Computational Thinking Boosters: Algorithmic Thinking 3-8

Date: Jan. 12, 2021

[Link to recording]

This work was supported by the National Science Foundation under grant award #1923314. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

Introductions

Agenda

What: 30min CT Boosters(3-8)

Plan for today:

- 5 minutes: **Introduction & Vocabulary**
- 15 minutes: **Lesson Ideas**
- 5 minutes: **Q & A**

Guiding Question:

- Why do we need detailed directions?
- Have you ever tried to follow directions that are not clear? What happened?
- What kinds of directions do you think computers need?

Technology & Computer Science in KY

7 Big Ideas of Technology

- Global Collaborator
- Computational Thinker
- Creative Communicator
- Empowered Learner
- Digital Citizen
- Knowledge Constructor
- Innovative Designer

5 Key Concepts of CS

- Networks & the Internet
- Using Algorithms & Programming
- Data Analysis
- Computing Systems
- Impacts of Computing

Kentucky Academic Standards (KAS) for Computer Science

Concept: Algorithms & Programming

Subconcept: Algorithms

E-AP-01: Create, follow, compare and refine algorithms for a task.
M-AP-04: Create flowcharts and/or pseudocode to address complex problems as algorithms.

KAS Technology Standards for 3-8

- CT1. Develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Learning Priority:
  - A: Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
  - D. Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

- CT2. Apply strategies for understanding and solving problems by using technological methods to develop and test solutions. Learning Priority C: Create and test automated solutions.
  - indicator: Use digital tools to identify and create algorithms, with guidance and support.

Characteristics of Algorithms

Algorithms are precise step-by-step plans or procedures to meet an end goal or to solve a problem; algorithmic thinking is the skill involved in developing an algorithm.

- Shuchi Grover in *Computer Science in K-12: An A-To-Z Handbook on Teaching Programming*

- **Finite**: They must always terminate (end) after a finite number of steps.
- **Input**: an algorithm has zero or more inputs. (The ingredients)
- **Outputs**: An algorithm generally has one or more outputs. (The results)
- **Effective**: An algorithm is generally expected to be effective.
- **Definiteness**: Each step must be precisely defined. Actions are carried out in a rigorous and unambiguous way. (Clear and easily interpreted.)

Characteristics of Algorithms

An algorithm must be seen to be believed, and the best way to learn what an algorithm is all about is to try it.

-Donald Knuth in *The Art of Computer Programming, Volume 1*

Examples:

- Maps and Directions
- Cooking/Baking
- Sorting Algorithms Computer Science Unplugged

Vocabulary: Algorithms

Words to teach:

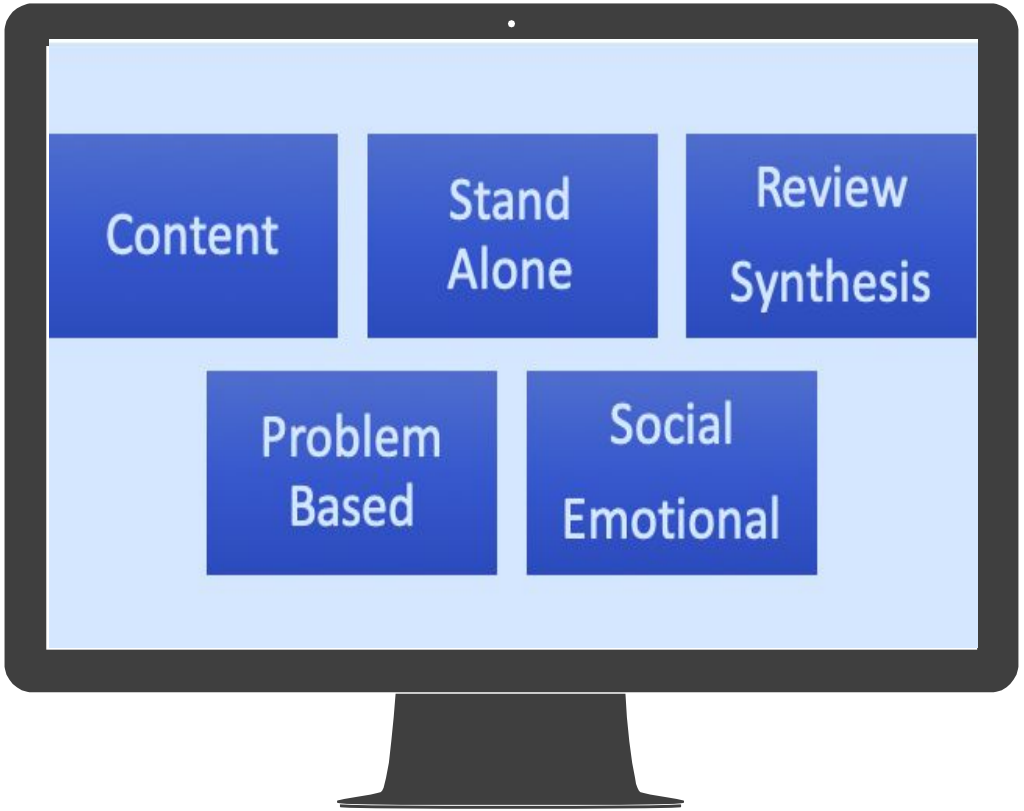
- **Algorithm** - A list of steps to finish a task
- **Bug** - Part of a program that does not work correctly
- **Debugging** - Finding and fixing problems in an algorithm or program
- **Loop** - The action of doing something over and over again
- **Program** - An algorithm that has been coded into something that can be run by a machine
- **Repeat** - To do something again
- **Decomposition** - Break a problem down into smaller, simpler parts
- **Abstraction** - To filter out unnecessary components within commands
- **Sequencing** - Determine the best order for the algorithm to follow
- **Pattern Recognition** - Recognition of patterns and regularities in data

When to teach Algorithms

Teachers might use algorithmic thinking lessons when:

- Teaching their content
- As a stand alone lesson
- As a social emotional lesson
- With problem-based strategies
- As a review/synthesis

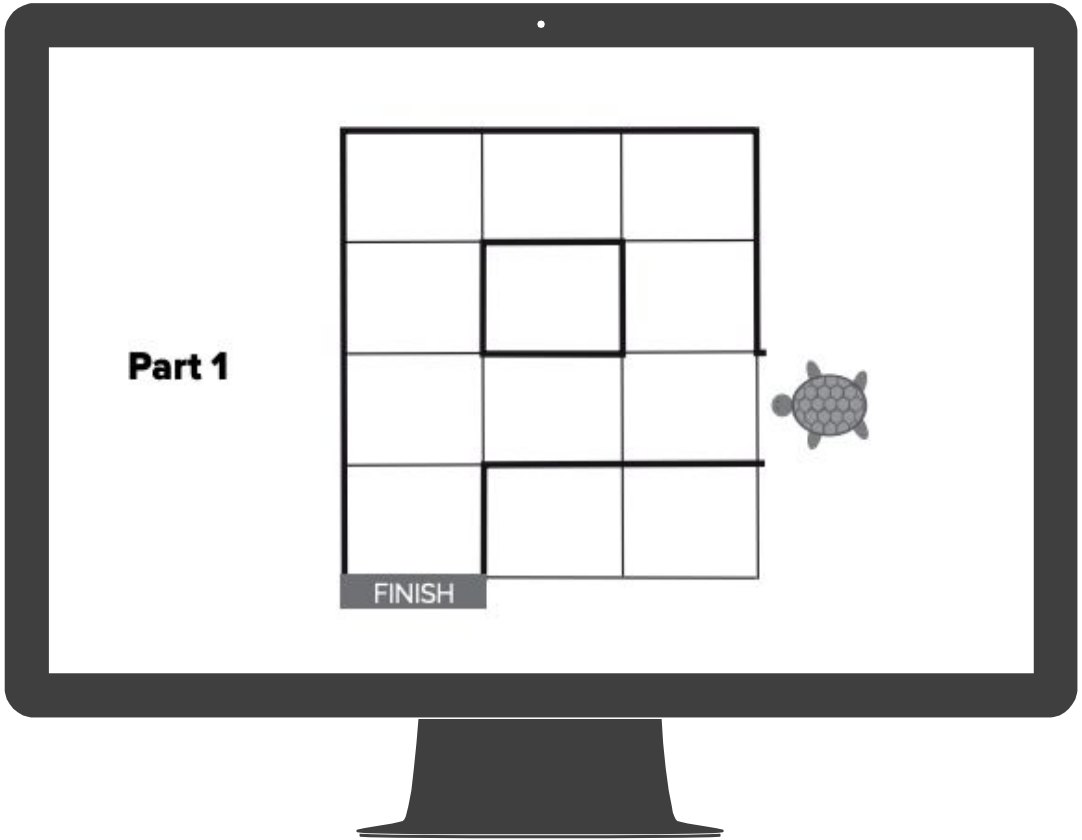
When you teach algorithms depends upon your students, the grade level, the content, and the context.



Codable Maze

Students will use this unplugged lesson to code the shortest distance through a maze. This could be applied to various content areas such as:

- moving through a map
- ordering a historical timeline
- ordering the parts of a story



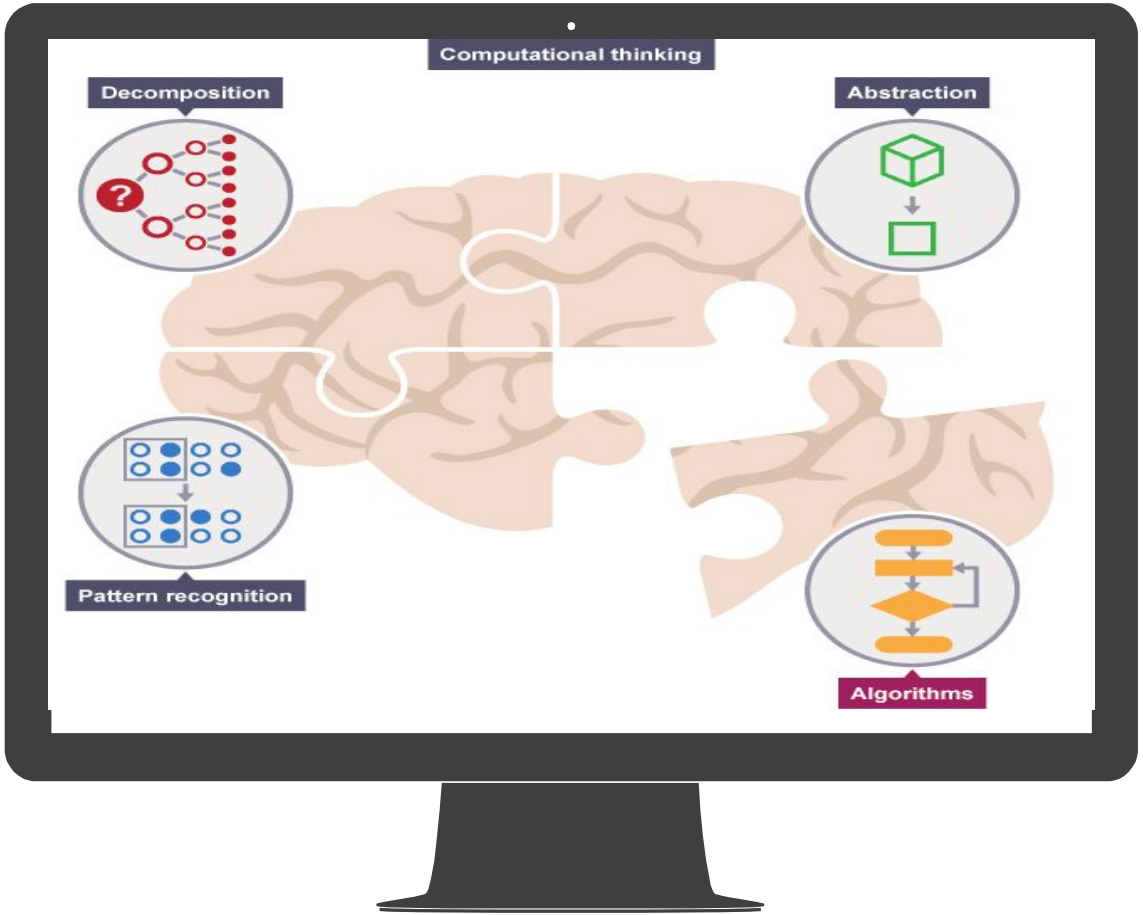
Code.org

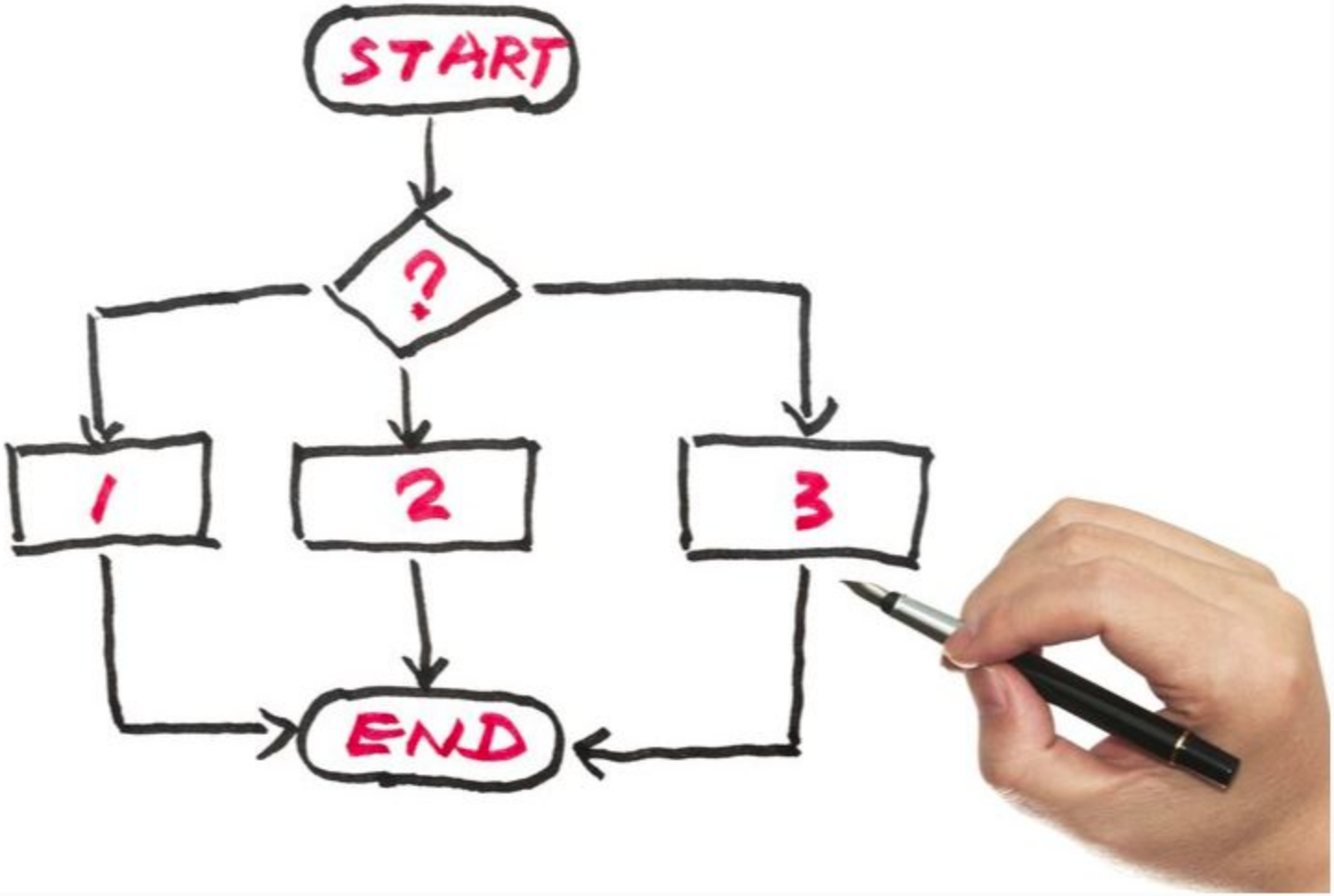
CS Fundamentals Lessons:

- Dice Race
- My Robotic Friends
- Real-life Algorithms:Paper Planes
- Real-life Algorithms: Plant a Seed
- Tangrams

Flowcharts

- A diagram that shows a process, made up of boxes representing steps, decision, inputs and outputs.
- **This step-by-step program will need planning, and to do this we use an algorithm.**




START
?
1
2
3
END

LAST UPDATED:
12:00 am PST
March 13, 2020

A REGULARLY UPDATED, EVOLVING

CORONA VIRUS CHEAT SHEET

STOP THE SPREAD

WHAT SHOULD I DO?!?

OR, HOW DO I PROTECT MYSELF and my FAMILY and OUR WHOLE COMMUNITY?

ARE YOU FREAKING OUT?

YES!

WE GET IT. THIS IS A STRESSFUL TIME. LET'S FIGURE THIS OUT TOGETHER.

NO.

GOOD. OKAY, SO LET'S FIGURE THIS OUT TOGETHER.

OH, BOY. ARE YOU STILL SAYING, "WHAT'S THE FUSS? IT'S JUST LIKE THE FLU." ??

OKAY, WRONG.
THE CORONA VIRUS, A.K.A 'COVID-19', IS MORE CONTAGIOUS & MORE DANGEROUS THAN THE FLU.
A TON of PEOPLE HAVE CORONA & A TON MORE WILL GET IT. SOME WILL EVEN DIE.
THE ONLY WAY ~~to~~ MINIMIZE THAT IS THROUGH EDUCATION & BEHAVIOR CHANGE. SO...

ARE YOU SICK?

YES

WELL, YOU SHOULDN'T GO OUT IF YOU'RE SICK ANYTIME, & ESPECIALLY NOT NOW. LET'S LOOK at YOUR SYMPTOMS.
DO YOU HAVE:

NO

HAVE YOU HAD CLOSE CONTACT with ANYONE DIAGNOSED with the CORONA VIRUS?

YES

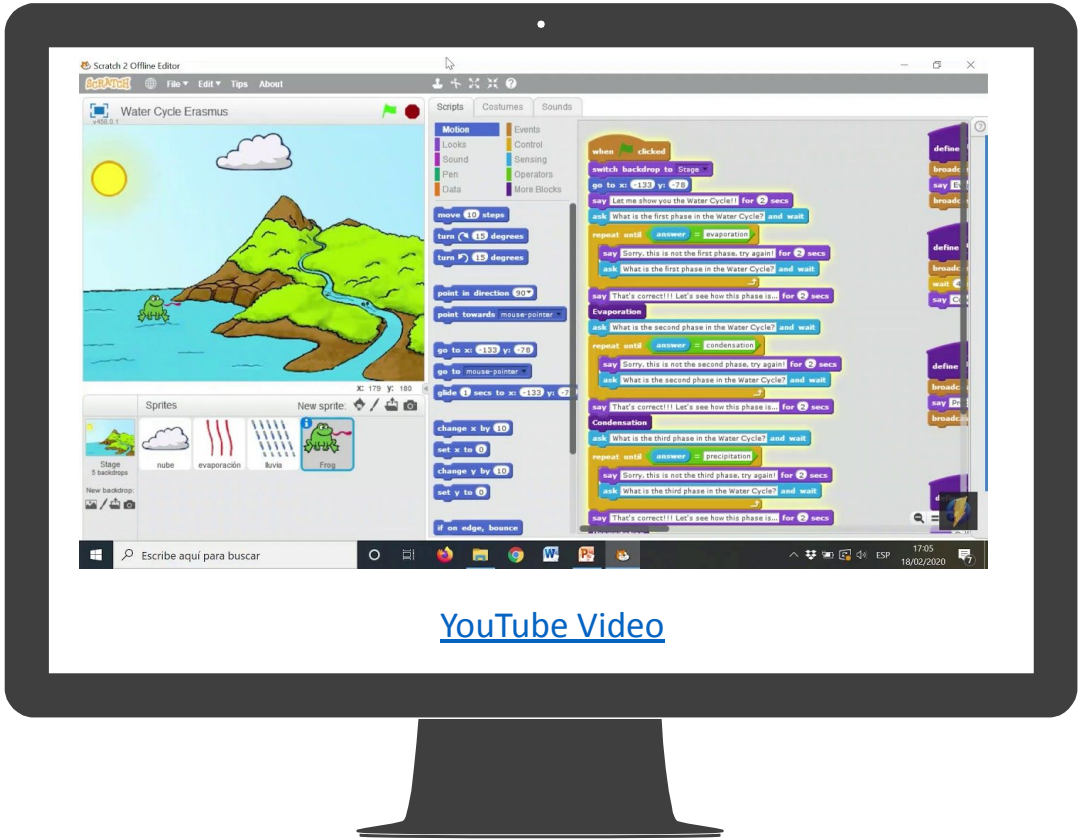
NO

ARE YOU CURRENTLY IN OR HAVE YOU BEEN IN

Scratch

Students will use Scratch to code:

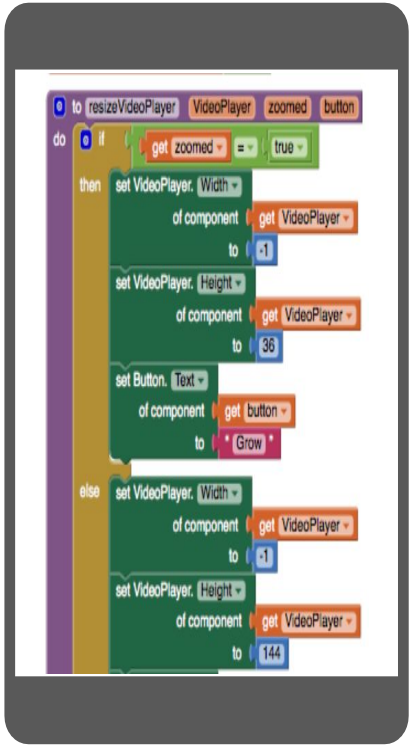
- Rock Cycle
- Animal Ecosystems
- Story retellings or new endings
- Content can be expressed through an interactive illustration, game or story.



YouTube Video

App Inventor

Video Tutorials



App Content Ideas:

- Build an App that solves a problem for your community
- Healthcare
- Tourist needs
- Quiz Game
- Vocabulary Practice
- Math Practice

Create a storyboard for an App