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Rock, Paper, Scissors, Code! Laying a Foundation for Writing Algorithms (Resource Exchange)

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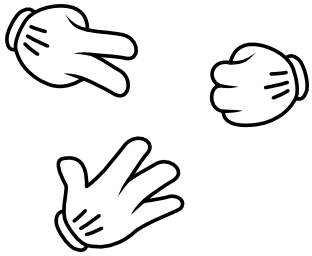
Rock, Paper, Scissors, Code!

LAYING A FOUNDATION FOR WRITING ALGORITHMS

ASEE 2023
PCEE DIV
RESOURCE
EXCHANGE



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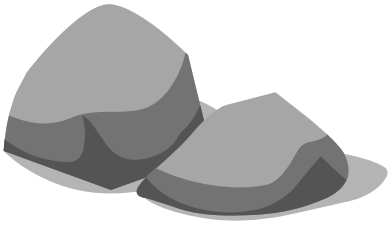
LESSON DESCRIPTION

With the recent incorporation of Computer Science into the K-12 space, students need concrete experiences with basic CS concepts prior to dealing with the abstraction they must face with coding. This ~50 minute decontextualized introductory coding activity will challenge students' critical thinking, communication, and collaboration skills while developing a robust understanding of the foundations of algorithms (sequence, selection, and repetition). Students will develop instructions for playing the game Rock, Paper, Scissors, with components of their instructions diagnosed during small group discussions to explicitly connect ideas to CS concepts. This low stakes, low resource activity is structured using the Learning Cycle aligns with the Next Generation Science Standards (NGSS). Additionally, students will understand the importance of understanding basic logic concepts for all STEM fields beyond CS through explicit connections to real-world applciations.

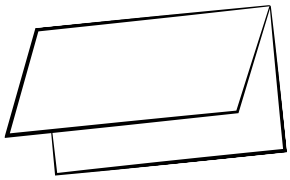
EST. TIME

- ~60 Minutes



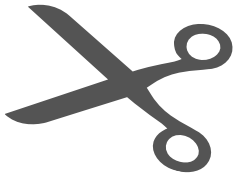
GRADE LEVEL

- Middle School
- High School
- College Freshman



MATERIALS

- Butcher Paper/Large Stickies
- Markers
- Whiteboard & Whiteboard Markers
- Engineering Notebooks



CSTA/NGSS STANDARDS ALIGNMENT

- Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. (3A-AP-16; CSTA)
- Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests. (3A-AP-13; CSTA)
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. (HS-ETS1-2; NGSS)
- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1; NGSS)
- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

LESSON STRUCTURE & SAMPLE QUESTIONS/RESPONSES

1 First, students individually develop written instructions for how to play "Rock, Paper, Scissors." Next, students swap instructions with a partner and attempt to play the game exactly as written. Inevitably, students will have issues with instructions!

What about your first set of instructions made the game not playable?

Not clear; not repeatable; not detailed enough to play; different experiences with playing the game are getting in the way

algorithm: step-by-step instructions; unambiguous, clear, precise, doable

What questions should we answer about changing the instructions in order to make it so anyone could play the game properly?

What does a "round" consist of?
How many rounds do you play?
How do we determine when to "go"?
How do we determine the winner of a round?

2 Students will work together to develop improved game instructions. After editing, groups will swap instructions (to showcase a variety of ideas and creativity). Through group discussion, we will look at similarities in instruction structures across groups to help students develop conceptual understanding of sequencing, selection, and repetition.

What is similar across each of the groups' instructions?

There is a start, a section of gameplay, and how to end

sequence: application of the steps of the algorithm in order

Each has a part explaining what happens if someone shows rock or scissors or paper

selection: True/False condition to decide which part of the algorithm to use

Repeating certain steps until someone wins

repetition: Repeat a part of the algorithm until a condition is met

3 Finally, students will apply their understanding of the foundations of algorithms by developing algorithms for a well-known game of their choosing. Students should go through multiple iterations of their instructions to ensure they are clear and repeatable.

Other concepts that can be developed through this activity with intentional questioning:
Iterations; loops; subroutines; pseudocode; how engineers use creativity; how engineers collaborate and communicate

ASSESSMENT

Individual assessment can be done at Step 3, with each student producing an instruction set for their own game. Students should identify the parts of their instructions that connect with concepts learned (e.g., selection, repetition). This can also be done as a group.

Questioning strategies and adequate wait time can be used throughout the lesson to determine students' prior conceptions about the concepts and scaffold students to the ideas.

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