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Array List, AP Computer Science A

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Computer Science A - Java

Array List

Belleville Board of Education

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Unit Overview

As students learned in the previous unit, data structures are helpful when storing multiple related data values. Arrays have a static size, which causes limitations related to the number of elements stored, and it can be challenging to reorder elements stored in arrays. The ArrayList object has a dynamic size, and the class contains methods for insertion and deletion of elements, making reordering and shifting items easier. Deciding which data structure to select becomes increasingly important as the size of the data set grows, such as when using a large real-world data set. In this unit, students will also learn about privacy concerns related to storing large amounts of personal data and about what can happen if such information is compromised.

Students need to consider the impact using ArrayList rather than an array has on the structure of their program code. This includes considering the use of ArrayList methods and the flexibility of a structure with a dynamic size. For instance, the use of an ArrayList will require students to analyze program code that uses method calls. Providing students with practice writing programs for data sets of undetermined sized—or at least larger than they would be able to analyze easily by hand—presents a more relevant and realistic experience with data. Additionally, this requires students to focus more on the algorithm and ensuring that it will work in all situations rather than on an individual result.

With larger data sets, programmers become concerned with the amount of time it will take for their program code to run. Students should have practice determining the number of times a code segment executes; this can help them gain an idea of how long it will take to run a program on a data set of a given size

Essential Questions

BIG IDEA 1 Variables - Why is an ArrayList more appropriate for storing your music playlist, while an array might be more appropriate for storing your class schedule?

BIG IDEA 2 Control - How can we use statement execution counts to choose appropriate algorithms?

BIG IDEA 3 Impact of Computing - What personal data is currently being collected, and how?

Exit Skills

Represent collections of related object reference data using ArrayList objects.

Determine code that would be used to complete code segments.

Write program code to create, traverse, and manipulate elements in 1D array or ArrayList objects

To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.

New Jersey Student Learning Standards (NJSLS-S)

CSTA Standards
Computing Systems

- 3A-CS-03 Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
- 3B-CS-02 Illustrate ways computing systems implement logic, input, and output through hardware components.

Networks and the Internet

- 3B-NI-03 Describe the issues that impact network functionality (e.g., bandwidth, load, delay, topology).

Data and Analysis

- 3A-DA-09 Translate between different bit representations of real-world phenomena, such as characters, numbers, and images.
- 3A-DA-12 Create computational models that represent the relationships among different elements of data collected from a phenomenon or process.
- 3B-DA-06 Select data collection tools and techniques to generate data sets that support a claim or communicate information.
- 3B-DA-07 Evaluate the ability of models and simulations to test and support the refinement of hypotheses.

Algorithms and Programming

- 3A-AP-13 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.
- 3A-AP-15 Justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made.
- 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
- 3A-AP-19 Systematically design and develop programs for broad audiences by incorporating feedback from users.
- 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible.
- 3A-AP-22 Design and develop computational artifacts working in team roles using collaborative tools.
- 3B-AP-10 Use and adapt classic algorithms to solve computational problems.
- 3B-AP-11 Evaluate algorithms in terms of their efficiency, correctness, and clarity.
- 3B-AP-14 Construct solutions to problems using student-created components, such as procedures, modules and/or objects.
- 3B-AP-20 Use version control systems, integrated development environments (IDEs), and collaborative tools and practices (code documentation) in a group software project.
- 3B-AP-21 Develop and use a series of test cases to verify that a program performs according to its design specifications.
- 3B-AP-22 Modify an existing program to add additional functionality and discuss intended and unintended implications (e.g., breaking other functionality).
- 3B-AP-23 Evaluate key qualities of a program through a process such as a code review.

Impacts of Computing

- 3A-IC-25 Test and refine computational artifacts to reduce bias and equity deficits.
- 3A-IC-26 Demonstrate ways a given algorithm applies to problems across disciplines.
- 3A-IC-29 Explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users.

8.2.12.B.1 Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review. 8.2.12.B.3 Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs. 8.2.12.C.1 Explain how open source technologies follow the design process. 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world. 8.2.12.E.2 Analyze the relationships between internal and external computer components. 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). 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and 8.2.12.B.1 Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review. 8.2.12.B.3 Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs. 8.2.12.C.1 Explain how open source technologies follow the design process. 8.2.12.E.1 Demonstrate an understanding of the problemsolving capacity of computers in our world. 8.2.12.E.2 Analyze the relationships between internal and external computer components. 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). 8.2.12.E.4 Use appropriate terms in conditional statements). Support Standards (CSTA): CPP.L2.04 Demonstrate an understanding of algorithms and their practical application CPP.L3A.05 Use Application Programming Interfaces (APIs) and libraries to facilitate programming solutions. CPP.L3A.08 Explain the program execution process. CRP Standards: 9.2.12.C.3 Identify transferable career skills and design alternate career plans. 9.2.12.C.5 Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures. 9.2.12.C.6 Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business. 9.2.12.C.7 Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace. CRP2 Apply appropriate academic and technical skills. CRP10 Plan education and career paths aligned to personal goals. CRP11 Use technology to enhance conditional statements).

CPP.L2.04 Demonstrate an understanding of algorithms and their practical application CPP.L3A.05 Use Application Programming Interfaces (APIs) and libraries to facilitate programming solutions. CPP.L3A.08 Explain the program execution process. CRP Standards: 9.2.12.C.3 Identify transferable career skills and design alternate career plans. 9.2.12.C.5 Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures. 9.2.12.C.6 Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business. 9.2.12.C.7 Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace. CRP2 Apply appropriate academic and technical skills. CRP10 Plan education and career paths aligned to personal goals. CRP11 Use technology to enhance.

	Integration of Knowledge and Ideas
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.
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.
	Determining an output value for a particular input involves evaluating an expression; finding inputs that yield a given output involves solving an equation. Questions about when two functions have the same value for the same input lead to equations, whose solutions can be visualized from the intersection of their graphs. Because functions describe relationships between quantities, they are frequently used in modeling. Sometimes functions are defined by a recursive process, which can be displayed effectively using a spreadsheet or other technology.

Interdisciplinary Connections

Primary interdisciplinary connections:

Infused within the unit are connections to the 2009 NJCCCS for Language Arts Literacy and Business, Science and Technology.

Critical reading, writing, and mathematical modeling skills are promoted within the problem solving process and as a means to explain solutions.

	Integration of Knowledge and Ideas
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.
	Functions

Learning Objectives

Represent collections of related object reference data using ArrayList objects.

To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.

The ArrayList class is part of the java. util package. An import statement can be used to make this class available for use in the program.

Suggested Activities & Best Practices

ArrayList Suggested Activities

1. Predict and compare, Have students look at the code they wrote to solve the free-response question in Unit 6 (or other code from Unit 6) on paper, and have them rewrite it using an ArrayList. Have them highlight the parts that need to be changed and determine how to change them. Then, have students type up the changes in an IDE and confirm that the program still works as expected. 2 7.1–7.5

2. Identify a subtask, Have students read through an ArrayList-based free-response question in groups, and have them identify all subtasks. These subtasks could be conditional statements, iteration, or even other methods. Once the subtasks have been identified, divide the subtasks among the group members, and have students implement their given subtask. When all students are finished, have them combine the subtasks into a single solution. 3 7.5

3. Discussion group, Discuss the algorithm necessary to search for the smallest value in an ArrayList. Without explaining what you are doing, change the Boolean expression so that it will find the largest value, and ask students to describe what the resulting algorithm will do. Then, change the algorithm to store and return the location of the largest value, and discuss the change

Assessment Evidence - Checking for Understanding (CFU)

- Complete various written checkpoint exercises that focus on the explanation and description of computer hardware and Java basics.-Alternate Assessment
- Develop a visual representation of the communication processes within a computer using appropriate

terminology.
- Properly document a program using correct indentation, spacing, and comment style.
- Debug programs and determine the types of errors in the program.
- Create programs based on programming exercises that display various types of output using string and numeric expressions.-Benchmark Assessment

Formative Evaluations:	**Summative Evaluations:**
Formative Assessment with polling codeIt! Nows Quizzes Long Programs (LP)/Lab Work Components of AP approved Lab	Unit Test/ReTest-Summative Assessment

Self Check Exemplar

BJP4 Self-Check 10.15: ArrayListMystery1

Language/Type: Java ArrayList Collections mystery
Author:Roy McElmurry (on 2016/09/08)

Consider the following method:

```
public static void mystery1(ArrayList<Integer> list) {
    for (int i = list.size() - 1; i > 0; i--) {
        if (list.get(i) < list.get(i - 1)) {
```

```
            int element = list.get(i);
            list.remove(i);
            list.add(0, element);
        }
    }
    System.out.println(list);
}
```

Write the output produced by the method when passed each of the following `ArrayList`s:

```
[2, 6, 1, 8]
[30, 20, 10, 60, 50, 40]
[-4, 16, 9, 1, 64, 25, 36, 4, 49]
```

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

By identifying the **Evidence of Student Learning with Checking for Understanding (CFU)** techniques used during the lesson and/or for Closure (Madeline Hunter), please list the variety of means used to access students' learning (e.g. quizzes, tests, academic prompts, observations, homework, journals).

- 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

NJCTL Curriculum

https://runestone.academy/runestone/books/published/csawesome/Unit7-ArrayList/topic-7-2-arraylist-methods.html?highlight=array%20list

Curriculum development Resources/Instructional Materials/Equipment Needed Teacher Resources: • www.gliffy.com • Eclipse IDE • MS DOS Prompt • Computers

Ancillary Resources

Java Resources

- Java Review for the AP CS A Exam - Great review site with lots of practice questions.
- Aplus Compter Science Exam Review Material -Slide, Free Response, and more!
- Introduction to Java - a textbook for a first course in computer science for the next generation of scientists and engineers
- Guru-99 Introduction Java Material
- Oracles (owners of Java) has their own tutorials
- Dick Baldwin - ACC - Introduction and Advanced Java Material
- Introduction to Computer Science using Java - by Bradley Kjell
- Thinking in Java
- Blue Pelican Java
- Java Coding Bat - Lots of good practice problems
- Code Academy - No Java but good practice.

https://chortle.ccsu.edu/CS151/cs151java.html

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Technology Infusion

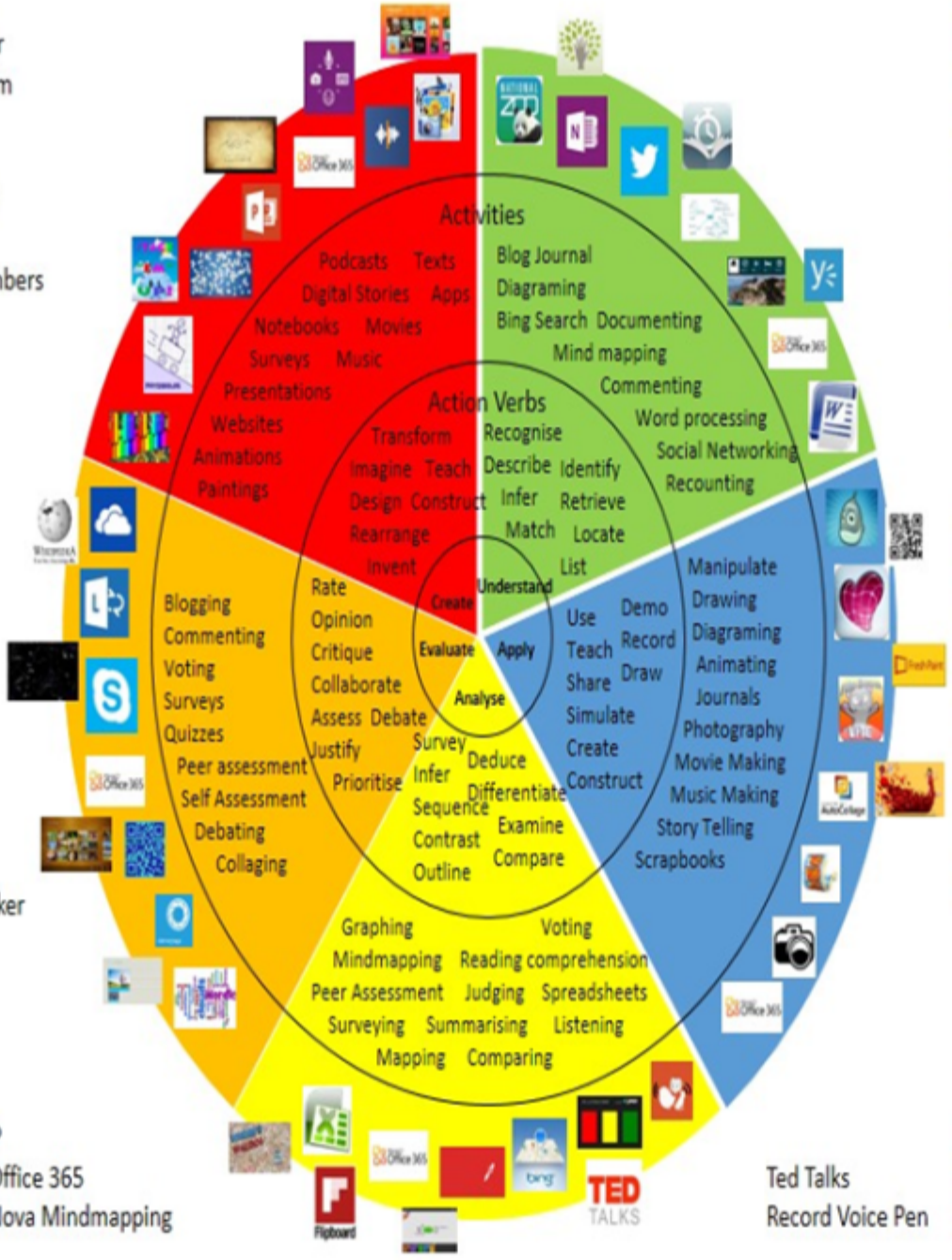
Technology Infusion and/or strategies include chromebooks online materials google/powerpoint slides

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

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

21st century themes: The unit will integrate the 21st Century Life and career standard 9.1 strands A-D. These strands include: critical thinking and problem solving, creativity and innovation, collaboration, teamwork, and leadership, and cross cultural understanding and interpersonal communication

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.

21st Century Skills/Interdisciplinary Themes

21st century themes: The unit will integrate the 21st Century Life and career standard 9.1 strands A-D. These strands include: critical thinking and problem solving, creativity and innovation, collaboration, teamwork, and leadership, and cross cultural understanding and interpersonal communication

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

9.3.12.BM-OP.3	Apply inventory tracking systems to facilitate operational controls.
12.9.3.IT.12	Demonstrate knowledge of the hardware components associated with information systems.

21st Century Skills

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

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

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.3	Identify transferable career skills and design alternate career plans.

Differentiation

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

Provide study guides, worksheets, and notes

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:

Exemplar: Students will be given a choice of 3 activities, 2 teacher designed and 1 design your own.

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

Exemplar:

- **Mini workshops to re-teach or extend skills**

- 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)

Please identify the **Special Education Learning** adaptations that will be employed in the unit, using the ones identified below.

Exemplar: Work with a partner

Adjust *the method of presentation or content.*

- **Develop** supplemental material.

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

- 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:

Extended Time

It's obvious that response time for ELLs is significantly greater than it is for students proficient in English. Given this, we know that ELLs may require more time to process and communicate information on assessments. To support your students in this area, give them additional time on tests to help. Extra time will also help to decrease anxiety, which often has a significant impact on test performance.

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

Exemplar:

Diagnosing the specific learning needs of individual students and using that information to provide targeted academic support or more personalized learning experiences, is the best way to support students who are at risk

A Strategy Summary

Planned interventions are far superior to remediation approaches. Always plan to address students at risk in your learning tasks, instructions, and directions. Try to anticipate where the needs will be and then address them. Intervene as much as possible to support students at risk. If your intervention strategies are working, continue to use them. If they're not working, plan for new interventions that will help students succeed.

Please identify 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:

Alternate assignments for high-ability students can either be projects related to the modified area of study that extend the curriculum, or they can be independent projects that are chosen based on students' individual interests.

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.

Please identify the **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

https://runestone.academy/runestone/books/published/csawesome/Unit7-ArrayList/topic-7-2-arraylist-methods.html?highlight=array%20list

Using the template below, please develop a **Sample Lesson** for the first unit only.

Unit Name:

NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: