Robots and Sequencing: 1st Grade

Lesson 1: Sequencing

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Robot: A robot can be defined as a mechanical device that is capable of performing a variety of tasks on command or according to instructions programmed in advance.

Subject Area: Computer Science and Security/Math/English/Engineering

Grade-Level: 1st grade

Lesson Title: Sequencing, Debugging, and Cryptography

Introduction: In this lesson students will be exposed to coding through a progression of skills. At the end of the unit, students will be able to understand sequencing, trouble-shooting, and using an algorithm to solve a problem. The unit will be used to help students make connections to Math, English Language Arts, and Engineering through the real world application of computer science learning. The main focus of this lesson is to start the scaffolding process of learning so that students will become educated digital citizens. With such a strong focus on Math and English Language Arts for many teachers, computer science has not been a focus in the elementary education setting. This lesson was developed with the idea that Common Core State Standards for Math and English Language Arts can be taught through a curriculum that many teachers feel that they do not have time to teach.

Lesson Overview: The purpose of this lesson is to introduce young learners to coding and computer security through an "unplugged" environment. At the end of this unit, students will be able to understand the basics of sequencing, coding, debugging, and cryptography. The first lesson starts with sequencing and transitions into coding and debugging in the second lesson. Finally, the third lesson uses the understanding of algorithms to introduce students to encryption through cryptography.

Lesson Learning Objectives:

- **Understand that sequencing is the order of events**
- **Using ordinal numbers to list steps is important in developing sequence**

Standards:

1) Computer Science

- CPP.L1:3-04 - Construct a set of statements to be acted out to accomplish a simple task.
- CT.L1:6-01 - Understand and use the basic steps in algorithmic problem-solving.
- CT.L1:6-02 - Develop a simple understanding of an algorithm using computer-free exercises.
- CT.L2-03 - Define an algorithm as a sequence of instructions that can be processed by a computer.
- CT.L2-06 - Describe and analyze a sequence of instructions being followed.

2) Math:

CCSS.MATH.CONTENT.1.OA.A.1

Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

CCSS.MATH.CONTENT.1.OA.A.1

Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

CCSS.MATH.CONTENT.1.OA.D.8

Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = _ - 3, 6 + 6 = _.*

3) ELA:

CCSS.ELA-LITERACY.RF.1.1

Demonstrate understanding of the organization and basic features of print.

CCSS.ELA-LITERACY.RF.1.3

Know and apply grade-level phonics and word analysis skills in decoding words.

CCSS.ELA-LITERACY.W.1.2

Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.

CCSS.ELA-LITERACY.W.1.7

Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions).

CCSS.ELA-LITERACY.W.1.8

With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

CCSS.ELA-LITERACY.SL.1.1

Participate in collaborative conversations with diverse partners about *grade 1 topics and texts* with peers and adults in small and larger groups.

CCSS.ELA-LITERACY.SL.1.1.A

Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).

CCSS.ELA-LITERACY.SL.1.1.B
Build on others' talk in conversations by responding to the comments of others through multiple exchanges.

CCSS.ELA-LITERACY.SL.1.1.C
Ask questions to clear up any confusion about the topics and texts under discussion.

CCSS.ELA-LITERACY.SL.1.2
Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
CCSS.ELA-LITERACY.SL.1.3
Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.
CCSS.ELA-LITERACY.L.1.1.A
Print all upper- and lowercase letters.
CCSS.ELA-LITERACY.L.1.2.B
Use end punctuation for sentences.
CCSS.ELA-LITERACY.L.1.2.E
Spell untaught words phonetically, drawing on phonemic awareness and spelling conventions.
CCSS.ELA-LITERACY.L.1.6
Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships (e.g., *because*).

Materials:

- **Whiteboard and marker or Pencil and paper**
- **Painter's Tape or Sidewalk Chalk**
- **Move the Flurbs Assessment Worksheet from Code.org (https://code.org/curriculum/course1/1/Assessment1-HappyMaps.pdf)**
- **Technology Journal (or any notebook that could be used for taking notes)**
- **Toothbrush and toothpaste (or something that could be used in lieu of)**

Engage: "Programmer Says"

- *In this activity students will be engaged by playing a familiar game in order to create an entry point into sequencing and robotics. The game is the same as "Simon Says" but will have the title replaced by*

"Programmer Says." This will allow students to understand that all robots must receive a command, using proper formatting, before performing an operation. The "programmer" will continue to make the "robots" move until there are only 3 robots left. The programmer will make the commands increasingly difficult and increase the speed until the desired number of robots remains.

- *If the students are really enjoying the game, let them become programmers and have them use commands to move the robots. Make sure that they students are always using vocabulary: command, programmer, and format.*

Student Directions:

- **Robots can only move if they receive a <u>command</u> from the <u>programmer</u>. You are all robots and I am the programmer. If you, a robot, move without a command, you will be powered down. Also, if you move without hearing the programmer use the correct <u>format</u>, you will be powered down. The correct format is, "Programmer Says." Only the best robots, the robots that follow commands correctly, will become robot leaders.**

Explore: "Mr. Robot brushes its teeth"

- *In this activity students will become programmers and have the teacher, "Mr. Robot", perform the task of brushing his/her teeth. The focus will be on using the correct format of commands. (i.e. "programmer says, pick up toothbrush."). The teacher will perform the tasks exactly how the students command. The winners of the game, "Programmer says," will become the first programmers for the robot. The programmers will take turns giving the robot directions until the task is completed. The robot can only perform the operations that the programmers command. Each programmer must give one command at a time. Once the first group has completed the task, select another group to complete the task. Allow as many groups to complete the task as necessary to establish a "best program." The more groups that command the robot, the more practice the students will have in creating a best sequence of events.*

Student Directions:

- **Mr. Robot needs to be programmed to brush its teeth. It is only able to perform one command at a time. The robot leaders are now programmers. Each programmer will take a turn giving the robot commands until the process of brushing teeth is complete. The robot can only follow simple commands, i.e. "Pick up toothbrush." The robot will crash and reset if too many commands are given at the same time. The programmers must follow proper format when commanding the robot, i.e. "programmer says, pick up toothbrush" If the robot does not receive the correct format, it will not perform the command. The programmers will take turns giving commands until the robot has correctly completed the teeth brushing process.**

Explain: Vocabulary Review and Sequencing Description

Vocabulary:

1) **Sequence:** a particular order in which related events, movements, or things follow each other. (order, series, string, timeline)
2) **Format:** the way in which something is arranged or set out. (pattern, setup, arrangement)
3) **Command:** an authoritative order. (order, instruction, direction, demand, request)
4) **Program:** a planned series of future events, items, or performances. (schedule, timetable, agenda)
5) **Programmer:** a person who uses code, or programming language, to tell a computer what to do.

Vocabulary Review: create a vocabulary poster for the lesson that the students will be able to reference throughout the entire process. When giving the definitions to the words, make sure to discuss possible synonyms and other definitions that the students will generate. Have the students write the vocabulary in their Technology Journal in order to maintain a reference and work on writing skills. (Make sure to use all new

vocabulary as much as possible during your discussions). The ability level of students may vary and so creating traceable letters may be necessary for a given class or group of students. The vocabulary words are multisyllabic but still can be broken down into more manageable and distinguishable parts.

Sequencing: discuss sequencing and how the students were able to "program their robot." Together as a class, discuss the steps that must be taken in order for the robot to successfully complete the task. As the teacher, write down a list of commands that are needed to make the robot complete the task. Make sure that all students are using ordinal numbers in their journal and copy the most important word or two from each command. Discuss, as a class, which word or words would best describe the action in the event. (Verb/Object) While transcribing the steps into journals, check for letter and number formation. An example of what the steps should look like is found below. The students and teacher will decide together the words that will be annotated.

1) Get out your toothbrush and toothpaste.
2) Squeeze toothpaste onto your toothbrush.
3) Wet toothbrush and toothpaste with water.
4) Move brush around in your mouth.
5) Spit out toothpaste.
6) Rinse off toothbrush.
7) Put toothbrush and toothpaste away.

Elaborate: "Happy Maps"

- *In this activity students will be using the "Happy Maps" worksheet from Code.org to complete simple programs. The programs are one and two step programs designed to familiarize the students with using commands to aid a robot in completing a task. The commands are nothing more than arrows that will direct their "Flurb" to the pot of gold. Allow the student's time to cut and paste their programs. Once all students are completed with their programs, have them explain in front of the class why they used the commands that they did. Once a good understanding of the single movements has been establish, discuss as a class how the extra credit section can prove to be more difficult.*
- *If the students are finding the exercise too easy, allow them to write a new program under their pasted program that would require more*

movement by their Flurb but still allow success in retrieving the pot of gold. You could even challenge them to use as many commands as possible to arrive at the pot of gold.

Student Directions:

- **The Flurb's pot of gold is in danger! Help her get to it as quickly as possible before it disappears. To show the Flurb how to get to her pot of gold, cut out the correct arrows from the bottom of the page and paste them in the program slots by each of the picture maps.**

Evaluate: Write Your Own Program

- In the evaluation section we will be using qualitative assessment to determine student understanding and ability. The students will be "robots" that must follow a program in order to complete a task. The teacher will create a 4x4 grid using sidewalk chalk or tape. The robot will then be placed in one of the squares in the grid. The teacher will then place a "treasure" that the robot must retrieve in one of the other squares in the grid. The students, using whiteboard and marker or another form of reproducible annotation, will then write a program, using arrows, which will allow the robot to achieve its goal. The students will then "run" their program to determine if the robot reaches its goal using their program. (Running the program is when the students tell the robot which direction to move using proper format and commands, like "Programmer Says"). The teacher can allow a student to run their entire program or can allow students to take turns moving their robot.
- The robot and treasure can be moved as many times as necessary to achieve students' understanding and can easily be modified to increase or decrease the level of difficulty. Obstacles can also be placed inside of the grid if the students need a greater challenge. Make sure that the students are using ordinal numbers when writing their programs.
- This assessment can be modified very easily to accommodate the goals of the teacher. If the teacher would like to assign a grade to student understanding, a predetermined course and program can be established and students can then fill out a worksheet in order to determine student comprehension.

- A great extension to this activity is to include math, specifically algebraic thinking. Write a partial program that the students will use to help the robot achieve its goal. Then have the students finish the program. Have the students add or subtract the number of steps they used to finish the program. The teacher can also have 3 different students write parts of the program and then discuss how they can add up the parts to find the total sum of moves.

Student Directions:

- **You are going to be robots and programmers! If you are a programmer, you will be commanding the robots to effectively navigate a maze. If you are a robot, you will be following commands to achieve a goal. Programmers will need to examine the best path for the robot to achieve its goal. Then, numbering all of your steps, you will write a program that will help the robot achieve its goal. Do not forget to use proper formatting when giving commands to your robot!!**