

**PARSIPPANY-TROY HILLS TOWNSHIP PUBLIC SCHOOL DISTRICT**  
**MTH522 COMPUTER SCIENCE AND PROGRAMMING CONCEPTS WITH**  
**PYTHON - HIGH SCHOOL**

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## I. OVERVIEW

The Introduction to Computing with Python course is based on the CodeHS Introduction to Computer Science in Python course with additional sections on Cyber Security, Hardware, History, Binary and the IDLE IDE. The CodeHS Introduction to Computer Science in Python course teaches the fundamentals of computer programming as well as some advanced features of the Python language. Students will develop an appreciation for how computers store and manipulate information by building simple console-based games. Other topics that will be included in this course include, the Binary Number System, introduction to cybersecurity, cryptography, hardware and the internet.

This course is a year long Computer Science elective in the Mathematics department. Introduction to Computing with Python is open to all students and is an introductory course. It is designed for students who are curious about computer science and would like to learn Python and how to learn the Python language to write programs and games.

## II. RATIONALE

Introduction to Computing with Python will be offered to a wide range of students who have an interest in learning about Computer Science. Each individual will have the opportunity to problem solve in ways most students have not experienced before. This course provides strong interdisciplinary connections to areas of mathematics, science, engineering, and technology. Students will consistently be afforded the opportunity to make real-world connections to technologies being used by them and around them everyday.

The Introduction to Computing with Python curriculum is aligned with the New Jersey Student Learning Standards for Science, 21<sup>st</sup>-Century Life and Careers, and the New Jersey Student Learning Standards for Technology.

## III. STUDENT OUTCOMES ([Link to New Jersey Student Learning Standards](#))

In accordance with district policy as mandated by the New Jersey Administrative Code and the New Jersey Student Learning Standards, the following are proficiencies required for the successful completion of Introduction to Computing with Python.

### **The student will:**

1. Learn the basics of programming by drawing shapes on their screens with Turtle Graphics.
2. Write programs that afford user interaction with the keyboard.
3. Write programs that make decisions based on the information received.
4. Decompose their programs into smaller pieces that work together to solve a problem, thereby reducing the complexity of the program and utilizing code reuse.
5. Use more sophisticated strategies for manipulating text in their programs - slicing,

concatenating, and formatting.

6. Build more complex programs that make use of lists, grids, and dictionaries.
7. Use the skills learned to build the game Hangman within CodeHS.
8. Use the skills learned to create other games like Hangman using PyGame (an extension on IDLE).
9. Change numbers from decimal to binary and binary to decimal.
10. Utilize a modification to Minecraft to create blocks of different types and input these into their “world.”
11. Encrypt and decrypt a message using Caesar cypher.
12. Discuss the need and utilization of cyber security.
13. Discuss current events regarding technology and computer science.

Link to NEW JERSEY STUDENT LEARNING STANDARDS

- [3 - English Language Arts](#)
- [4 - Mathematics](#)
- [5 - Science](#)
- [8 - Technology](#)
- [9 - 21st Century Life and Careers](#)

Modifications/Differentiation and Adaptations:

For guidelines on how to modify and adapt curricula to best meet the needs of all students, instructional staff should refer to the [Curriculum Modifications and Adaptations](#) included as an Appendix in this curriculum. Instructional staff of students with Individualized Education Plans (IEPs) must adhere to the recommended modifications outlined in each individual plan.

#### IV. ESSENTIAL QUESTIONS AND CONTENT

Overarching Essential Questions:

- a) What is algorithmic thinking?
- b) What is a program, and how do we run it?
- c) How do computers impact our daily lives?
- d) Where have computers come from, and where are they going?
- e) What are the differences between IDLE IDE and Code HS IDE?
- f) What is a loop, and how does it impact the overall flow of a program?
- g) How can we document our programs so they are usable by multiple people?
- h) How can we write codes so our programs can make decisions?
- i) What are functions, and how do we utilize them to maximize our code?
- j) What is a string, and how do we utilize them in Python?
- k) How does cyber security affect our lives?
- l) What data structures are used in Python?
- m) How do we utilize lists in our programs?

- n) How do we build a game in Python?
- o) How do we develop a program incrementally?
- p) What is iterative development and how can it affect the overall programming process?

## **Content:**

### **Computational Thinking**

- What is an algorithm?
- How do we use algorithms in our everyday life?
- How do you analyze algorithms and make them more efficient and effective?

### **Tracy the Turtle**

- How do you use basic controls in Python?
- How do we program graphics (in Code HS)?
- How can we make our programs more efficient?

### **Hardware, History, and Binary**

- How do computers store information?
- What are some of the innovations that brought us to where we are today?
- How do we change a decimal number into the binary number system and a number in the binary system to a decimal?

### **Basic Python and Console Interaction**

- How do we print using python?
- What is debugging and why is it important?
- How do we convert input as a string into useable data?

### **IDLE Application**

- How can we translate the code from Code HS to IDLE?

### **Control Flow**

- What is DeMorgan's Law?
- How can we analyze computer exceptions and fix our code?
- What is a short circuit evaluation?
- How are Boolean variables used in Python?
- How do we nest control structures?

### **Strings**

- What are indexing and slicing of strings?
- How can we complete math operations on strings?
- What methods can we use with strings?

### **Cyber Security and Cryptography**

- What types of encryption are used in the real world?
- How can you encrypt/decrypt a secret message?
- What is happening with cyber security today?

### Data Structures

- How can we use tuples and lists in our programs?
- What is the difference between immutable and mutable?
- Why do we need to pack and unpack?
- How do we create and manipulate a 2-Dimensional list?

### Hangman

- How do you combine a variety of topics (strings, loops, Booleans, user input, etc.) in a single program?
- How do you debug a larger project?
- What should your testing plan be for a full program?

### Classes and Inheritance

- What is the difference between a class variable and an instance variable?
- How can we use composition, inheritance, and polymorphism in our program?
- Why would we use private attributes?

## V. STRATEGIES

- Student projects
- Group discussion
- Individual conferencing

## VI. EVALUATION

- **Programs: 30%**
- Class Participation and Homework: 10%
- Assessments and Projects: 60% Projects consist of research and presentations.

## VII. REQUIRED RESOURCES

- **Hardware**
  - Computer (in class) or possibly Chromebook
- **Software**
  - CodeHS website and class log in
  - IDLE IDE (downloaded onto computer).
- **WEBSITES**
  - <https://codehs.com/>
  - <https://www.python.org/downloads/>
  - <https://www.xarg.org/tools/caesar-cipher/>
  - <https://www.khanacademy.org/>
  - <https://www.dhs.gov/topic/cybersecurity>

## VIII. SCOPE AND SEQUENCE

### 1. Computational Thinking/Digital Citizenship: (About 4 days)

**Standards Covered:** 8.2.12.C.1, 8.2.12.D.1, 8.2.12.E.4, 9.3.IT.2, 9.3.IT.4, 9.3.ST.6, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.1.12.D.2, 8.2.12.B.3, 8.2.12.E.1

Suggested Activities:

- a. Discuss what algorithms are, and how we use them every day.
- b. Students find algorithms in their everyday life and share these verbally and in writing.
- c. Students write their own algorithms and have a peer follow them.
- d. Give students an incorrect algorithm and have them make corrections.
- e. Discuss “digital citizenship,” what it is and what it means.
- f. Have a media specialist present copyright laws, issues, violations, etc.

### 2. Tracy the Turtle: (3 weeks)

**Standards Covered:** 9.3.IT-PRG.3, 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Commands
- Colors
- Loops
- Functions

Suggested Activities from <https://codehs.com/>:

- a. Draw simple shapes with different colors
- b. Reduce redundancy in your program using loops and functions

### 3. Hardware, History, and Binary (2 weeks)

**Standards Covered:** 9.3.IT.12, 9.3.IT.6, 9.3.ST-ET.5, 9.3.ST-SM.1, 9.3.ST-SM.3, 8.1.12.D.5, 8.1.12.F.1, 8.2.12.B.1, 8.2.12.B.4, 8.2.12.E.1, 8.2.12.E.2, 8.2.12.E.4

Suggested Activities:

- a. Watch video on history of computing and discuss.
- b. Investigate the inner mechanisms and component parts of a computer.
- c. Convert decimal numbers to binary and binary numbers to decimal.
- d. Research an emerging technology and present to class.

### 4. Basic Python & Console (3 weeks)

**Standards Covered:** 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Printing
- Debugging
- Variables
- Types
- Arithmetic expressions
- User input
- Converting input from a string

Suggested Activities on <https://codehs.com/>:

- a. Printing
  - i. Print messages to the console
- b. Variables
  - i. Create variables of different types, and print them to the console.
- c. Types
  - i. Investigate the types of different variables
  - ii. Convert between types
- d. Input/output, arithmetic expressions
  - i. Age in one year - ask the user how old they are, and tell them how old they will be in one year
  - ii. Rectangle, part 1 - make variables for length and width and compute area and perimeter
  - iii. Rectangle, part 2 - ask the user for length and width and compute area and perimeter
  - iv. Quadratic formula - ask the user for the coefficients of a quadratic equation, and compute the solutions

**5. IDLE (1 week)**

**Standards Covered:** 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.C.1, 8.2.12.E.3, 8.2.12.E.4

Suggested Activities:

- a. Describe the differences between the Code HS IDE and IDLE IDE
- b. Use IDLE to create programs such as
  - i. perimeter
  - ii. area of shapes
  - iii. math conversions
  - iv. temperature conversion

**6. Control Flow (10 weeks)**

**Standards Covered:** 9.3.IT-PRG.1, 9.3.IT-PRG.3, 9.3.IT-PRG.5, 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Comments
- If statements
- Boolean values
- Logical operators
- Comparison operators
- Truth tables
- De Morgan's Laws
- Short-circuit evaluation
- Floating point numbers and "equality"
- While loops
- For loops
- Nested control structures
- Functions
- Exceptions

Suggested Activities from <https://codehs.com/>:

- a. If statements and Boolean values
  - i. Is it raining? - Write a program that uses a Boolean variable to determine whether or not it is raining
- b. Boolean operators, and expressions
  - i. Boolean variable - take a variable and use it in an if statement
  - ii. Old Enough to Vote? - user reports age and program tells them whether or not they can vote in the US
  - iii. Transaction - user reports balance and deposit/withdrawal, and program prints new balance or error
  - iv. Recipe - ask the user for ingredients, amounts per serving, and number of servings, and report the total amount of each ingredient needed
- c. Loops
  - i. Average test score - compute the average of several test scores
  - ii. Divisibility - ask the user to enter a numerator and denominator, and re-prompt

**7. Strings (3 weeks)**

**Standards Covered:** 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Indexing and slicing
- Math operators on strings
- For loops over a string
- String methods

Suggested Activities from <https://codehs.com/>:

- a. Indexing
  - i. Full name - write a function that takes two strings (a first name and a last name) and returns a full name as a single string
  - ii. Replace a letter - write a function that takes a string and returns a copy with the character at a particular index replaced with a dash
- b. Math operators and strings
  - i. First character - write a function that takes a string and returns the first character
  - ii. All but the first character - write a function that takes a string and returns everything but the first character
- c. For loops on strings
  - i. Count occurrences - write a function that takes two strings and returns the number of times the second string appears in the first string

**8. Cyber Security & Cryptography (2 weeks)**

**Standards Covered:** 9.3.IT.10, 9.3.IT.8, 9.3.ST.6, 9.3.ST-ET.2, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.1.12.D.2, 8.1.12.E.2, 8.2.12.B.3, 8.2.12.E.4

Suggested Activities:

- a. Investigate and understand what cyber security is and how it is used today.
- b. Encrypt and decrypt a message using Caesar's cypher.
- c. Perform a lock box activity to show another form of cyber security.

d. Research and present a form/use of cyber security - pairs or small groups.

## 9. Data Structures (6 weeks)

**Standards Covered:** 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Tuples
- Lists
- Dictionaries
- 2D lists
- List comprehensions
- Packing and unpacking
- Mutable vs. immutable
- Equivalence vs. identity

Suggested Activities from <https://codehs.com/>:

- a. Tuples
  - i. Point distance - represent two points as tuples, and make a function to compute the distance between them
- b. Lists
  - i. Max in List- find the maximum value in a list
  - ii. Slopes - ask for ten coordinate pairs, store the pairs as a list of tuples, and report the slope between each adjacent pair
- c. Dictionaries
  - i. Phone book - user repeatedly enters name, and program either asks for the person's phone number or reports the phone number already provided
- d. 2D lists
  - i. Checkerboard - write a program that prints the initial setup of a checkerboard, with a 1 where a piece would be and a 0 where a blank square would be

## 10. Hangman(3 weeks)

**Standards Covered:** 8.1.12.B.2, 9.3.IT.9, 9.3.IT-PRG.1, 9.3.IT-PRG.4, 9.3.IT-PRG.5, 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Allow students to combine a variety of topics (strings, loops, Booleans, user input, etc.) in a single program
- Introduce students to incremental development
- Strengthen debugging skills by having students develop a larger project
- Testing

Suggested Activities from <https://codehs.com/>:

- a. Part 1 - store a secret word in a variable, ask the user for a guess, and report whether or not it is correct
- b. Part 2 - refine fetching guesses to check for invalid guesses and repeatedly ask until guess is valid
- c. Part 3 - allow the user to guess ten times, and print a combination of dashes and correct guesses before each guess
- d. Part 4 - only penalize the user for incorrect guesses

## 11. Classes (1 weeks)

**Standards Covered:** 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- Classes
- Attributes
- Class variables vs. instance variables
- Methods
- Built-in methods
- Composition, inheritance, and polymorphism
- Private attributes

Suggested Activities from <https://codehs.com/>:

- a. Rectangle class
  - i. Create a program capable of computing area and perimeter of a rectangle
- b. Inheritance
  - i. Examine a program that has a Food class, a Vegetable class that inherits from Food, and a Broccoli class that inherits from Vegetable
  - ii. Predict what happens when instance and class variables are accessed in different ways

## 12. Final Exam (3 weeks)

**Standards Covered:** 8.1.12.B.2, 9.3.IT-PRG.4, 9.3.IT-PRG.5, 9.3.IT-PRG.6, 9.3.IT-PRG.7, 9.3.ST.2, 9.3.ST.6, 9.3.ST-ET.1, 9.3.ST-ET.3, 9.3.ST-SM.2, 9.3.ST-ET.2, 9.3.ST-ET.4, 9.3.ST-ET.5, 9.3.ST-SM.1, 8.2.12.E.3, 8.2.12.E.4

Learn about the topics:

- File reading
- Allow students to combine a variety of topics in a single program
- Re-emphasize incremental development
- Strengthen debugging skills by having students develop a larger project
- Testing

Suggested Activities from <https://codehs.com/>:

- a. Part 1 - Make a dictionary of word counts for a shortened version of Pride and Prejudice and Hamlet.
- b. Part 2 - Test your code from Part 1 on the full text of Pride and Prejudice and Hamlet.
- c. Part 3 - Use your dictionary of word counts to predict whether a small text sample was written by Jane Austen or William Shakespeare. Test this prediction program on shortened versions of the text.
- d. Part 4 - Test your code from Part 3 on the full text.

