Unit 1: Fundamentals of Programming

Content Area: **Technology**
Course(s):   **Computer Programming C++ I & II**
Time Period: **8 weeks**
Length: **Weeks**
Status: **Published**

Unit Overview

In this unit students will learn classroom expectations and safety rules, become familiar with the history of computers and the C++ write-compile-link-run-debug cycle, and learn the fundamentals of writing C++ programs. The fundamental concepts introduced include use of variables, the mathematical, logical and relational operators, boolean expressions, and the concept of an algorithm. Special emphasis will be given to students comprehending written code and their ability to write simple code from given requirements or specification.

Transfer

Students will be able to independently use the content in this unit to read and write simple C++ programs involving variables, console input/output, and logical expressions. Additionally, students will be able to explain the history of computing, the parts of a computer, and have a basic understanding of the internal operation of a computer. Students should be able to use their skills learned to write a program that performs a useful function (e.g., a simple calculator).

Meaning

Understandings

Students will understand...

-the specific rules and expectations surrounding the use of computers

-health and safety issues related to the use of computers

-that computers operate on data expressed internally as bits, which are used to represent numbers via the binary number system

-computers execute a program expressed in machine language, which are primitive operations like add, subtract, and store, expressed in binary

-C++ is a high-level language; programmers write source code, which is then compiled and linked to produce an executable program

-the importance of comments and quality documentation of programs

-how to use variables and mathematical and relational operators in programs

-what a data type is, and what primitive data types are available in the C++ language

-that logical conditions can be encoded in C++ code using logical operators

-what the preprocessor is and its use in C++ programs

Essential Questions

Students will keep considering...

-how does a computer, which operates only with electrical signals that are 1 (on) or 0 (off), represent familiar concepts such as numbers, letters and strings?

-what are the fundamental operations that any computer does when it executes a program?

-wow can I use knowledge of these fundamental operations to build more complex operations?

-how can I determine what a given excerpt of code does?

-what happens when I compile source code into an executable?

-how can I take an idea of what I want the computer to do and turn it into a program?

Application of Knowledge and Skill

Students will know...

Students will know...

-all the specific rules involving classroom routines, expecations, and computer health and safety

-the basic parts of a computer, including the CPU, main memory, peripherals, etc..., and be aware of the distinction between hardware and software

-that computers represent data in binary, a base-2 number system using only 1 and 0

-computer memory is organized such that each byte of memory has an address that the computer uses to operate on the data (the bits) at that address

-the generations of computer technology since the introduction of the first digital computers

-computers operate on machine language, and high-level languages like C++ need to be compiled to machine language before they can be run

-what constitutes a valid identifier in C++

-how to express fundamental mathematical operations in C++, including arithmetic

-the meaning and use of the modulus operator, as well as the increment, decrement, and compound assignment operators

-the order of operations of common operators in C++

-the importance of comments and quality documentation of a program

-what the preprocessor does and the meaning of #include directives

-what a data type is and the meaning of the data types int, float, char, bool, and std::string

-what an alogithm is

Students will be skilled at...

Skills that students will master include...

-opening the IDE, creating a new project and source file, and compiling, linking and running simple programs

-including proper documentation and comments in a C++ source file

-declaring, initializing, and accessing variables, and assigning values to variables

-printing out text and variables to a console using cout and reading data in from the keyboard using cin

-determining the value of a given logical expression involving constants, variables, and relational, mathematical and logical operators

-predicting the output of a given simple C++ program

-writing a boolean expression from a given description

-translating simple algorithms into C++ code

Academic Vocabulary

binary, bit, byte, machine language, assembly language, high-level language, compile, link, variable, declare, initialize, data type, algorithm, compound assignment operator, modulus operator, boolean expression, logical operator, mathematical operator, relational operator, string, preprocessor, hardware, software, CPU, main memory, RAM, IDE, compiler

Learning Goal 1

Students will know essential classroom rules and fundamental concepts necessary for programming a computer, and identify

potential problems encountered in the programming process

Target 1

Students will know and follow all classroom expectations and safety rules, and identify the problems and issues these rules are designed to address

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CRP.K-12.CRP3.1	Career-ready individuals understand the relationship between personal health, workplace performance and personal well-being; they act on that understanding to regularly practice healthy diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial well-being, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.
TECH.8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).

Target 2

Students will know the history of computers, be able to describe the various generations of computers, and compare and contrast the different innovations that led to the progression of technology

Additional standards:

9.3.IT.12

TECH.8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
TECH.8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).

Target 3

Students will be able to describe in abstract terms the internals of a computer (CPU, main memory), the relevant peripherals and

hardware components, and differentiate the functions of hardware and software

TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.2	Analyze the relationships between internal and external computer components.
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Target 4

Students will be able to explain the binary number system and the terms bit, byte, and machine word, as well as describe how a compiler translates source code into binary data called machine language that a CPU can execute

TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Learning Goal 2

Students will be able to read and understand, as well as write, simple C++ programs using variables, operators, input/output, and Boolean expressions, as well as identify common errors involving braces, indentation and semicolons

Target 1

Students will be able to write, compile, and run a simple C++ program that uses console input and output, as well as describe the relationships between various parts of the program (preprocessor directives, 'using' directives, main function)

TECH.8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Target 2

Students will be able to use variables in programs, including declaring, initializing, assigning and accessing variables, print out the value of variables to the console, and identify common errors that can arise

TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).

TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Target 3

Students will be able to describe what a data type is and compare and contrast the essential fundamental data types int, float, char, and bool as well as std::string.

TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Target 4

Students will be able to analyze and construct mathematical and logical/Boolean expressions, and predict their values using mathematical, logical and relational operators.

TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Learning Goal 3

Students will communicate their ideas effectively, follow established ethical practices in their creation of programs, and compare & contrast different types of software licenses.

Target 1

Students will understand and be able to correctly apply the concepts of copyright, fair use, intellectual property, and compare and contrast public domain, Creative Commons and Open Source licensing of software.

Additional Standards:

9.3.IT.4

TECH.8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
TECH.8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
TECH.8.2.12.C.1	Explain how open source technologies follow the design process.

Target 2

Students will write programs individually and collaboratively that communicate their intentions clearly to the reader using descriptive variable names and effective and informative comments in their code, as well as identify what software reliability problems can be prevented or mitigated using clear communication.

TECH.8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.

Summative Assessment

Chapter and Benchmark Assessments as well as Project-Based Assessments, examples of which may include:

-calculator project

-math games project

-typing speed game

21st Century Life and Careers

CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.

Formative Assessment and Performance Opportunities

Quizzes, individual and group project presentations, portfolio assessments, in-class observation, demonstration and questioning

Accommodations/Modifications

Resources for differentiation and enrichment include:

-supplemental project guides and one-on-one assistance

-expansion of existing projects to meet the needs of students ready for a greater challenge, e.g. adding more challenges in the typing speed game or writing a mathematical expression parser for the math practice game

Unit Resources

Project guides for the calculator, math game, and typing speed game projects; Powerpoint presentations, individual handouts and packets, Youtube videos on relevant topics

Interdisciplinary Connections

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.6	Attend to precision.
MA.K-12.8	Look for and express regularity in repeated reasoning.
LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
MA.S-IC.B.6	Evaluate reports based on data.
MA.S-MD.B.5b	Evaluate and compare strategies on the basis of expected values.