![EIS Elementary Institute of Science logo]

STEAM Subject: Coding
Lab: Coding Maze

Grades: 2nd-5th

Learning Objective: Students will be able to:
- design a coding maze that a toy must get through by following "programmer" instructions
- explore the basics of coding, including algorithms and debugging

ENGAGE:
Ask students the following questions:
- How do humans communicate with computers?
  - *Through different coding languages, such as HTML, CSS, JavaScript, Python, SQL, C++, and more.*
- What is the simple definition of coding?
  - *The process of using a programming language to get a computer to behave how you want it to*
- Name all the things you know that are coded to operate.
  - *Video games, cars, phones, apps, websites, robots, drones, and more!*

EXPLORE:
Coding Maze Activity

You will need two people for this activity – one person to be the "computer" and the other to be the "programmer." The purpose of the coding maze is for the "computer" to navigate the stuffed animal to the end of the path by listening to the "programmer's" instructions.

Materials you need:
- A standard deck of cards
- A stuffed animal (or any other toy)
- Other toys or objects to use as treats and traps
- 2 pieces of paper
- Pen/pencil
- A blind-fold or bandana

Stuffed Animal

Deck of Cards

"Traps"

"Treats"

Photo taken by EIS Coding Instructor Maria Morgan

Procedure:
You should go through two rounds of this and switch the roles of "programmer" and "computer". See which person gets a higher score as the "computer".

For the "programmer":
1. Make a path with the deck of cards as shown below. It is your choice to make it easy or hard!
2. Choose some toys or objects to be the treats and others to be the traps. The stuffed animal must avoid the traps, but it can "eat" the treats.
3. Grab the piece of paper and write steps for the computer on how they should maneuver through the path and reach the end. An example is shown below.
   a. Some examples of steps are "turn right/left and move ___ units," "jump one space to avoid the trap," and "eat the treat on this spot."
4. Read the instructions out loud to the computer so they can move the stuffed animal from start to finish.

Photo taken by EIS Coding Instructor Maria Morgan

For the "computer":
1. You must be blind-folded! Grab the stuffed animal and get ready to guide it to the finish line. The programmer will be reading the instructions for you.

Here are the rules!
- Every treat you land on and eat, you get one point. To make it harder, assign the toy treats to be different point values (this can be based on their color, size, shape, etc.).
- Every trap you land on, you lose two points. To make it harder, if you land on a trap, you must start again from the beginning, and your point total will start at -2.
- The person with the most amount of points as the "computer" wins!

EXPLAIN:

How Computers Work*:*
Here is a video from code.org that answers the question "what makes a computer, a computer?": https://youtu.be/mCq8-xTH7jA

Here are the main points from the video:

- There are four different tasks that every computer has. **It receives input, stores information, processes that information, and outputs the results. This is what makes a computer, a computer!**
  - Input is the stuff that the programmer or user does that makes the computer do stuff.
  - Storage is where the computer stores the information from the input in memory.
  - A processor is what takes information from memory and changes it using an algorithm. The processed information is then sent back to memory.
  - Output is the information a computer puts out, depending on what the computer is designed to do (ex. signals, display of text or images or videos, etc.).
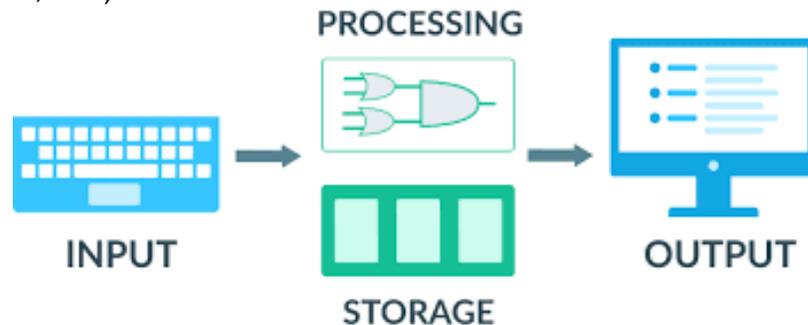

Image credit: https://www.khanacademy.org/computing/ap-computer-science-principles/computers-101/introducing-computers/a/what-is-a-computer

What are Algorithms*:*
In the coding maze activity, the "programmer" wrote instructions for the "computer" on how to reach the finish line. This is considered an algorithm. Programmers write algorithms that instruct the computer how to perform a task. Algorithms are not only used in coding though. They are also used when we read recipes for making food, when we learn how to do math problems, and even our morning routine!

Let's give an example – how to make a peanut butter and jelly sandwich:
1. Grab two slices of bread.
2. Place the two slices of bread next to each other.
3. Grab the peanut butter jar and the jelly jar.
4. Open both jars.

5. Use a knife to scoop out some peanut butter from the peanut butter jar.
6. Spread the peanut butter on one of the slices of bread.
7. Use the knife again to scoop out some jelly from the jelly jar.
8. Spread the jelly on the other slice of bread.
9. Grab the slice of bread with peanut butter on it and place it on top of the slice of bread with the jelly on it. The peanut butter and the jelly should be touching now.
10. You now have a peanut butter and jelly sandwich!

Image credit:
http://www.fotosearch.com/CSP852/k8528242/

Notice the detail that is used in these instructions. As humans, we do not need this much detail because most people know how to make a peanut butter and jelly sandwich easily, and we can just use our common sense for certain instructions. However, a computer does not work this way, and needs every single step given with much detail. As you learn to code, do not forget this! **A computer is smart because humans make it smart. It cannot perform tasks without detailed algorithms.**

Challenge: Write your own set of instructions for your morning routine, how to make your favorite meal, and one other process of your choice. Make sure you include every step that you do!

Debugging Code*:*
This means finding the problems and mistakes in the code so that the code can be fixed and can run properly. In the coding maze activity, there may have been instructions that were incorrect and led the computer through a wrong path. The process of correct these mistakes is called debugging.
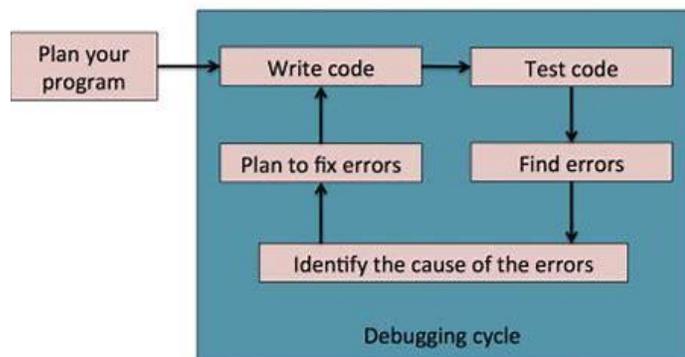

Image credit:
https://www.theschoolrun.com/what-is-debugging

As you see in this diagram, debugging is a cycle. The error is not always fixed from the first try. **That is why coding requires patience!** It can be frustrating at times, but when you finally solve the problem and your code works, then it is super rewarding.

Review STEAM Vocabulary:
- **Input:** the data that is taken in by the computer system from the user's actions
- **Storage:** also known as the memory, this is where the input data that was received is stored
- **Processor:** an electronic circuit that processes the basic instructions that drive a computer, it receives the input and provides the appropriate output
- **Output:** the data or information produced by the operation of a computer program that is in user-readable form
- **Algorithm:** a set of step-by-step instructions for performing a task
- **Debugging:** the process of identifying and removing errors from computer code so that the code may work correctly

ELABORATE
- Visit https://www.tynker.com/hour-of-code/ to find coding puzzles and projects. This will help you to start learning how to code.
- There is also the home page for hour of code that has more coding games and projects: https://hourofcode.com/us/learn.
- Explore artificial intelligence and how coding is used in this. Here is one example of a famous Artificial Intelligence (AI) robot named Sophia: https://youtu.be/G-zyTlZQYpE. Find some other examples of artificial intelligence and how it is used today!

EVALUATE

Students will be able to explain what is a computer and does it work.
Students can "write" their own algorithms to give instructions to a computer to complete a different task and share it with us at @eissandiego!

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