

FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

COMPUTER SCIENCE ACADEMY

**ADVANCED PLACEMENT COMPUTER
SCIENCE A**

COURSE PHILOSOPHY

Talented computer science students are offered a solid foundation of programming skills which can be utilized in their future computer science courses. Students will obtain advanced knowledge and practical skills in the efficient implementation of algorithms in computer science.

COURSE DESCRIPTION

Grade Level: 11

Department: Computer Science Academy

Course Title: Advanced Placement
Computer Science A

Credits: 5

Course Code: 036450

BOARD OF EDUCATION INITIAL ADOPTION DATE: AUGUST 30, 2010

FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

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Course Philosophy

This course is designed to provide students with an enriched study of concepts in programming in the Java language. The logical reasoning and programming skills that are emphasized in this course can be applied in future computer science courses. Students will be required to continually and consistently analyze and interpret various applications in order to become effective programmers.

Course Description

This course is the third course of the Computer Science Academy. The students will continue their study of the Java programming language. By using the AP Computer Science A guidelines, the students will be introduced to advanced data structures including array lists, matrices, linked lists, trees, maps and sets. By using the current case study, students will learn how to design a project that uses several interacting classes. The students may choose to sit for the AP Computer Science A exam in May.

**Freehold Regional High School District
Curriculum Map
Advanced Placement Computer Science A**

Relevant Standards ¹	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Java code involves data manipulation, conditionals, loops and methods.	How is a conditional used? What are the different types of loops? What purpose does a method serve? How are methods implemented?	Oral questions / discussion	Assignment/ Trace code that includes conditionals and loops	Quiz
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Standard Java programs include the String and Wrapper classes.	What is the String class? What are the methods in the String class? What is the Wrapper class? What are the methods in the Wrapper class?	Oral questions / discussion	Assignment/ Write program that uses multiple String methods Assignment/ Write a program that makes use of the Wrapper class	Graded programming assignment Unit test
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Designing more complex software is accomplished by writing classes that define objects to perform whatever services are needed.	What is an object? How is a class and an object related? What is the difference between a class method and an object method?	Oral questions / discussion	Assignment/ Write a Student class and implement it in a driver	Graded programming assignment Quiz
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Inheritance is a technique for organizing and creating hierarchies of classes used to form polymorphic references.	What is an interface? What does the word super mean when developing a hierarchy of classes? What is polymorphism?	Oral questions / discussion	Assignment/ Develop an inheritance hierarchy involving several related classes	Graded programming assignment Unit test

Relevant Standards ¹	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Arrays are data structures used to group homogeneous data to facilitate data manipulation and organization.	How is an array created? What is a multi-dimensional array and how is it used? What is a ragged array? How can arrays and other objects be combined to manage complex information?	Oral questions / discussion	Assignment / Develop programs using arrays	Execute program with required input Graded programming assignment
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	The Java standard classes, ArrayList and LinkedList, are data structures that increase and decrease dynamically and are used to hold objects.	What is the difference between an Array List and a Linked List? What is the underlying structure of an Array List? What is the underlying structure of a Linked List? How are Array Lists and Linked Lists implemented as generic types? What methods are available for Array Lists and Linked Lists?	Oral questions / discussion	Assignment/ Develop programs using Array Lists and Linked Lists	Graded programming assignment Unit test
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Recursion is a necessary and powerful programming technique used to solve specific problems.	What is recursion? How does recursion work? Why do you need a base case in recursion?	Oral questions / discussion	Assignment / Develop numerous recursive methods	Graded programming assignment Quiz
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Sorting is the process of arranging a list of items in a designated order.	How do you perform a selection sort? How do you perform a bubble sort? What are recursive sorts?	Oral questions / discussion	Assignment / Develop programs involving basic sorting techniques including bubble and selection sorts	Graded programming assignment Unit test
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Constructing and defining Linked Lists gives the programmer control over the behavior of the data structure.	How do you construct a singly Linked List? How do you construct a generic Linked List? How do you construct a sorted Linked List? What are circularly Linked Lists?	Oral questions / discussion	Assignment/ Develop several types of Linked Lists	Graded programming assignment Unit test

Relevant Standards ¹	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Stacks and queues are data structures that are needed in various situations.	What is a stack and how is it implemented? What is a queue and how is it implemented? What is a priority queue?	Oral questions / discussion	Assignment/ Develop a program using a stack and a queue	Execute program with required input Graded programming assignment
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Trees are a good way to organize hierarchical information.	What is a binary search tree? How do you construct a binary search tree? How do you delete information from a binary search tree? How are various traversals performed in a binary search tree?	Oral questions / discussion	Assignment/ Develop a program that constructs a binary search tree and implements methods to perform traversals and to delete particular nodes	Graded programming assignment Quiz
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Sets are unordered collections that contain no duplicates.	What is a set? How are operations performed on sets including intersection, union and difference?	Oral questions / discussion	Assignment/ Develop a program that implements methods to determine the intersection, union and difference between sets	Graded programming assignment Demonstrate programs
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Maps are data structures that map keys to values.	What is a map? How is a map implemented? What is a tree map?	Oral questions / discussion	Assignment/ Create a program that utilizes a map	Graded programming assignment Unit test
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	Big Oh notation is a mathematical means to represent the efficiency of the algorithm.	What is the running time of various sorting techniques? What is the running time of various searching techniques? What is the running time of performing manipulations on particular data structures?	Oral questions / discussion	Assignment / Evaluate the running times of the basic sorts Assignment / Evaluate the running times of recursive sorts	Graded programming assignment Unit test

Relevant Standards ¹	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
12.4.5A2.2 12.4.5A.4 12.4.5A.5 12.4.5C.4 9.4.12.K(4).6	GridWorld is a case study provided by the College Board to test various programming principles and techniques.	What is GridWorld? How is GridWorld set up to run on the computer? How are various operations in GridWorld performed?	Oral questions / discussion	Assignment/ Work through the documentation provided by the College Board	Graded exercises

**Freehold Regional High School District
Course Proficiencies and Pacing**

Advanced Placement Computer Science A

Unit Title	Unit Understandings and Goals	Recommended Duration
Unit #1: Java Basics Review	<p>Java code involves data manipulation, conditionals, loops and methods.</p> <ol style="list-style-type: none"> 1. Students will compose conditional statements. 2. Students will design while loops and for loops effectively. 3. Students will implement static methods. 4. Students will write overloaded methods. 	1 week
Unit #2: Review of Standard Classes Including the String Class	<p>Standard Java programs include the String and Wrapper classes.</p> <ol style="list-style-type: none"> 1. Students will manipulate Strings and use methods from the String class. 2. Students will implement the Wrapper class to represent primitive data as objects. 3. Students will implement the static methods of Wrapper classes to perform particular algorithms. 	1 week
Unit #3: Review of User Defined Classes	<p>Designing more complex software is accomplished by writing classes that define objects to perform whatever services are needed.</p> <ol style="list-style-type: none"> 1. Students will demonstrate that a class is a blueprint of an object. 2. Students will differentiate the difference between a class method and an object method. 3. Students will construct a class and instantiate its objects in a driver. 	1 week
Unit #4: Inheritance	<p>Inheritance is a technique for organizing and creating hierarchies of classes used to form polymorphic references.</p> <ol style="list-style-type: none"> 1. Students will construct a hierarchy of classes that inherit each other's properties. 2. Students will demonstrate the use of the keyword super to facilitate the construction of methods and constructors in the hierarchy. 3. Students will demonstrate the difference between 'is a' relationship and 'has a' relationship. 4. Students will demonstrate what overridden methods are. 5. Students will demonstrate the use of an interface. 	4 weeks
Unit #5: Arrays: One and Two-Dimensional	<p>Arrays are data structures used to group homogeneous data to facilitate data manipulation and organization.</p> <ol style="list-style-type: none"> 1. Students will implement arrays of primitive values as well as of arrays of object values. 2. Students will implement and use a multi-dimensional array. 3. Students will design nested for loops to populate data in a multi-dimensional array. 	2 weeks
Unit #6: Array Lists and Linked Lists in the Java standard class library	<p>The Java standard classes, ArrayList and LinkedList, are data structures that increase and decrease dynamically and are used to hold objects.</p> <ol style="list-style-type: none"> 1. Students will explain the underlying data structures of an Array List and a Linked List. 2. Students will explain that Array Lists and Linked Lists increase and decrease dynamically. 3. Students will incorporate the use of the methods of the ArrayList class and the LinkedList class that are part of the Java standard library. 	3 weeks

Unit Title	Unit Understandings and Goals	Recommended Duration
Unit #7: Recursion	Recursion is a necessary and powerful programming technique used to solve specific problems. <ol style="list-style-type: none"> 1. Students will apply the underlying ideas of recursion. 2. Students will understand that each recursive algorithm needs a base case to end recursion. 3. Students will compose programs that incorporate recursion to solve problems. 	2 weeks
Unit #8: Sorting and Searching	Sorting is the process of arranging a list of items in a designated order. There are various searching techniques used to locate a particular element within an array. <ol style="list-style-type: none"> 1. Students will use basic sorts such as selection, insertion and bubble. 2. Students will use recursive sorts such as merge sort and quick sort. 3. Students will write sequential and binary searches. 4. Students will write a heap sort. 	3 weeks
Unit #9: User Defined Linked Lists	Constructing and defining Linked Lists gives the programmer control over the behavior of the data structure. <ol style="list-style-type: none"> 1. Students will design their own linked list class. 2. Students will design a generic linked list. 3. Students will design a sorted linked list. 4. Students will analyze the structure of circularly linked list. 	4 weeks
Unit #10: Stacks and Queues	Stacks and queues are data structures that are needed in various situations. <ol style="list-style-type: none"> 1. Students will design and implement a stack. 2. Students will design and implement a queue. 3. Students will implement a priority queue. 	2 weeks
Unit #11: Trees	Trees are a good way to organize hierarchical information. <ol style="list-style-type: none"> 1. Students will construct a binary search tree (BST). 2. Students will perform the traversals of a BST. 	3 weeks
Unit #12: Sets and Maps	Sets are unordered collections that contain no duplicates. Maps are data structures that map keys to values. <ol style="list-style-type: none"> 1. Students will use the Set interface. 2. Students will create various methods and to develop a class that implements the Set interface. 3. Students will design programs that use the HashSet and TreeSet classes. 4. Students will design programs that use the TreeMap and HashMap classes that implement the Map interface. 	2 weeks
Unit #13: Big Oh, Prefix and Postfix Notation	Big Oh notation is a mathematical means to represent the efficiency of the algorithm. <ol style="list-style-type: none"> 1. Students will rearrange an arithmetic expression into prefix or postfix notation. 2. Students will evaluate algorithms in terms of running time and Big Oh notation. 	2 weeks
Unit #14: GridWorld Case Study	GridWorld is a case study provided by the College Board to test various programming principles and techniques. <ol style="list-style-type: none"> 1. Students will analyze the GridWorld case study. 2. Students will modify methods and add methods to manipulate the behavior of the objects in GridWorld. 	4 weeks

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #1: Java Basics Review**

Enduring Understanding: Java code involves data manipulation, conditionals, loops and methods.

Essential Questions: How is a conditional used?
What are the different types of loops?
What purpose does a method serve?
How are methods implemented?

Unit Goals: Students will compose conditional statements.
Students will design while loops and for loops effectively.
Students will implement static methods.
Students will write overloaded methods.

Duration of Unit: 1 week

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How are conditionals used to control the different types of loops?	Develop a program that implements different varieties of loops.	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes
What are static methods?	Develop a simple program that uses several static methods to perform functions that are repeated.	Java Programming language		Writing and debugging of computer programs
What is an overloaded method?	Write code that implements several overloaded methods to find the averages of different number of grades.			Appearance of the program

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

Freehold Regional High School District
Advanced Placement Computer Science A
Unit #2: Review of Standard Classes Including the String Class

Enduring Understanding: Standard Java programs include the String and Wrapper classes.

Essential Questions: What is the String class?

What are the methods in the String class?

What is the Wrapper class?

What are the methods in the Wrapper class?

Unit Goals: Students will manipulate Strings and use methods from the String class.

Students will implement the Wrapper class to represent primitive data as objects.

Students will implement the static methods of Wrapper classes to perform particular algorithms.

Duration of Unit: 1 week

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills Center Alignment	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How are the methods in the String class used?	Develop a program that implements different methods of the String class.	Computers	Lecture and class discussion	Written test and quizzes
How is primitive data represented as an object?	Develop a simple program to convert primitive data to its corresponding Wrapper class. Use auto-boxing and auto-unboxing when appropriate.	Notes Reference books		Writing and debugging of computer programs
How are the static methods in the Wrapper class used?	Write code that uses static methods of a Wrapper class such as parseInt to facilitate certain operations.	Java Programming language		Appearance of the program
<p>Suggestions on how to differentiate in this unit:</p> <ul style="list-style-type: none"> Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods. A wide variety of assessments and strategies complement the individual learning experience. 				

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #3: Review of User Defined Classes**

Enduring Understanding: Designing more complex software is accomplished by writing classes that define objects to perform whatever services are needed.

Essential Questions: What is an object?

How is a class and an object related?

What is the difference between a class method and an object method?

Unit Goals: Students will demonstrate that a class is a blueprint of an object.

Students will differentiate the difference between a class method and an object method.

Students will construct a class and instantiate its objects in a driver.

Duration of Unit: 1 week

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills Center Alignment	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How is a class used to define an object?	Develop a program that defines an object and a driver program that instantiates the object.	Computers	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
What are class methods as opposed to static methods?	Develop a program that includes both static and class methods. Develop a class that defines Student objects.	Notes Reference books		
What is the purpose of a driver program?	Develop a program that defines an object and a driver program that instantiates the object.	Java Programming language		

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #4: Inheritance**

Enduring Understanding: Inheritance is a technique for organizing and creating hierarchies of classes used to form polymorphic references.

Essential Questions: What is an interface?

What does the word super mean when developing a hierarchy of classes?

What is polymorphism?

Unit Goals: Students will construct a hierarchy of classes that inherit each other's properties.

Students will demonstrate the use of the keyword super to facilitate the construction of methods and constructors in the hierarchy.

Students will demonstrate the difference between 'is a' relationship and 'has a' relationship.

Students will demonstrate what overridden methods are.

Students will demonstrate the use of an interface.

Duration of Unit: 4 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills Center Alignment	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is an interface and how is it used?	Develop a Shape interface that will be used for a hierarchy of classes, namely a Circle class and a Cylinder class.	Computers Notes Reference books Java Programming language	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you use an interface to develop the first level of a hierarchy of classes?	Develop a Circle class that implements the Shape interface.			
What is the purpose of a protected instance variable?	Declare the instance variable in a Circle class as protected and discuss how they will be helpful at the next level in the hierarchy.			
How do you use the word super when developing the second level of the hierarchy of classes?	Demonstrate the use of the word super to represent methods and constructors in parent classes. Develop a Cylinder class that extends the Circle class.			
How do you implement override method?	Design the Cylinder program to override methods of the same name from the Circle class.			
What is the difference between 'is a' relationship and 'has a' relationship?	Relate an 'is a' relationship to inheritance and hierarchy of classes and a 'has a' relationship to a class that contains the object of another class.			

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #5: Arrays: One- and Two-Dimensional**

Enduring Understanding: Arrays are data structures used to group homogeneous data to facilitate data manipulation and organization.

Essential Questions: How is an array created?

What is a multi-dimensional array and how is it used?

What is a ragged array?

How can arrays and other objects be combined to manage complex information?

Unit Goals: Students will implement arrays of primitive values as well as of arrays of object values.

Students will implement and use a multi-dimensional array.

Students will design nested for loops to populate data in a multi-dimensional array.

Duration of Unit: 2 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you create arrays using initializer lists?	Develop a program that creates one-dimensional and multi-dimensional arrays using initializer lists	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you create and print a ragged array?	Develop a simple program that creates a ragged array. The program will be printed by using the length static variable for arrays. The program will also print the array transposing rows and columns.	Java Programming language		
How do you create an array of objects?	Write code that declares an array of objects and instantiates each object in the array.			

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

Freehold Regional High School District
Advanced Placement Computer Science A
Unit #6: Array Lists and Linked Lists in the Java standard class library

Enduring Understanding: The Java standard classes, ArrayList and LinkedList, are data structures that increase and decrease dynamically and are used to hold objects.

Essential Questions: What is the difference between an Array List and a Linked List?
 What is the underlying structure of an Array List?
 What is the underlying structure of a Linked List?
 How are Array Lists and Linked Lists implemented as generic types?
 What methods are available for Array Lists and Linked Lists?

Unit Goals: Students will explain the underlying data structures of an Array List and a Linked List.
 Students will explain that Array Lists and Linked Lists increase and decrease dynamically.
 Students will incorporate the use of the methods of the ArrayList class and the LinkedList class that are part of the Java standard library.

Duration of Unit: 3 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you create a generic or a raw ArrayList?	Develop a program that creates a generic and raw ArrayList. Students will demonstrate that in a raw ArrayList the objects must be cast to access the particular methods of the class whereas the objects in the generic ArrayList do not need to be cast.	Computers Notes Reference books Java Programming language	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you create a generic or a raw LinkedList?	Develop a program that creates a generic and raw LinkedList. Students will demonstrate that in a raw LinkedList the objects must be cast to access the particular methods of the class whereas the objects in the generic LinkedList do not need to be cast.			
How is an ArrayList implemented?	Logic will be presented and students held responsible to understand how an ArrayList grows dynamically.			
How is a LinkedList implemented?	Logic will be presented and students held responsible to understand how a LinkedList grows dynamically.			
What methods are available when using the LinkedList class or ArrayList class?	Students will develop programs that access the methods common to both data structures including the remove, add, set, get, and size methods.			

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #7: Recursion**

Enduring Understanding: Recursion is a necessary and powerful programming technique used to solve specific problems.

Essential Questions: What is recursion?
How does recursion work?
Why do you need a base case in recursion?

Unit Goals: Students will apply the underlying ideas of recursion.
Students will understand that each recursive algorithm needs a base case to end recursion.
Students will compose programs that incorporate recursion to solve problems.

Duration of Unit: 2 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How is a simple recursive method set up?	Develop a program that finds the sum of the first n positive integers both recursively and iteratively. Describe why a base case is needed to end the recursion.	Computers Notes Reference books Java Programming language	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How does a computer execute a recursive method?	Trace a recursive program and determine how the computer executes the recursion.			
How can recursion be used to solve a maze?	Develop a program to solve a maze.			

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #8: Sorting and Searching**

Enduring Understandings: Sorting is the process of arranging a list of items in a designated order.
There are various searching techniques used to locate a particular element within an array.

Essential Questions: How do you perform a selection sort?
How do you perform a bubble sort?
What are recursive sorts?

Unit Goals: Students will use basic sorts such as selection, insertion and bubble.
Students will use recursive sorts such as merge sort and quick sort.
Students will write sequential and binary searches.
Students will write a heap sort.

Duration of Unit: 3 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you perform a binary search?	Trace a program that performs a binary search.	Computers	Lecture and class discussion	Written test and quizzes
How do you sort objectives as opposed to primitive types?	Develop code that uses sort routines including selection sort and bubble sort to sort objects and sort primitive types.	Notes Reference books		Writing and debugging of computer programs
How do you sort recursively using QuickSort and MergeSort?	Trace a QuickSort program that sorts primitive types. Demonstrate how the recursion ends and how the routine is completed.	Java Programming language		Appearance of the program

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #9: User Defined Linked Lists**

Enduring Understanding: Constructing and defining Linked Lists gives the programmer control over the behavior of the data structure.

Essential Questions: How do you construct a singly Linked List?
How do you construct a generic Linked List?
How do you construct a sorted Linked List?
What are circularly Linked Lists?

Unit Goals: Students will design their own linked list class.
Students will design a generic linked list.
Students will design a sorted linked list.
Students will analyze the structure of circularly linked list.

Duration of Unit: 4 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is the structure of a Linked List?	Develop the structure of a Linked List that includes routines for adding, deleting, and printing.	Computers Notes Reference books Java Programming language	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you enhance a Linked List?	Develop a Linked List program that contains a back and front reference and contains routines addFirst (), addLast (), deleteFirst (), and deleteLast ().			
How do you develop a generic Linked List?	Develop a user defined generic LinkedList program that includes the main methods from the List Interface including remove, set and add methods. Contrast the difference between a generic Linked List and a raw Linked List.			
How do you develop a sorted Linked List?	Develop a program that creates a sorted Linked List. Demonstrate that the list is created by changing links. Contrast the differences between array structures and Linked List structures.			
What are other types of Linked Lists?	Develop routines that reflect the concept of circularly linked list and doubly linked list.			

Suggestions on how to differentiate in this unit:

- Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of visual and auditory teaching methods.
- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #10: Stacks and Queues**

Enduring Understanding: Stacks and queues are data structures that are needed in various situations.

Essential Questions: What is a stack and how is it implemented?
What is a queue and how is it implemented?
What is a priority queue?

Unit Goals: Students will design and implement a stack.
Students will design and implement a queue.
Students will implement a priority queue.

Duration of Unit: 2 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you develop a stack class?	Develop a program that creates a stack class using an ArrayList as its underlying structure. Include the methods push (), pop (), and peekTop ().	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you develop a queue class?	Develop a program that creates a queue class using a LinkedList as its underlying structure. Include the methods peekFront (), enqueue (), and dequeue ().	Java Programming language		
How do you develop a priority queue?	Develop a program that creates a priority queue class by developing an array of queues where the index in the array serves a priority. Develop a program that uses a heapSort to create a priority queue.			

Suggestions on how to differentiate in this unit:

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- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #11: Trees**

Enduring Understanding: Trees are a good way to organize hierarchical information.

Essential Questions: What is a binary search tree?

How do you construct a binary search tree?

How do you delete information from a binary search tree?

How are various traversals performed in a binary search tree?

Unit Goals: Students will construct a binary search tree (BST).

Students will perform the traversals of a BST.

Duration of Unit: 3 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you create a binary search tree?	Develop a program that creates a binary search tree that performs in, pre and post order traversals.	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes Writing and debugging of computer programs Appearance of the program
How do you find or delete a node from a binary search tree?	Using the previous program add code to determine if an object is in the binary search tree. Add additional code to find and delete a particular object.	Java Programming language		
How do you perform a level order traversal?	Using the previous program and the Queue class previously developed; implement a method to perform a level order traversal?			

Suggestions on how to differentiate in this unit:

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- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #12: Sets and Maps**

Enduring Understandings: Sets are unordered collections that contain no duplicates.
Maps are data structures that map keys to values.

Essential Questions: What is a set?
How are operations performed on sets including intersection, union and difference?
What is a map?
How is a map implemented?
What is a tree map?

Unit Goals: Students will use the Set interface.
Students will create various methods and to develop a class that implements the Set interface.
Students will design programs that use the HashSet and TreeSet classes.
Students will design programs that use the TreeMap and HashMap classes that implement the Map interface.

Duration of Unit: 2 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you implement a set in a program?	Develop a program that uses a HashSet to implement a set. Develop a program that implements a sorted set using the TreeSet class.	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes
How do you declare and instantiate a map?	Using the Map interface and the HashMap class implement a map that contains Strings as the keys and student objects as the value type.	Java Programming language		
How do you develop set operations?	Using methods from the Setinterface develop various operations on sets including intersection, union and 'is a subset of'.			

Suggestions on how to differentiate in this unit:

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- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #13: Big Oh, Prefix and Postfix Notation**

Enduring Understanding: Big Oh notation is a mathematical means to represent the efficiency of the algorithm.

Essential Questions: What is the running time of various sorting techniques?

What is the running time of various searching techniques?

What is the running time of performing manipulations on particular data structures?

Unit Goals: Students will rearrange an arithmetic expression into prefix or postfix notation.

Students will evaluate algorithms in terms of running time and Big Oh notation.

Duration of Unit: 2 weeks

NJCCCS: 12.4.5A2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is the running time of various sort routines?	Determine the running time or Big Oh notation for selection sort, bubble sort, insertion sort, merge sort and QuickSort. Contrast the differences between each sort.	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes
What are the running times of various operations on Lists?	Determine the running time or Big Oh notation for performing operations on arrays, ArrayLists and LinkedLists such as addFirst, addLast, deleteFirst, insert and deleteIndex.	Java Programming language		Writing and debugging of computer programs
What is the running time of various search routines?	Determine the running time or Big Oh notation for sequential searches and binary searches. Consider the best case, worst case and average case in each routine.			Appearance of the program

Suggestions on how to differentiate in this unit:

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- A wide variety of assessments and strategies complement the individual learning experience.

**Freehold Regional High School District
Advanced Placement Computer Science A
Unit #14: GridWorld Case Study**

Enduring Understanding: GridWorld is a case study provided by the College Board to test various programming principles and techniques.

Essential Questions: What is GridWorld?

How is GridWorld set up to run on the computer?

How are various operations in GridWorld performed?

Unit Goals: Students will analyze the GridWorld case study.

Students will modify methods and add methods to manipulate the behavior of the objects in GridWorld.

Duration of Unit: 4 weeks

NJCCCS: 12.4.5A.2.2, 12.4.5A.4, 12.4.5A.5, 12.4.5C.4, 9.4.12.K (4).6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do the bugs in GridWorld move and turn?	Run the GridWorld program and observe how the bugs interact. Trace the code within the Bug class. Develop different types of Bugs by writing different classes such as CircleBug and SpiralBug.	Computers Notes Reference books	Lecture and class discussion	Written test and quizzes
How do objects from the Critter class behave?	Run the GridWorld program and observe how critters interact. Create different classes of critters such as BlusterCritter that inherits the critter class.	Java Programming language		Writing and debugging of computer programs
How does the CrabCritter class behave?	Run the GridWorld program and observe how the CrabCritters interact. Create a QuickCrab class that inherits the CrabCritter class.			Appearance of the program

Suggestions on how to differentiate in this unit:

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- A wide variety of assessments and strategies complement the individual learning experience.