Unit 1: Computational Thinking

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AP Computer Science, Computational Thinking

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Computer Science Principles

Computational Thinking

Belleville Board of Education

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Board Approved:

Unit Overview

Introduction to computational thinking, logical reasoning, and describing processes through algorithms and pseudocode.

Upon completion of this unit students will be able to: Identify and use a graphical blocks-based programming language (Scratch) to implement algorithms. Identify Google sites portfolio as an example of cloud computing. Create a Google sites portfolio that they will use during the course to post their work. Clearly communicate with a global audience about personal ideas. Understand how humans and computers interact through different languages. Identify and use the App Inventor program to create a very basic application.

Enduring Understanding

- Creativity and computing are prominent forces in innovation.

- Abstraction is a central problem-solving technique.
- Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages.
- Cybersecurity is an important concern for the Internet and the systems built on it.

Essential Questions

- What kinds of problems are easy, difficult, or impossible to solve algorithmically?
- How are algorithms created and evaluated?
- How are programs used for creative expression, to satisfy personal curiosity, or to create new knowledge?

Exit Skills

Algorithmic Thinking:

- Examine strategies for approaching large-scale problems and the applications of employing a top-down approach as well as a bottom-up approach to problem solving.
- Identify and examine a number of common features of algorithms, including sequencing, selection, and repetition.
- Compare the differences between sequential search and binary search algorithms.
- Design and evaluate a sorting algorithm.
- Compare the methods and relative efficiencies of different sorting algorithms.

Programming Languages:

- Incorporate clarity and precision in communicating an algorithmic solution to a problem.

- Examine the shortcomings and ambiguities of natural languages.
- Identify the elements of clear communication, including grammar, vocabulary, and syntax.
- Compare and contrast high-level languages with low-level language by examining the process in which a program is written in a high-level language, compiled into a low-level language, loaded into memory, and executed by a processor.

Solvability and Performance:

- Examine the factors that affect the decidability of a problem.
- Identify which problems can and cannot always be solved by an algorithm.
- Compare and evaluate equivalent algorithms for relative efficiency.

Coding Skills:

- Identify the needs and applications of cryptography in our digital world.
- Examine the mathematical basis of cryptography.
- Encode and decode messages using common cryptographic techniques.

Global Impact:

- Investigate common threats to cybersecurity, and identify the needs for robust cybersecurity.
- Analyze the function and effectiveness of common cybersecurity and classify its components.
- E

New Jersey Student Learning Standards (NJSLS-S)

CS.9-12.8.1.12.CS.1	Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.8.1.12.CS.4	Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
CS.9-12.CS	Computing Systems
CS.9-12.NI	Networks and the Internet
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).

TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
	The scalability and reliability of the Internet are enabled by the hierarchy and redundancy in networks. Network topology is determined by many characteristics.
	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve.
	A computing system involves interaction among the user, hardware, application software, and system software.
	Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences.
	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.
	Innovative ideas or innovation can lead to career opportunities.
	With a growth mindset, failure is an important part of success.

Interdisciplinary Connections

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
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.
LA.RST.11-12.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
	Functions

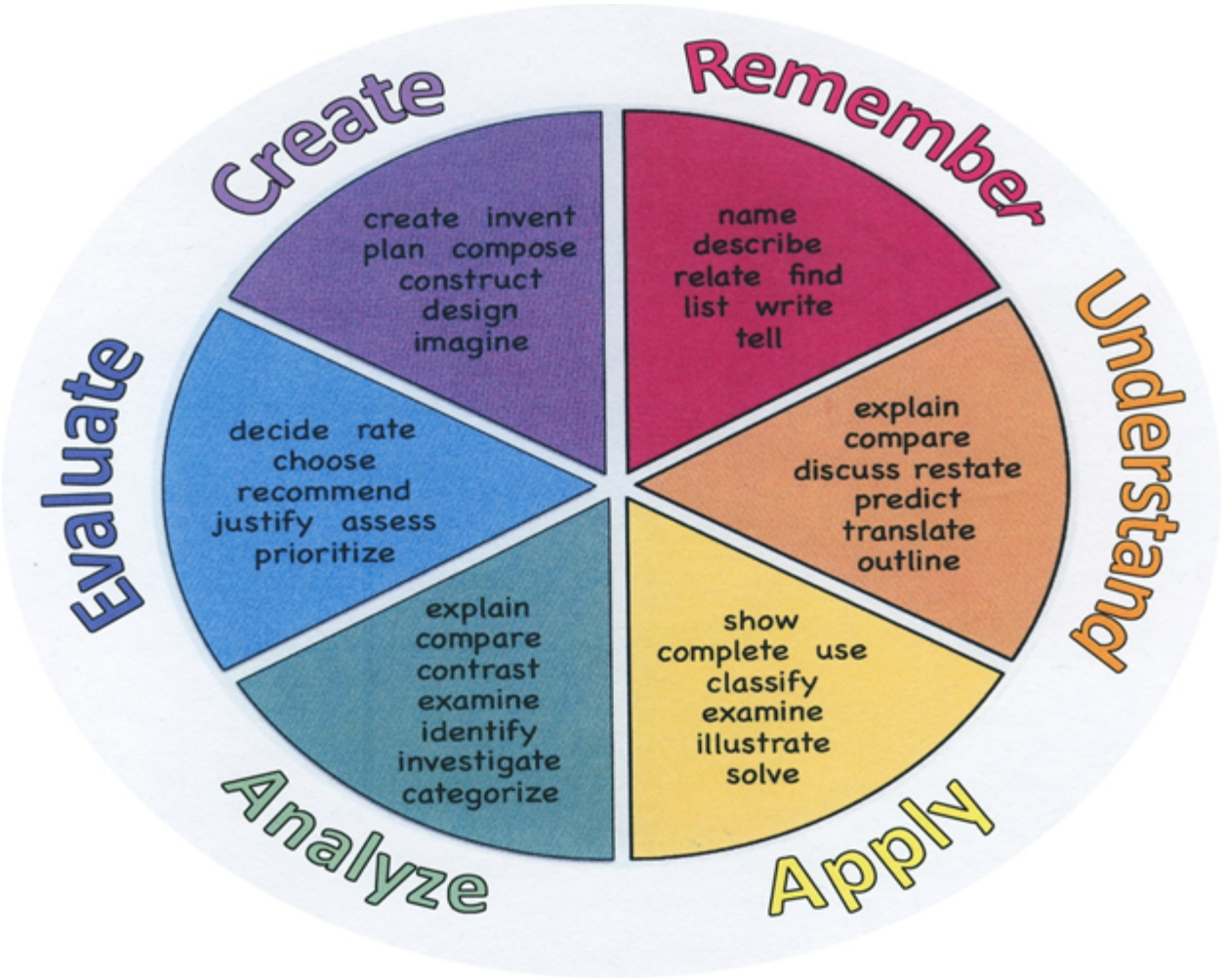
Learning Objectives

Why do we need algorithms?

- How is designing an algorithm to solve a problem different from other kinds of problem solving?
- How do you design a solution for a problem so that it is programmable?

- Explain the global effect of computing -- both beneficial and harmful -- on people and society.
- Recognize how computing enhances communication, interaction, and cognition.
- Understand how Computing enables innovation in nearly every field.
- Describe the positive and negative impacts a computer innovation has had on the world.
- How do computer represent information?
- How does information get from one computer to another?
- Define the challenges involved when developing systems to represent or transmit information?
- Communicate the computing innovation has had the most significant personal impact on your life?
- Explain what life / the world be like without computers?
- Give a detailed description of who or what is “in charge” of the internet?

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

- Code Studio Labs
- Demonstrations
- Flash Talk: students will prepare a talk on Net Neutrality, Internet Censorship, or Computer/Network Surveillance
- Discussion Boards on the first 2 chapters of blown to bits. Using the course sites platform
- Hands on Practice
- Lectures
- Powerpoint/ Prezi Presentations

- Student will be able to identify famous African Americans in the field of computer programming

- Students will also be introduced to the basic energy efficient models in the programming field to help reduce global warming

Assessment Evidence - Checking for Understanding (CFU)

Formative Assessments	• Class discussions • Discussion boards • Exploratory activities • Quizzes • Student participation • Student presentation • Teacher observation and feedback
Summative assessments	• Code.org progress • Quizzes

Alternate Assessment

Written reports

Benchmark Assessment

Flash Talk: students will prepare a talk on Net Neutrality, Internet Censorship, or Computer/Network Surveillance

Powerpoint/ Prezi Presentations

- 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

Primary Resources:

- Edhesive Online Training
- Code.Org Online Training

Computers and Internet Access

- AP Central at Collegeboard.org
- Massive Open Online Course
- Code.org
- Multimedia Applications Tools
- Abelson, H., Ledeen, K., and Lewis, H. R. Blown to Bits: your life, liberty, and happiness after the digital explosion. Upper Saddle River, N.J.: Addison-Wesley, 2008.

Ancillary Resources

AP Approved Programming Resources:

Alice - This 3-D modeling environment allows students to create and animate 3-D worlds. This environment lends itself well to creating stories and games.

- App Inventor - This open-source Web application allows students to create their own applications on mobile devices. App Lab - This is a programming environment for creating web applications with JavaScript. It allows students to develop programs and toggle back and forth between block-based and text-based programming modes.
- EarSketch - This browser-based application allows students to create their own music using either JavaScript or Python. Greenfoot - This Java IDE is designed for use in education to create two-dimensional graphic applications, such as simulations and interactive games.
- Java - There are several IDEs that can be used to write in Java. The Java language allows students to create and solve problems that vary widely in difficulty.
- JavaScript - This language is commonly used to create interactive effects within Web browsers.
- Lego Mindstorms NXT - This product integrates programming with Lego bricks and sensors to create and program robots. The instructions are assembled by linking together function blocks.
- Processing - This programming language was initially created to serve as a software sketchbook, and it can be used to teach programming using a visual context.
- Python - This language has the benefit of readability that might be helpful to new programmers.
- Scratch - This blocks-based programming language allows students to build scripts to run animations. This product can be downloaded and installed on a computer or run in the browser.
- Snap! - This Scratch-style programming language is block-based and allows users to define new primitives in JavaScript. Users can read and write information from the Internet using server-defined APIs and make mobile applications.
- Swift - This programming language is designed for use with iOS, OS X, tvOS and watchOS. This environment allows students to create their own Apple apps and includes interactive environments that allow students to see the effects of changes or additions to code as they type.

Design and Development Process:

What Is the Software Development Life Cycle?" Official Blog Airbrake Bug Tracker. https://airbrake.io/blog/insight/what-is-the-software-development-life-cycle

- "Engineering Design Process." https://www.teachengineering.org/ engrdesignprocess.php
- "The Engineering Design Process." http://www.eie.org/overview/engineeringdesign-process Mohammed, Nabil, Ali Munassar, and A. Govardhan.
- "A Comparison Between Five Models of Software Engineering." IJCSI International Journal of Computer Science 7.5 (2010): 94-101.

Open Source:

"What Is Open Source?" Opensource.com. https://opensource.com/resources/whatopen-source

- Open Source Initiative. http://opensource.org/

Technology Infusion

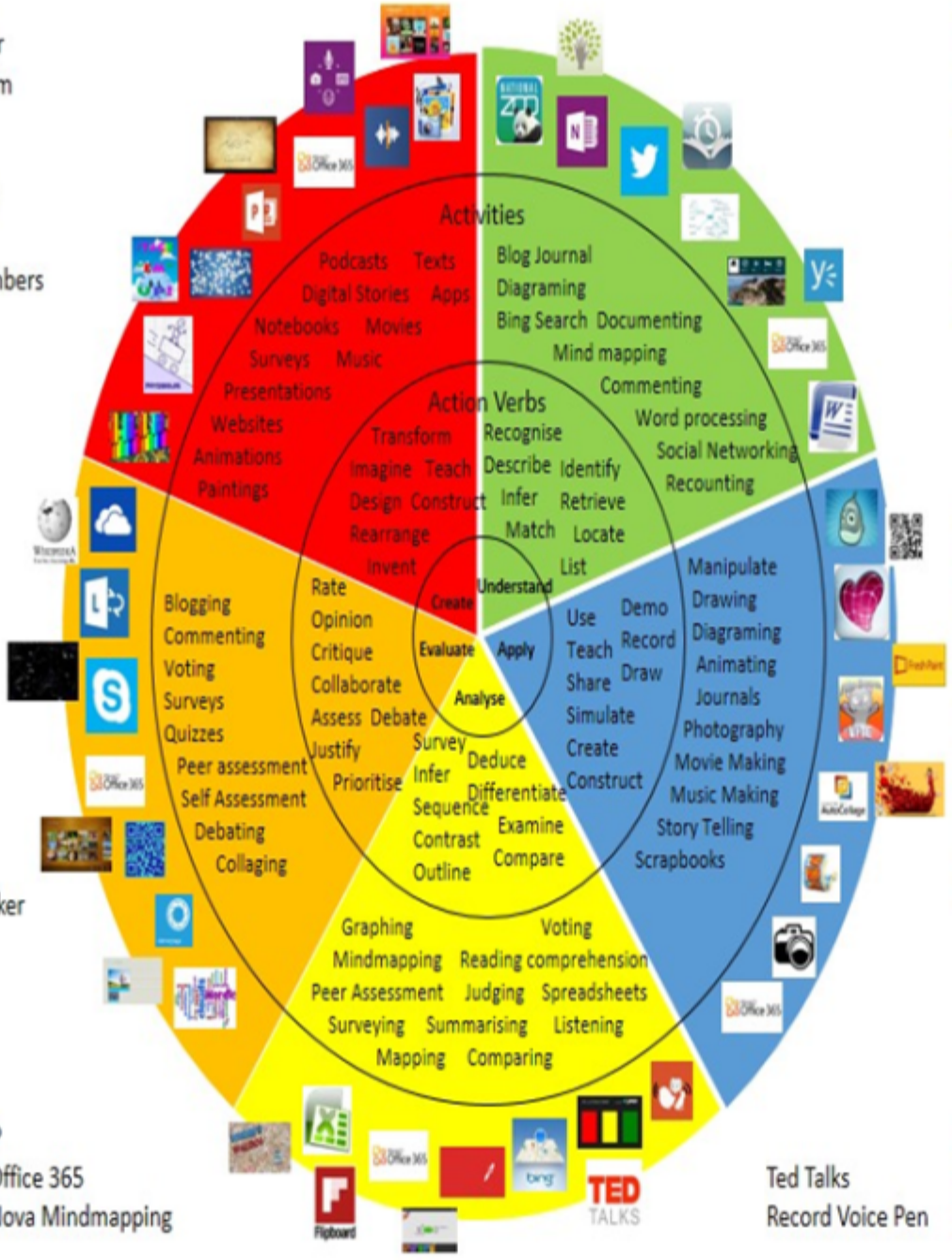
Please reference video links and websites listed under Ancillary Resources and Suggested Activities & Best Practices.

The Computer Science curriculum is solely technology infused.

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

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



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

Ted Talks
Record Voice Pen

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

Alignment to 21st Century Skills & Technology

WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.1	Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
WRK.9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
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TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
	With a growth mindset, failure is an important part of success.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	Innovative ideas or innovation can lead to career opportunities.

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

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.
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.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.

21st Century Skills

21st Century Skills that will be incorporated into this unit.

Critical Thinking & Problem Solving

Creativity and Innovation

Collaboration, Teamwork and Leadership

Cross-Cultural and Interpersonal Communication

Communication and Media Fluency

Accountability, Productivity and Ethics

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

Differentiation

• Technology Resources • Teacher Tutoring • Peer Tutoring • Cooperative Learning Groups • Differentiated Instruction • Follow all IEP Modifications/504 Plan

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

Differentiations Include:

- 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)

Special Education Learning adaptations that could possibly be employed in the unit, using the ones identified below.

Exemplar -Adapting existing materials, simplifying or supplementing materials

- **Adjust** the method of presentation or content.
- **Develop** supplemental material.
- **Tape-record** directions for the material.
- **Provide** alternatives for responding to questions.
- **Rewrite** brief sections to lower the reading level.
- **Outline** the material for the student before reading a selection.
- **Reduce** the number of pages or items on a page to be completed by thestudent.
- **Break** tasks into smaller subtasks.
- **Provide** additional practice to ensure mastery.
- **Substitute** a similar, less complex task for a particular assignment.
- **Develop** simple study guides to complement required materials.

Special Education Learning adaptations that could be employed in this unit,

- 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)

Exemplar:

*provide additional wait time for student responses to questions

When asked a question, ELL students typically translate it into their first language, formulate an answer in their first language, and translate an approximation of the answer into English, before giving their response.

- 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

Exemplar:

Caring, Sustained Relationships

One of the shortcomings of our educational structure is that relationships with teachers, especially in secondary school, may be caring, but they are not easy to sustain. Yet at-risk youth need relationships that are both caring and stable. They need to build a sense of trust and have the time to communicate the complexity, frustrations, and positive aspects of their lives in and out of school. Only after creating a strong relational base will an adult have the platform to be a source of enduring and cherished advice to a student. Students won't confer trust to an adult based on his or her role as a counselor, psychologist, or social worker. We have to earn it by building a relationship.

Possible 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)

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

http://www.grandviewlibrary.org/CurriculumAdaptations/General_Gifted.pdf

Grouping • Group gifted students with other gifted students or higher-level learners. • Refrain from grouping gifted students with lower-level students for remediation.

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

Unit Name: **Computational Thinking - Unplugged**

NJSLS:

See Below

Interdisciplinary Connection:

- 21st century life and careers
- Technology
- Digital Literacy
- English Language Arts
- Reading
- Writing
- Speaking and Listening (communication skills)
- Mathematics
- Social science
- Science and the Engineering Practices

Career Ready Practices

- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

Statement of Objective:

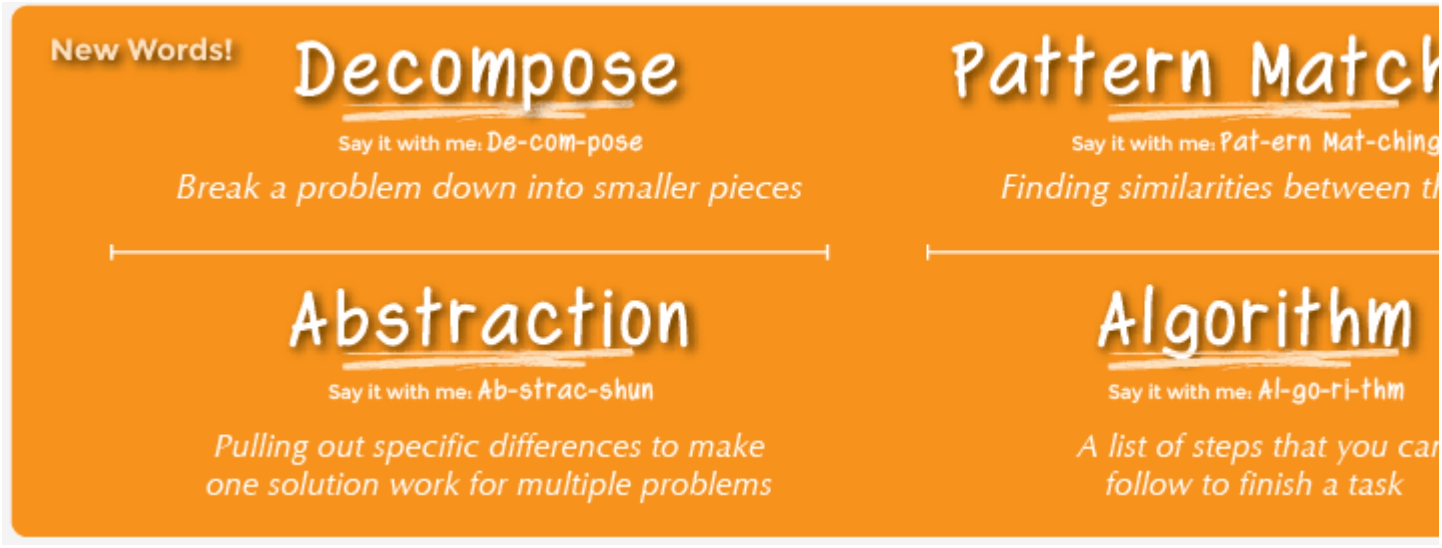
Students will:

- Analyze information to draw conclusions
- Match identical portions of similar phrases to match patterns
- Identify differences in similar phrases and abstract them out

Anticipatory Set/Do Now:

Review Vocabulary in Lesson:

This lesson has four new and important words:



Algorithm - A list of steps that you can follow to finish a task

Decompose - Break a problem down into smaller pieces

Abstraction - Pulling out specific differences to make one solution work for multiple problems

Pattern Matching - Finding similarities between things

After the Vocabulary words are reviewed then:

Figuring it Out

- Tell your students that you want them to sum up all of the numbers between 1 & 200.
    - Use your body language to indicate that this is not a "serious" or graded exercise.
        - Now, let them know that they must do it all in their heads.
        - Add the time constraint of thirty seconds.
        - They may feel overwhelmed. This is intentional. You can indicate with your tone and demeanor that you might be crazy asking this of them, but begin timing with a resounding: "Starting NOW".

- Watch the class as you keep time. How many are lost in thought?
- When time is up, ask if anyone was able to get the total.
- Ask if there is anyone who thought the problem was so hard that they didn't even attempt it.
- Did anyone attempt it and just not finish?
    - What did they try?
- Guide students toward thinking a little smaller.
    - If we break the problem up into smaller pieces, it becomes easier to manage.
    - Let's start at the two ends. What is 200 + 1?
    - What is 199 + 2?
    - What is 198 + 3?
    - See a pattern?
    - How many of these pairs will we have?
        - What is the last pair we will find? 100 + 101
        - That means that we have 100 total pairs.
        - If we have 100 total pairs of sums of 201, how do we find the final total?
        - What is 100 * 201?
            - Now, what if we wanted to find the trick to do this with other numbers?
    - Can we do it easily with 2,000?
    - How about 20,000?
    - What stays the same? What is different?
    - If we use abstractions to make our end goal something that can change (say we name it "blank") then we can make an algorithm that will work for any number
- Work through the problem until you ultimately get ? = ("blank"/2) * ("blank"+1)
- Do a few simple examples to show that the algorithm is correct for blanks= 2, 3, 4, & 5.

"This is all to show that if you use the tools of Computational Thinking (decomposition, pattern matching, abstraction, and algorithms), then you can figure out how to solve problems that no one has already taught you how to solve...just like we did here! This will be an extremely powerful skill for the rest of your life!"

Learning Activity:

Computational Thinking - (see worksheet at) https://code.org/curriculum/course3/1/Activity1-ComputationalThinking.pdf

This lesson is all about a "Game with No Instructions." Students will be charged with figuring out how to play the game as a small group. The small details of their final algorithm are unimportant. What *is* important is that they were able to take a huge task like "figuring out how to play a game on their own" and take small steps toward achieving the goal.

Students will be guided toward discovering the rules using the steps of computational thinking. Resist the temptation to point the students toward "doing it right" and allow them just to do it on their own. If they feel stumped or confused, encourage the students to look at the information that has been given to them, or if they must, ask a classmate.

Directions:

1) Divide students into groups of 2-4.

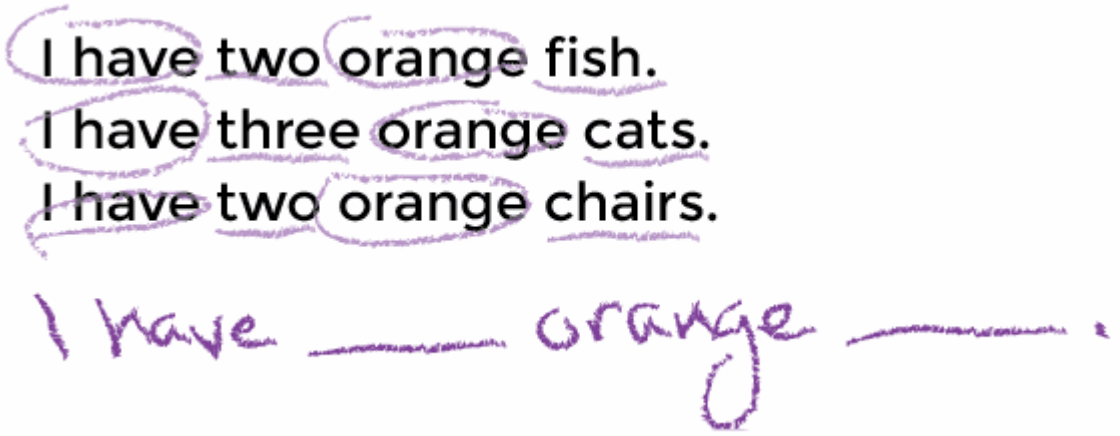
2) Have the groups read over user experiences to get an idea of how other students have played the “Game with No Instructions.”

3) Encourage them to pattern match between each experience by circling the sections of words

that are identical from player to player.

4) Next, have them abstract away differences from each experience by underlining words that change from player to player.

5) Using pattern matching and abstraction, have them make a script template for game play by writing up the circled parts of the other students' experiences, and leaving the underlined sections as blanks. For example:



6) Give students a blank sheet of paper to write a list of instructions for how they think this game should be played based on the user experiences that they just read. This will be their algorithm.

7) Have students play the game using the algorithm that they just made. Each player should get at least two turns.

Student Assessment/CFU's:

Formative Assessments	• Class discussions • Discussion boards • Exploratory activities • Quizzes • Student participation • Student presentation • Teacher observation and feedback
Summative assessments	• Code.org progress • Quizzes

Materials:

Computers, handouts. internet connection

Introduction videos:

https://www.youtube.com/watch?v=VFcUgSYyRPg

https://www.youtube.com/watch?v=mUXo-S7gzds

21st Century Themes and Skills:

21st century life and careers

Technology

Digital Literacy

Career Ready Practices

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Differentiation/Modifications:

- Project Based Learning
- Highlighting key vocabulary.
- Additional testing time.
- Using paired/cooperative learning.
- Using hands-on learning.
- Making curricular and personal connections.
- Developing oral, reading, and writing skills.
- Using graphic organizer and/note taking guides
- Use of technology for class
- Use of scaffolding and tiered assessments
- Other differentiation based on IEP and 504 accommodations

Integration of Technology:

Computers, Internet Connection, Smart Board

CS.9-12.8.1.12.CS.1	Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
CS.9-12.CS	Computing Systems
TECH.9.4.12.CI	Creativity and Innovation

TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	With a growth mindset, failure is an important part of success.
	Successful troubleshooting of complex problems involves multiple approaches including research, analysis, reflection, interaction with peers, and drawing on past experiences.
	A computing system involves interaction among the user, hardware, application software, and system software.
	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve.