4.AP.2 Algorithms and Programming

> *The student will plan and implement algorithms that consist of sequencing, loops, variables, user input, and conditional control structures using a block-based programming language. (a) Identify user input and its role in improving a program. (b) Describe the concept of a variable. (c) Read and explain a design document to trace and predict an algorithm using plain language, pseudocode, or diagrams. (d) Create a design document to plan an algorithm using plain language, pseudocode, or diagrams. (e) Write programs that initialize, assign values to, name, and modify variables.*

Understanding the Standard

Programs are collections of code organized in algorithms that can accomplish a variety of tasks (ie. perform calculations, manipulate data, or express creativity). Students will build up on their application of sequencing, events, and loops by incorporating conditional control structures with variables into their programs. Conditionals (if-statements) are added to a program to determine whether or not to run a command, thus impacting the flow of control. One way that variables can be used in programs is to perform numeric calculations. For example, when using the self checkout line at a grocery store, as you scan each item, the price is stored as a variable within the program. When you click checkout the computer adds up the items and provides you with a total as an output. Students will use block or text based programming to construct a program that performs number calculations on variables. Flowcharts and decision trees are effective planning tools for these types of programs.

Term	Definition
Loop	A set of actions repeated until a condition is met
Event	Something that causes a portion of a program to run (e.g., a mouse click)
Conditional (if-statement)	A set of actions that only runs if a condition is met.
Variable	A named unit of data that is assigned a value. If the value is modified, the name does not change, allowing a program to store and modify data.

Prerequisite Knowledge

Students should have a foundational knowledge of following step-by-step instructions and some experience with writing step-by-step instructions incorporating loops (or repeating steps), events, and conditional structures.

Integration Opportunities

History VS d,e,g,i Plan and execute plugged and unplugged algorithms to show understanding of historical concepts and skills.

Science 4.2b Create a design document with a diagram identifying the steps of photosynthesis.

Music 4.1b Create an algorithm of short melodic and rhythmic phrases.

English 4.RV.1 c,e Have students create a design document to plan an algorithm that determines the meaning of complex words using knowledge of root words, inflectional endings, and morphology.

Math 4.CE.4 Design a decimal diner program to calculate the total cost of a customer's meal by performing addition or subtraction with decimals based on menu item prices and quantities and display the final result.

Summary of a Lesson

As a class, discuss the term variable. Ask students how variables are used in math in comparison to how variables are used in computer science. Students will work in pairs to explore the variable expression template via Scratch (https://scratch.mit.edu/projects/783311652). Students will then remix the project to create their own variable expression.