

# Unit 2: Introducing the Python Collections (Physical Science, Engineering Design)

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## **Title Section**

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## **Department of Curriculum and Instruction**



**Belleville Public Schools**

**Curriculum Guide**

# PROGRAMMING FOR STEM, GRADES 9-12

## UNIT 2:INTRODUCING THE PYTHON COLLECTIONS

**Belleville Board of Education**

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Board Approved: September 23, 2019

## **Unit Overview**

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- Students will understand Python lists and integrate Physics/Chemistry programming concepts
- Students will use lists as a means of storing data - identify areas of data points - concepts to explore.
- Students will use dictionaries to store associative data
- Students will implement algorithms to compute elementary statistics

## **Enduring Understanding**

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- What is data?
- What are lists?
- What are strings?

Students will understand how to:

- To use lists as a means of storing data
- To use dictionaries to store associative data
- To implement algorithms to compute elementary statistics

## **Essential Questions**

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- What is data?
- What are lists?
- What are strings?

## Exit Skills

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- Data point analysis
- Creating lists
- Using Python to create spreadsheets and analyze data points from experiments conducted in class

## New Jersey Student Learning Standards (NJSL-S)

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### [NextGen Science Standards](#)

9-12.HS-PS1-5.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.2	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
9-12.HS-PS1-7.5	Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
9-12.HS-PS1-6.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.
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.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.

## Interdisciplinary Connections

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- Math

- Physics
- Chemistry

## Learning Objectives

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- Students will be able to design and implement programs using standard design principles and technologies.
- Students will be able to explain and apply the concepts of testing and iteration within computer science.
- Students will be able to explain and apply the concepts of data manipulation within computer science.
- Students will be able to explain and apply the libraries (i.e. String, Math) of a high level programming language.
- Students will be able to explain and apply the concepts of interfacing with external files.
- Students will be able to explain and apply the concepts of manipulating digital images.
- Students will be able to explain the process for designing, developing and manipulating a class and objects in terms of object oriented design.

**Action Verbs:** Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



### **Suggested Activities & Best Practices**

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- Projects based on unit goals.
- Utilize Defined STEM to share concepts.
- Allow students to program their own data and/or share with partner.
- Demonstrate finished products.
- Provide additional support to struggling students.
- On line tutorials when necessary.
- Share all scoring rubrics in advance - allow students to discuss and modify.

## **Assessment Evidence - Checking for Understanding (CFU)**

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- Project - check in at intervals during the process (Alternate)
  - Journaling of progress (Alternate)
  - Exit tickets to share questions and concerns with the instructor (Formative)
  - Common, Department Quarterly Benchmarks (Benchmark)
  - Oncourse Assessment Tools (Formative)
  - Unit Test/Quiz (Summative)
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- 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**

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<https://www.fullstackpython.com/best-python-resources.html>

<https://www.khanacademy.org/science/physics>

## **Ancillary Resources**

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Suggested Resource: Programming in Python Python Programming in Context; Miller & Ranum; Jones & Bartlett Learning; 2014

Defined STEM

## **Technology Infusion**

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# Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts  
 Photostory 3  
 Kid Story Builder  
 Music Maker Jam  
 Paint A Story  
 Office 365  
 MS PowerPoint  
 Stack 'Em Up  
 NqSquared Numbers  
 Physamajig  
 Xylophone 8

Khan Academy  
 National Zoo  
 One Note  
 Twitter  
 Reading Trainer  
 M8  
 Travel  
 Yammer  
 Office 365  
 MS Word

Wikipedia  
 Skydrive  
 Lync  
 SkyMap  
 Skype  
 Office 365  
 Puzzle Touch  
 Easy QR  
 Memorylage  
 Life Moments  
 Word Cloud Maker

Kodu  
 QR Barcode Generator  
 Sketch  
 Fresh Paint  
 Flip Boom Lite  
 Auto Collage  
 Sketchbook Express  
 Windows Movie Maker  
 Time Lapse  
 Memorylage  
 Office 365

Where's Waldo?  
 MS Excel  
 Office 365  
 Flipboard  
 Nova Mindmapping

Ted Talks  
 Record Voice Pen  
 Animal and Bird Sounds  
 Vote Collector  
 Bing Maps



Originally taken from <http://www.coetell.com/vzimmer/files/2013/02/IPPedagogy-Wheel.001.jpg>  
 And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

## Alignment to 21st Century Skills & Technology



- 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.

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.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.

## **21st Century Skills/Interdisciplinary Themes**

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- 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

## **21st Century Skills**

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- Civic Literacy
- Environmental Literacy
- Global Awareness
- Health Literacy

## Differentiation

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- Small group assignments to practice coding
- Use manipulatives to practice physics
- Orally present concepts to check for understanding
- Use tech centers to break assignments into parts

### 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)**

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- Allow students to re-do assignments to full credit
  - Provide study guides and step-by-step printed instructions
  - Utilize a behavior management plan to assist with self-monitoring
  - Check each step of the project prior to moving forward to the next step
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- 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
- multiple test sessions
- multi-sensory presentation
- 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)**

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- Pair with native language speaker
  - Allow additional time to complete work
  - Modify assignments based on language abilities and scaffold presentation
  - Allow students to use Google translate
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- teaching key aspects of a topic. Eliminate nonessential information
  - using videos, illustrations, pictures, and drawings to explain or clarify
  - 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 work presented 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**

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- Peer tutoring and choice grouping

- Allow choices for assignments
- 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 work presented 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)**

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- Allow students to work at their own pace.
- Provide additional projects.
- Student can create new ways to execute assignments.
- 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**

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See sample in Unit 1