with their neighbours can discuss the answers to these questions.
Then as a group, consolidate these answers.

Action

-In partners, students can work through the tutorial on how to create an app from the University of San Francisco, http://www.appinventor.org/.
-Now in partners, students are going to create their own app.
-Students can create their own apps using one of the free app makers below or another of their choice.
-They have been hired by Google or App to create a new App that will teach a math skill to either someone younger or of the same age. They will need to create the app and plan on how they are going to market their app to the public.
-Brainstorm ideas together
-Create a functioning app.

Consolidation
- When finished their app, the partners will have to introduce their app to the class, and a target audience.
- During an App Marketplace (Gallery Walk), they will have to explain what their app does, what skills are being taught and how does it appeal to others.
- The other students will ask questions and evaluate the feasibility of their app.
- When finished they will complete a reflection on their project.

Novice	Learning	Master	Expert
iBuild App https://ibuildapp.com/about-us/ -Making apps (iPhone, iPad, Android, Symbian, Win Mobile, Blackberry) -Very simple app, no coding, -drag and drop activities -will need to sign in with Google account **Kid's App Maker** http://www.kidsappmaker.com/home -Very simple app, no coding, -drag and drop activities mostly -will need to sign in with Google account -creates a storybook	**AppMaker** http://www.appmakr.com/ -Making apps (iPhone, Android, Web) -Very simple app, no coding, -drag and drop activities -will need to sign in with Google account **Kid's App Builder** http://www.appypie.com/kids-app-builder -Android or iPhone apps -drag and drop activities -will need to sign in with Google account	**MIT App Inventor** http://appinventor.mit.edu/explore/ -Makes Android apps -drag and drop activities -has tutorials & lesson plans Apper on the iPad	Swift **Appsbar** http://www.appsbar.com/ -Makes apps for Android, Apple, BlackBerry and Windows. -drag and drop activities mostly -more features available

Multimedia Resources

AppMaker. (2017). *AppMaker*. Available at: http://www.appmakr.com/. (Last Access: May 14, 2017).

AppGeneration. (2011). *Kid's App Maker*. Available at: http://www.kidsappmaker.com/home. (Last Access: May 12, 2017).

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iBuild App, Inc. (2017). *iBuild App.* Available at: https://ibuildapp.com/about-us/. (Last Access: May 14, 2017).

Massachusetts Institute of Technology. (2015). MIT App Inventor. Available at: http://appinventor.mit.edu/explore/ . (Last Access: May 14, 2017).

University of San Francisco's Democratize Computing Lab. (Unknown). Teaching with the App Inventor Course-in-a-Box. Available at: http://www.appinventor.org/. (Last Access: May 14, 2017)

Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Think/Pair/Share
-Turn & Talk
- Using Google Classroom to create a post describing the group's plan and reasoning for their app choice.

Assessment as Learning (Formative):
-Oral conferencing and observation
- Exit Tickets
-Descriptive Feedback

Assessment of Learning (Summative):
-Demonstration
-Rubric/Checkbric for Final Product
-Peer and Self Evaluation Reflection

References & Supporting Resources

Apple Inc. (2017). *Intro to App Development with Swift (iBook)*..Available at: https://itunes.apple.com/us/book/intro-to-app-development-with-swift/id1118575552?mt=11. (Last Access: May 12, 2017).

Gazdecki, A. (2017). *How To Build A Mobile App In 12 Easy Step*. Available at: https://www.biznessapps.com/blog/how-to-build-a-mobile-app-in-12-easy-steps/. (Last Access: May 12, 2017).

Swift Education. (Unknown). *Teaching App Development with Swift (iBook).* Available at: https://swifteducation.github.io/teaching_app_development_with_swift/. (Last Access: May 12, 2017).

Lesson 7: Web Page Design

Big Idea: to be able to create a functioning website to present information.

Curriculum Expectations:

Grade 6, 7 & 8: Mathematical Process Expectations

-Develop, select, and apply problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;
-Develop and apply reasoning skills to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;
-Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;
-Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems
-Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;
-Create a variety of representations of mathematical ideas, make connections among them, and apply them to solve problems
-Communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions

Number Sense & Numeration

-Solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools and strategies
-Use estimation when solving problems involving operations with whole numbers, decimals, percents, integers, and fractions, to help judge the reasonableness of a solution

Measurement

-Solve problems that require conversion between metric units of measure

Patterning & Algebra

-Compare pattern rules that generate a pattern by adding or subtracting a constant, or multiplying or dividing by a constant, to get the next term
-Evaluate algebraic expressions by substituting natural numbers for the variables
-Translate statements describing mathematical relationships into algebraic expressions and equations

Objective: to create a website to share information for a variety of purposes.

Vocabulary:

-will depend on coding language used

Minds On

-Discuss with students what makes a good website. What features are there? Do these feature make it a good site/or a bad site? Is it easy to explore. Would you come back to it?
-Make a chart of what design features make it a good or a bad site. Do the features reflect on the sites purpose?

-Show 3-4 different websites (personal, advertisements, educational, blogs etc). Have students turn and talk to a neighbour about its features and its organization.

Action
After going through the lessons on webpage design by Khan Academy https://www.khanacademy.org/computing/computer-programming/ . Students can create a simple website on their own that represents themselves.

Consolidation
-In small groups of 3-4, students will choose a math problem from a selected list of Dan Meyer's Three Act Problems at https://docs.google.com/a/pdsb.net/spreadsheets/d/1jXSt_CoDzyDFeJimZxnhgwOVsWkTQEsfqouLWNNC6Z4/pub?output=html.
-Once the groups have their problems, they can work together to find their solutions. As part of their solutions, they may want to think about their algorithms, experiments, strategies, models, diagrams, animations, pictures,
-After they have figured out how to solve their problem. They can create a website showing others how they solved the problem.
-The website can include words, pictures, videos, animations, graphics etc that shows their selected problem and their proposed solution
-When completed the group can share their web page on Google Classroom for others to view.

Novice	Learning	Master	Expert
Education Weebly https://education.weebly.com/ -mostly a drag and drop block -very simple	Code School https://www.codeschool.com/courses How to create a webpage with videos and lessons. Some courses are free	Codecademy https://www.codecademy.com/learn/make-a-website Build a website	Codecademy https://www.codecademy.com/courses/web-beginner-en-LceTK/0/1 -Build an interactive webpage

Multimedia Resources

Codecademy. (2017). *Make an Interactive Website*. Available at: https://www.codecademy.com/courses/web-beginner-en-LceTK/0. (Last Access: May 14, 2017).

Codecademy. (2017). *Make a Website*. Available at: https://www.codecademy.com/learn/make-a-website. (Last Access: May 14, 2017).

Code School. (2017). Code School Courses. Available at: https://www.codeschool.com/courses. (Last Access: May 14, 2017).

Weebly, Inc. (2017). *Create a Free Class Website*. Available at: https://education.weebly.com/ (Last Access: May 14, 2017).

Assessment (for, as and of) :

Assessment for Learning (Diagnostic):
-Think/Pair/Share
-Turn & Talk
- Using Google Classroom to create a post describing the group's plan and reasoning for their app choice.

Assessment as Learning (Formative):
-Oral conferencing and observation
- Exit Tickets
-Descriptive Feedback
- Experimenting

Assessment of Learning (Summative):
-Demonstration
-Rubric/Checkbric for Final Product
-Peer and Self Evaluation Reflection

References & Supporting Resources

Meyer, D. (Unknown). *Dan Meyer's Three-Act Math Tasks.* Available at: https://docs.google.com/a/pdsb.net/spreadsheets/d/1jXSt_CoDzyDFeJimZxnhgwOVsWkTQEsfqouLWNNC6Z4/pub?output=html. (Last Access: May 14, 2017).