# Unit 1 : Introduction to  Python - Computer Science

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**Introduction to Python -Computer Science**

## Department of Curriculum and Instruction

**Belleville Public Schools**

**Curriculum Guide**

# Introduction to Python

## Unit 1 - Computer Science Concepts

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## Unit Overview

This unit is designed to be an introduction to basic programming concepts, such as algorithms, syntax, loops, and variables.

Students will be introduced to vocabulary and key terms in a fun learning environment.

## Key Terms

**Algorithm** - a step-by-step set of instructions for completing a task. When algorithms are written using code, computers can follow them.

**Basic Syntax** - the rules for correct spelling, grammar, and punctuation in a programming language. The syntax must be exactly right for code to execute properly. The syntax is language-specific; for example, while Python and JavaScript are used to do similar things in Course 1, the syntax for them is noticeably different.

**Object** - a character or thing that can perform actions.

**Property** - data about or belonging to an object.

**Method** - an action performed by an object.

**Argument** - extra information passed into a method to modify what the method does. In both Python and JavaScript, arguments are represented by code that is inside the parentheses after a method. For example, in the method `hero.moveLeft(3)`, the argument _3_ is a number that tells how many spaces the hero should move. In the method `hero.Attack("Brak")`, the argument *"Brak"* is a string that tells the name of the character that should be attacked.

**String** - a type of data that represents text. In both Python and JavaScript, strings are represented by text inside quotes. In Course 1, strings are used to identify objects for the hero to attack.

**Loop** - a programming structure used to repeat actions without the player needing to write the same lines of code over and over. In Python, the code that loops must be indented. In JavaScript, the code that loops must be enclosed by curly brackets {}. There are different kinds of loops:

- **For Loops** repeat a block of code a certain number of times.
- **While Loops** repeat a block of code while a certain condition is true, such as `while gems < 4`. In Course 1, a type of while loop called a **while True loop** is used to repeat a block of code infinitely until the level is complete.

**Variable** - a symbol that represents data. The value of a variable can be modified over the course of the program. In Course 1, variables are used to name enemies, then passed along as arguments to the attack method so that the hero can attack the correct enemy.

## Enduring Understanding

Students find that sequencing is critical to coding because when a computer runs a program, it executes every command in the order it is given, from start to finish. Students are also introduced to commenting code, a common practice used by programmers to document and communicate about their work.

## Essential Questions

**Why are sequence and syntax important?**

Sample Response:

> Computers only do exactly what you tell them, so the sequence is important because if the computer does the steps in the wrong order, the program doesn't turn out right. If there is an error in the syntax, the computer doesn't know how to read it at all.

**How is the way a computer reads instructions different from the way a human would understand them?**

Sample Response:

> Humans can use their own knowledge and other clues to figure things out if they don't make sense. Computers can only execute exactly what they are told

**What's the difference between an object and a method?**

## Exit Skills

Lessons within this unit include

Basic Syntax

Loops

Variables

Captone Challenge

Our exit skills will include: Sequencing, syntax, strings, comments, arguments, Repeat code sequences using while-true loops, Save and access data using variables/

## New Jersey Student Learning Standards (NJSLS)

**Standards**

- **CSTA: 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem.
- **CCSS-Math: MP.1** Make sense of problems and persevere in solving them.
- **CCSS-Math: MP.6** Attend to precision.

| | |
|---|---|
| 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.CS1 | Computational thinking and computer programming as tools used in design and engineering. |

## Interdisciplinary Connections

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| LA.RH.6-8.5 | Describe how a text presents information (e.g., sequentially, comparatively, causally). |
| LA.RH.6-8.7 | Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts. |

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| SCI.HS-ETS1-2 | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| SCI.HS-ETS1-4 | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.<br><br>Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (). |

## Learning Objectives

### Learning Objectives

- Use correct syntax when writing code.
- Use proper sequencing when writing code.
- Use arguments to input information into a method.
- Use strings to input text data.
- Use comments to document code.
- Understand and use basic vocabulary: algorithm, argument, code, method, program, sequence, syntax, string

## Suggested Activities & Best Practices

# Unplugged Activies for CS Concepts

## The Activities

#### Data: Representing Information

- Binary Numbers
- Image Representation
- Text Compression
- Error Detection
- Information Theory
- Sound Representation
- Databases

#### Algorithms: Putting Computers to Work

- Searching Algorithms
- Sorting Algorithms
- Sorting Networks

- Minimal Spanning Trees
- Routing and Deadlock
- Network Protocols
- Phylogenetics
- Divide and Conquer
- Line Drawing

**Procedures: Telling Computers What to Do**

- Finite State Automata
- Programming Languages
- Class Simulation of a Computer
- Programming Languages – Harold the Robot

**Intractability: Really Hard Problems**

- Graph Colouring
- Dominating Sets
- Steiner Trees

**Cryptography: Sharing Secrets**

- Information Hiding
- Cryptographic Protocols
- Public Key Encryption

**The Human Face of Computing: Interacting with Computers**

- Human Interface Design
- The Turing Test
- Artificial Intelligence

**Community Activities**

- Phylogenetics
- Class Simulation of a Computer
- Harold the Robot
- Modems Unplugged
- Divide and Conquer (Santa's Dirty Socks)
- Databases
- Line Drawing
- Scout Patrol (Encryption)

## Assessment Evidence - Checking for Understanding (CFU)

Quizzes

Unit tests-summative assessment

Admit/Exit tickets-formative assessment

Web Based Assesments-alternate assessment

Create a Multimedia poster-benchmark assessment

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite

- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

## Primary Resources & Materials

Code Combat Platform, Code.org Platform, Game Salad Platform

## Ancillary Resources

1. LightBot
2. SpriteBox
3. Hour of Code
4. Code.org
5. Scratch
6. Grasshopper App
7. CS First

## Technology Infusion

You Tube

Khan Academy

Office 365

**Technology Infusion** and/or strategies are integrated into this unit to enhance learning



## Alignment to 21st Century Skills & Technology

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

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| 9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| CAEP.9.2.12.C | Career Preparation |
| CAEP.9.2.12.C.1 | Review career goals and determine steps necessary for attainment. |
| CAEP.9.2.12.C.2 | Modify Personalized Student Learning Plans to support declared career goals. |
| CAEP.9.2.12.C.3 | Identify transferable career skills and design alternate career plans. |
| TECH.8.1.12 | Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. |

## 21st Century Skills/Interdisciplinary Themes

**21st Century/Interdisciplinary Themes** that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving

- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

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| 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.CRP2 | Apply appropriate academic and technical skills. |
| CRP.K-12.CRP2.1 | Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation. |
| CRP.K-12.CRP4 | Communicate clearly and effectively and with reason. |
| CRP.K-12.CRP12 | Work productively in teams while using cultural global competence. |
| CRP.K-12.CRP12.1 | Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings. |

## 21st Century Skills

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

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| TECH.8.1.12.A | Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations. |
| TECH.8.1.12.A.CS2 | Select and use applications effectively and productively. |

## Differentiation

- Exemplars

- Show students how to find the hints, methods reference cards, error messages, and sample code provided within each level.
- Students struggling with a given level will be automatically directed to additional practice levels within the game.

- Meeting with small groups to re-teach an idea or skill for struggling learners, or to extend the thinking or skills of advanced learners.

. Varying the length of time a student may take to complete a task in order to provide additional support for a struggling learner or to encourage an advanced learner to pursue a topic in greater depth.

Using rubrics that match and extend students' varied skills levels

**Differentiations:**

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

**Hi-Prep Differentiations:**

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading

- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

**Lo-Prep Differentiations**

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

## Special Education Learning (IEP's & 504's)

- **Exemplars**
- If students struggle with breaking down problems, you can use the printable Engineering Cycle Worksheet to reinforce a step-by-step problem-solving approach.
- If students struggle to follow correct syntax, provide a copy of the printable Python Syntax Guide or JavaScript Syntax Guide

IEP:

1. Adherence to the students' Individualized Learning Plan.

2. Students will have extra time or fewer assignments, one-to-one assistance, and group work will often be enlisted.

3. Students may use speech-to-text or audio/video record assignments

4. Teacher may adapt learning style to fit the needs of the child.

5. Teacher will use graphic organizer to visually help students plan out their work.

6. The teacher will scaffold the lesson with a slow release from assisted support with guided practice to independent practice.

7. Front-loaded notes to enable students to more accurately follow along with teacher's instruction.

8. Step-by-step directions written out for students.

504:

1. Any necessary accommodations will be made as outlined in students' 504 plan.

2. Preferential seating while teacher is lecturing, explaining, etc.

3. Extended time on projects or assessments.

4. Verbal, visual or technology aids.

5. Use of digital audio-visual materials, such as YouTube, to assist the child with directions.

6. Students will have access to "How To" videos, so they may more easily follow along with directions for their assignments.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions

- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

## English Language Learning (ELL)

Exemplars: English Language Learners: 1. Most of the games have instructions available in other languages, and Google translate will be used as necessary. Students will be allowed to work with partners. 2. Sheltered Instruction Observation Protocol (SIOP) – instructional model that helps teachers plan and deliver lessons that allow English learners the ability to acquire academic knowledge as they develop English language proficiency. 3. Provide leveled texts or translations by using Google Chrome Extension: Snap&Read, which is a reading tool that can cover the most diverse reading needs. It features Read Aloud, Dynamic Text Leveling, Translation, and Study tools, such as pulling text into an outline, then organizing it and adding notes. 4. Teacher creates a culturally responsive classroom. 5. Teacher employs teaching strategies and learning resources that make content comprehensible. 6. Teacher employs Total Physical Response (TPR) – uses a direct action to help students internalize new language

Using videos, illustrations, pictures, and drawings to explain or clarify

**English Language Learning** adaptations that will be employed in the unit, using the ones identified below.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test

- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

## At Risk

Exemplars:

Collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.

Intervention Strategies that will be employed in the unit, using the ones identified below.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

## Talented and Gifted Learning (T&G)

Exemplars:

Gifted and Talented:

1. Students will have the opportunity to publish their writing (reviews/analysis) online, submit their projects to developers, and enter in game design competitions. They may also extend their investigation to some video games, possibly extending their final projects into another format.

2. Teacher can use a pre-assessment to determine students' knowledge of standard being taught in lesson and then provide an extension activity for students

3. Compact lesson

4. Provide students with problem-based learning activity using multiple standards from the unit.

Higher order, critical & creative thinking skills, and discovery

**Talented and Gifted** adaptations that will be employed in the unit, using the ones identified below.

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

## Sample Lesson

# Lesson 1 - Basic Syntax

***(Levels 1-8)***

## Summary

These levels introduce basic concepts and vocabulary, including syntax, strings, and arguments. Students find that sequencing is critical to coding because when a computer runs a program, it executes every command in the order it is given, from start to finish. Students are also introduced to commenting code, a common practice

used by programmers to document and communicate about their work.

The opening classroom activity introduces Python syntax and the importance of order in a sequence of instructions, or algorithm. As the teacher, you will imitate a robot that executes the commands given by the class. By the end of the activity, the class will collaboratively write a program something like this:

```
teacher.pickUpBall()
teacher.turnRight()
teacher.moveForward()
teacher.moveForward()
teacher.turnLeft()
teacher.moveForward()
teacher.dropBall()
```

### Materials

- Desk or table
- Recycling bin
- Balls of paper to recycle
- Optional: Progress Journal
- Optional: Engineering Cycle Worksheet
- Optional: Python Syntax Guide or JavaScript Syntax Guide

### Learning Objectives

- Use correct syntax when writing code.
- Use proper sequencing when writing code.
- Use arguments to input information into a method.
- Use strings to input text data.
- Use comments to document code.
- Understand and use basic vocabulary: algorithm, argument, code, method, program, sequence, syntax, string

### Standards

- **CSTA: 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem.
- **CCSS-Math: MP.1** Make sense of problems and persevere in solving them.
- **CCSS-Math: MP.6** Attend to precision.

## Opening Activity (15 minutes): *Recycling Robot*

### Explain

Explain the following terms to students:

- **Syntax** is how we write code. Just as spelling and grammar are important in writing narratives and essays, syntax is important when writing code. Humans are good at figuring out what something means, even if it isn't exactly correct, but computers aren't that smart, and they need you to write very precisely.
- **Sequence** is the order of the commands in a program. Computers follow commands in exactly the order they are written.
- **Objects** are the building blocks of Python. They are things or characters that can perform actions. In the game, your hero is an object. The actions an object performs are called **methods**. For example, `moveRight()` is a method. Method names are always followed by parentheses.

Write the sample code `hero.moveRight()` on the board, and describe the components:

- This is read aloud as "hero dot move right", where `hero` is the object, and `moveRight` is the method.
- The period, capitalization, and parentheses are essential parts of the syntax that must be exactly right:
    - Period: separates the object from the method
    - Capital letters: used to show the start of a new word when a period or space can't be used (this is called "camel case")
    - Parentheses: create a place where a programmer could add extra details, or **arguments** to a method.

**Interact**

At the front of the class, set some scrunched up paper balls on a flat surface. Place the recycling bin a few steps away. Explain that you are a recycling robot, and the class's job is to program you.

The robot is a Python object. Choose a name for yourself and write it on the board, beginning with a lowercase letter. For example:

```
teacher
```

To make the robot perform an action, students have to call a method. Write a dot after your object name, then have the class decide what the first action should be. After the dot, write the method name using camel case followed by empty parentheses. For example:

```
teacher.pickUpBall()
```

Off to one side, draw a "Run" button and have a volunteer press it. As a robot, execute the program *precisely* as the students have written it.

Invite students to work together to add commands to the program one at a time until you can successfully get a ball into the recycling bin. They can test the program at any time by pressing the "Run" button. Each time they press "Run", you should execute every command from start to finish exactly as written. If there is an error in the syntax, make a funny beeping sound and stop. After each test, reset yourself and have the class revise, or *debug*, the program until it works.

**Discuss**

Use one or more of the following discussion questions to prompt a brief reflection:

**Why are sequence and syntax important?**

Sample Response:

> Computers only do exactly what you tell them, so the sequence is important because if the computer does the steps in the wrong order, the program doesn't turn out right. If there is an error in the syntax, the computer doesn't know how to read it at all.

**How is the way a computer reads instructions different from the way a human would understand them?**

Sample Response:

> Humans can use their own knowledge and other clues to figure things out if they don't make sense. Computers can only execute exactly what they are told.

## Coding Time (30-40 minutes)

Tell students they will be playing Levels 1 - 8 today. Allow students to move through these levels at their own pace. Circulate and assist, calling attention to the Hints button in the top right corner of each level as needed.

*We recommend stopping students after Level 8 and using the next lesson plan to introduce the next concepts before beginning Level 9.*

**Look Out For:**

- Initially, some students may want to type and run one command at a time. Explain to them that the code must contain all the instructions for the program from start to finish, like a story: it has a beginning, a middle, and an end. Every time you click Start, the hero returns to the beginning of the level, and the full program runs again.

## Closure (5 minutes)

Use one or more of the following questions to prompt reflection. You can facilitate a short discussion, or have students submit written responses on Exit Tickets.

**Explain how to play CodeCombat to someone who has never played before. Use as many programming terms as you can.**

Sample Response:

> You have to move to the gem without hitting the spikes by writing a program. I learned that you have to type the object name first, like “hero.” then the method to make them do an action. You have to spell it right and put () at the end. You click RUN to make it go. It runs the whole program every time, and you can fix the code and try again as many times as you need.

**What’s the difference between an object and a method?**

Sample Response:

> The object is the hero, and she has methods that are things she can do. The object has a dot after it, and the method has ().

**How can you tell when you’ve made a mistake in your code? How do you fix it?**

Sample Response:

> Sometimes the code won't run because there is a mistake in it. They put a red ! next to the mistake and try to help you. You have to read the code to figure out what's wrong.

**How do comments work, and what are they for?**

Sample Response:

> Comments are lines you write in the program that the computer doesn't read. If you start a line with the # symbol, the computer doesn't see it. You can write comments to remind yourself how you did something or to leave a note for another human who might want to understand your code.

## Differentiation

**Additional Supports:**

- Show students how to find the hints, methods reference cards, error messages, and sample code provided within each level.
- Students struggling with a given level will be automatically directed to additional practice levels within the game.
- If you would like students to take notes as they work, a printable template is available here: Progress Journal
- If students struggle with breaking down problems, you can use the printable Engineering Cycle Worksheet to reinforce a step-by-step problem-solving approach.
- If students struggle to follow correct syntax, provide a copy of the printable Python Syntax Guide or JavaScript Syntax Guide

**Extension Activities:**

- Have students come up with a backstory for their hero. For example, why are they in the Kithgard Dungeon? What is their quest? What obstacles have they faced along their journey, before reaching the dungeon? Have them produce a written narrative, video, short play, or other creative artifact to share their backstory with others.