

Robots and Sequencing: 1st Grade

Lesson 3: Cryptography



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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 encryption is used to keep information or data safe**
- **Understand that an algorithm is a set of steps used to solve a problem**

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) ELA:

- CCSS.ELA-LITERACY.RI.1.10: With prompting and support, read informational texts appropriately complex for grade 1.
- 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.1.8: 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*).

NGSS:

-Science and Engineering Practices

- **K-2-ETS1-1:** Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions.
 - Ask questions based on observations to find more information about the natural and/or designed world
 - Define a simple problem that can be solved through the development of a new or improved object or tool

-Disciplinary Core Ideas

- **ET S1.A:** Defining and Delimiting Engineering Problems
 - A situation that people want to change or create can be approached as a problem to be solved through engineering.
 - Asking questions, making observations, and gathering information are helpful in thinking about problems.
 - Before beginning to design a solution, it is important to clearly understand the problem.

Engage: “Secret Number”

- *In this activity students will be using their previous knowledge of programming and coding to determine a secret number. The secret number will then be used as an introduction to having a “key” when encrypting and decrypting information. The students will be given a 4x4 grid that will have random numbers located in each box. The students will then use a code/program to find the secret number. Teacher will need to draw the grid on the whiteboard or overhead. The numbers and code can be changed as many times as teacher determines. The activity can be repeated as many times as needed to achieve student understanding.*
- *This activity can be extended to student choice of secret number. Students will simply need to select a number and then write the code to use to arrive at that number.*

Student Directions:

You need to find the secret number. You are going to be given a 4x4 grid that has numbers randomly distributed throughout. Your job is to use the code given to you to find the secret number.

45	28	67	20
38	12	94	48
68	14	57	75
Start Here	82	99	33

Explore: “Secret Words”

- *In this activity students will be using a 4x7 grid that has the English alphabet spaced out within the boxes. The students will be given lines of code to determine what the secret words are. The words can be anything that you would like to use or it could be the vocabulary words for this lesson. The sheet for the vocabulary words is attached.*

Student Instructions:

You need to find the secret words! The words are secret and so you must use the lines of code to figure out each letter of the word. There are five words that you must figure out. You can work as a team or you can work individually. Good luck!

Explain: Algorithms and Encryption

Vocabulary:

- 1) Task:** a piece of work to be done
- 2) Cipher:** a secret or disguised way of writing a code (**Code:** a system of symbols substituted for letters for the purposes of secrecy.)
- 3) Encrypt:** the process of changing letters into symbols to prevent access
- 4) Algorithm:** a list of rules in order to solve a problem
- 5) Key:** the set of instructions used to encrypt or decrypt messages

- *In this section the students will be discussing the vocabulary words in order to understand the process of encryption. Students will need to understand that a **task** needs to be determined (encrypting a word, or message). They will then need to use a **cipher to encrypt** the message. From here, they will then need to use an **algorithm** to decipher or decrypt the message. It is important to*

tell students that the same algorithm does not need to be used to get to the answer (they can start moving right instead of moving up, they can move up and down, left and right) as long as the algorithm used helps them to arrive at the answer.

- *Some students will recognize that an algorithm is the same thing as a line of code. This is a great discussion to have with kids. An algorithm is a set of steps used to solve a problem. However, without*

Elaborate: Caesar Cipher

- *In this activity, students will be using the Caesar cipher to create their own encrypted messages. The students will need to create their encrypted message and then have the students in the group “run” the code to make sure that it creates the desired message. Once the message has been “debugged,” the students will pass the message to another group and have them decipher the code using the designated key for the cipher. It is important to remember to use the vocabulary from all the lessons when talking or discussing the process with the students.*

Student Instructions:

- **Now that you have learned how to use a Caesar cipher, you will be creating your own encrypted messages to send to friends and classmates. The first thing you will need to do is decide what kind of a shift you would like to use. The second thing you should do is create a short message that is NOT encrypted. Once you have checked the spelling of your message for accuracy, count how many letters your word or message has. Then, draw the same number of blanks that your message has. Finally, going letter by letter, encrypt your message using the selected shift.**