Unit 6-Inheritance

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Course(s): **Sample Course**
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Status: **Published**

AP Computer Science A, Inheritance

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP COMPUTER SCIENCE A

Inheritance

Belleville Board of Education

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Unit Overview

Inheritance in Java is not an estate or a classic car from a long-lost relative. It means certain classes can share attributes from other classes. In this unit we'll learn the concept and the syntax for this powerful feature of Java.

Inheritance is a wonderful thing in Java. It's a term used often in object-oriented programming. But what does it really mean? And how do you harness this powerful concept?

To **inherit** in Java means allowing all methods and variables from one class to be accessible by another class. That is, the new class inherits these items. The **parent class**, also called superclass, is the class whose methods and variables can be used in the **child class** (also called subclass).

Another way to think of the inheritance concept is the phrase: A union employee is an employee; a paperback book is a book. It's more than a child inheriting 50% of their parent's DNA - they get all of it. The subclass gets all the goodies from the parent class, but it can also create its own variables and methods.

Inheritance is a key part of object-oriented programming. It allows for use and re-use of objects, methods, and variables, without having to add extra/redundant code.

Creating objects, calling methods on the objects created, and being able to define a new data type by creating a class are essential understandings before moving into this unit. One of the strongest advantages of Java is the ability to categorize classes into hierarchies through inheritance. Certain existing classes can be extended to

include new behaviors and attributes without altering existing code. These newly created classes are called subclasses. In this unit, students will learn how to recognize common attributes and behaviors that can be used in a superclass and will then create a hierarchy by writing subclasses to extend a superclass. Recognizing and utilizing existing hierarchies will help students create more readable and maintainable programs.

Students can design hierarchies by listing the attributes and behaviors for each object and pulling common elements into a superclass, leaving unique attributes and behaviors in the subclass. By creating a hierarchy system, students only need to write common program code one time, reducing potential errors and implementation time. This also allows for changes to be made more easily, because they can be made at the superclass level in the hierarchy and automatically apply to subclasses. During the development of a program, programmers often use comments to describe the behavior of a given segment of program code and to describe the initial conditions that are used. Students who develop the skill of explaining why program code does not work, such as methods being overloaded improperly or superclass objects attempting to call subclass methods, are much better equipped to foresee and avoid these hierarchy issues.

Enduring Understanding

When multiple classes contain common attributes and behaviors, programmers create a new class containing the shared attributes and behaviors forming a hierarchy.

Modifications made at the highest level of the hierarchy apply to the subclasses.

Essential Questions

How might the use of inheritance help in writing a program that simulates crops being grown in a virtual world?

How does inheritance make programs more versatile?

Exit Skills

Determine an appropriate program design to solve a problem or accomplish a task (not assessed). 3.B Write program code to define a new type by creating a class. 9.2 Writing Constructors for Subclasses 3.B Write program code to define a new type by creating a class. 5.A Describe the behavior of a given segment of program code. 9.3 Overriding Methods 3.B Write program code to define a new type by creating a class. 5.D Describe the initial conditions that must be met for a program segment to work as intended or described. 9.4 super Keyword 1.C Determine code that would be used to interact with completed program code. 3.B Write program code to define a new type by creating a class. 9.5 Creating References Using Inheritance Hierarchies 3.A Write program code to create objects of a class and call methods. 5.B Explain why a code segment will not compile or work as intended. 9.6 Polymorphism 3.A Write program code to create objects of a class and call methods. 5.B Explain why a code segment will not compile or work as intended. 9.7 Object Superclass 1.C Determine code that would be used to interact with completed program code. 3.B Write program code to define a new type by creating a class

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.NI.1	Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.
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.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).
	With a growth mindset, failure is an important part of success.
	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.

Interdisciplinary Connections

LA.RL.11-12	Reading Literature
LA.RL.11-12.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
LA.RL.11-12.2	Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
LA.RL.11-12.3	Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).
LA.RL.11-12.4	Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (e.g., Shakespeare as well as other authors.)
LA.L.11-12.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.
LA.L.11-12.4.A	Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
LA.L.11-12.4.B	Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable).
LA.L.11-12.4.C	Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.
LA.L.11-12.4.D	Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

Learning Objectives

Students will learn how to recognize common attributes and behaviors that can be used in a superclass and will then create a hierarchy by writing subclasses to extend a superclass. Recognizing and utilizing existing hierarchies will help students create more readable and maintainable programs.

Suggested Activities & Best Practices

1 Activating prior knowledge Have students review what they know about classes, methods, and the scope of variables by having them write a class based on specifications that can easily be extended by subclasses. This class will become the superclass for subclasses they write later in the unit. 2 9.2–9.4 Create a plan Given a class design problem that requires the use of multiple classes in an inheritance hierarchy, students identify the common attributes and behaviors among these classes and write these into a superclass. Any additional information that does not belong in the superclass will be categorized to determine the additional classes that might be necessary and what methods will need to be added or overridden in the subclasses. 3 9.4 Think aloud Provide students with a code segment that contains method calls using the super keyword. Have students describe the code segment out loud to themselves. Give students several individual statements that attempt to interact with the given code segment, and have them talk through each one, describing which statements would work and which ones would not, as well as the reasons why those statements wouldn't work. 4 9.5–9.6 Student response system Provide students with several statements where objects are created and the reference type and object type are different but related. Then provide students with calls to methods on these created objects. Use a student response system to have students determine whether each statement is legal, would result in a compile-time error, or would result in a run-time error.

- -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)

- 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

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

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

Technology Infusion

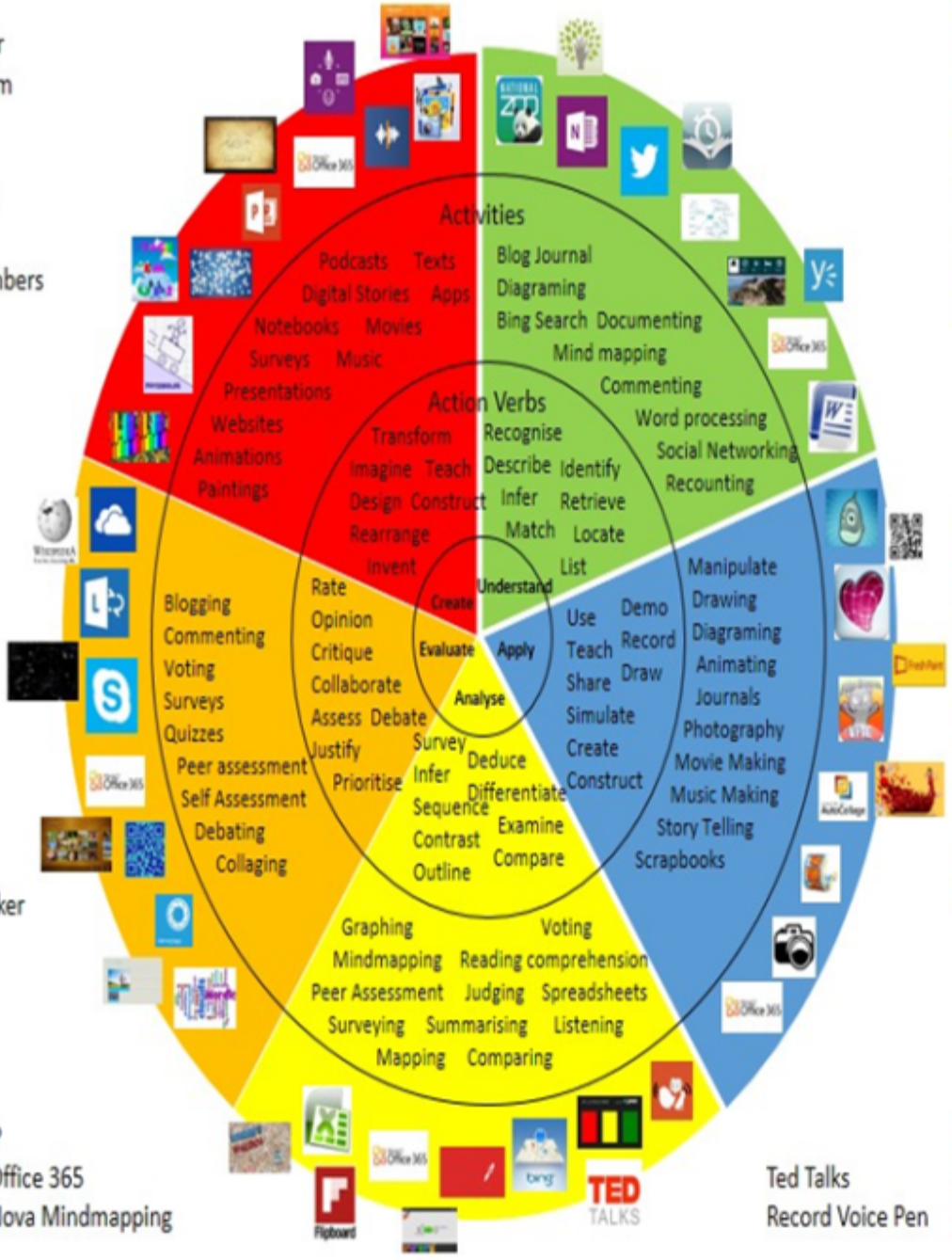
Technology Infusion and/or strategies include chromebooks online materials google/powerpoint slides

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
Flipboard
Office 365
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.5	Assess and modify a personal plan to support current interests and post-secondary plans.
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.DC.7	Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
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).
	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.

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

TECH.K-12.1.2	Digital Citizen
TECH.K-12.1.5	Computational Thinker
TECH.K-12.1.5.a	formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
TECH.K-12.1.5.b	collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
TECH.K-12.1.5.c	break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
TECH.K-12.1.5.d	understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

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.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.

Differentiation

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

Exemplar: Pairing oral instruction with visuals

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)

Exemplar:

Students work with an assigned partner.

Weekly Assignment Sheet in Google Classroom

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 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: Give simplified written and verbal instructions

Whether you're giving instructions for a test or assignment verbally or textually, you should simplify them as much as possible for students with LEP. Many times, this can be easily done by taking out extra words or turning complex sentences into simple ones.

- 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:

Directions or Instructions

Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

- 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:

Students will create a blog or social media page on a topic of their choice within 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.

- 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/Unit9-Inheritance/toctree.html?highlight=inheritance

Unit 7 Lesson Plan – Inheritance & Polymorphism

Teacher:	Corey Woodring	Time Frame:	14 days
Grade:	9-12	School:	Belleville High School
Subject:	AP Computer Science A		

AP Essential Knowledge

(Referenced from CollegeBoard AP CS A Course & Exam Description)

- Create an inheritance relationship from a subclass to the superclass.
- A class hierarchy can be developed by putting common attributes and behaviors of related classes into a single class called a superclass.
- Classes that extend a superclass, called subclasses, can draw upon the existing attributes and behaviors of the superclass without repeating these in the code.
- Extending a subclass from a superclass creates an “is-a” relationship from the subclass to the superclass.
- The keyword extends is used to establish an inheritance relationship between a subclass and a superclass. A class can extend only one superclass.
- Constructors are not inherited.
- The superclass constructor can be called from the first line of a subclass constructor by using the keyword super and passing appropriate parameters.
- The actual parameters passed in the call to the superclass constructor provide values that the constructor can use to initialize the object’s instance variables.
- When a subclass’s constructor does not explicitly call a superclass’s constructor using super, Java inserts a call to the superclass’s no-argument constructor.

- Regardless of whether the superclass constructor is called implicitly or explicitly, the process of calling superclass constructors continues until the Object constructor is called. At this point, all of the constructors within the hierarchy execute beginning with the Object constructor.
- Method overriding occurs when a public method in a subclass has the same method signature as a public method in the superclass.
- Any method that is called must be defined within its own class or its superclass.
- A subclass is usually designed to have modified (overridden) or additional methods or instance variables.
- A subclass will inherit all public methods from the superclass; these methods remain public in the subclass.
- The keyword super can be used to call a superclass's constructors and methods.
- The superclass method can be called in a subclass by using the keyword super with the method name and passing appropriate parameters.
- Define reference variables of a superclass to be assigned to an object of a subclass in the same hierarchy.
- When a class S "is-a" class T, T is referred to as a superclass, and S is referred to as a subclass.
- If S is a subclass of T, then assigning an object of type S to a reference of type T facilitates polymorphism.
- If S is a subclass of T, then a reference of type T can be used to refer to an object of type T or S.
- Declaring references of type T, when S is a subclass of T, is useful in the following declarations: Formal method parameters and arrays — T[ ] var ArrayList var
- Call methods in an inheritance relationship.
- Utilize the Object class through inheritance.
- At compile time, methods in or inherited by the declared type determine the correctness of a non-static method call.
- At run-time, the method in the actual object type is executed for a non-static method call.
- Call Object class methods through inheritance.
- The Object class is the superclass of all other classes in Java.
- The Object class is part of the java.lang package
- The following Object class methods and constructors—including what they do and when they are used—are part of the Java Quick Reference:

    a. boolean equals(Object other)

b. String toString()

- Subclasses of Object often override the equals and toString methods with classspecific implementations.

Enduring Understanding & CTP Skills

(Referenced from CollegeBoard AP CS A Course & Exam Description)
MOD-3 When multiple classes contain common attributes and behaviors, programmers create a new class containing the shared attributes and behaviors forming a hierarchy. Modifications made at the highest level of the hierarchy apply to the subclasses.

1.A Determine an appropriate program design to solve a problem or accomplish a task (not assessed).

1.C Determine code that would be used to interact with completed program code.

3.A Write program code to create objects of a class and call methods.

3.B Write program code to define a new type by creating a class

5.A Describe the behavior of a given segment of program code.

5.B Explain why a code segment will not compile or work as intended.

5.D Describe the initial conditions that must be met for a program segment to work as intended or described.

Essential Questions

(Some referenced from CollegeBoard AP CS A Course & Exam Description)

(What questions will the student be able to answer as a result of the instruction?)

1. How does inheritance differ from using classes to create objects?

2. How does inheritance make programs more versatile?

Assessment

(What is acceptable evidence to show desired results (rubrics, exam, etc.)? Attach Copy

- Complete various written checkpoint exercises that focus on the explanation and description of computer hardware and Java basics.

- 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.
- Unit 7 Assessment

Formative Evaluations:

Formative Assessment with polling

codeIt! Nows

Quizzes

AP Classroom AP Computer Science A Topic Questions

Long Programs (LP)/ Lab work

Summative Evaluations:

Unit 7 Test/ReTest

AP Classroom AP Computer Science A Progress Checks

Sequence and Scope

Day	Topic/Activities	CW-HW
1	• Inheritance Hierarchy • codeIt! Now	Problems #1-14
2	• Finish codeIt! Now • Super & Sub Classes • codeIt! Now	Problems #15
3	• Finish Super & Sub Classes • codeIt! Now	Problems #16, AP Classroom topic questions 9.1 – 9.5
4	• Quiz Question #1 • The Object Class	Problems #17
5	• The Object Class • Problem #18	Finish #18
6	• Overloading & Overriding	Study for Quiz
7	• Quiz Question #2 • Polymorphism	Problems #19

8	• Finish Polymorphism • Finish Problem #19	Finish Problem #19, AP Classroom topic questions 9.6 – 9.7
9	• ArrayLists & Type Compatibility • codeIt! Now	Problems #20
10	• Lab Work: LP Part 1	LP Part 1 Problems #20
11	• Lab Work: LP Part 1	LP Part 1
12	• Lab Work: LP Part 2	LP Part 2
13	• Lab Work: LP Part 2	Study for Test Problems #21-23
14	• Unit 7 Assessment	None

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.NI.1	Evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing.
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.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.
	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.
	Innovative ideas or innovation can lead to career opportunities.