SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Computer Science A	**Length of Course:** 30 cycles
Grade Level(s): 10 - 12	**Periods Per Cycle:** 6
Units of Credit: 1	**Length of Period:** 43 minutes
Classification: Elective	**Total Instructional Time:** approximately 129 hours

Course Description

Advanced Placement Computer Science A is equivalent to a first-semester, college-level course in computer science. The course introduces students to computer science with fundamental topics that include problem solving, design strategies and methodologies, organization of data (data structures), approaches to processing data (algorithms), analysis of potential solutions, and the ethical and social implications of computing. The course emphasizes both object-oriented and imperative problem-solving and design using Java language. These techniques represent proven approaches for developing solutions that can scale up from small, simple problems to large, complex problems. The Advanced Placement Computer Science A course curriculum is compatible with many CS1 courses in colleges and universities.

Instructional Strategies, Learning Practices, Activities, and Experiences

Direct Instruction Reading Research Problem-Solving	Video Instruction High-Level Questioning Programming	Instructional Examples Community Forum Questions Community Partnership

Assessments

Tests Quizzes Programs	Projects Portfolio Free Response Questions	Presentations Peer Group Work

Materials/Resources

Books Software Community Members APLUS Computer Programming Curriculum	Local Businesses Project Supplies iPad Eclipse JAVA Compiler	Video Conference Equipment Computer Equipment Calculator

Adopted: 5/20/2019
Revised:

Object-Oriented Program Design - Unit 1

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Program and Class Design 1. Problem analysis 2. Data abstraction and encapsulation 3. Class specifications, interface specifications, relationships ("is-a," "has-a"), and extension using inheritance 4. Code reuse 5. Data representation and algorithms 6. Functional decomposition <u>Related Vocabulary:</u> syntax class interface Graphical User Interface (GUI) algorithm function inheritance <u>Essential Questions</u>: What is a class? What is Inheritance? What are the ideals of programming?	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them, and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use

Program Implementation – Unit 2

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Implementation Techniques 1. Top-down 2. Bottom-up 3. Object-oriented 4. Encapsulation and information hiding 5. Procedural abstraction B. Programming Constructs 1. Primitive types versus reference types 2. Declaration a. Constants b. Variables c. Methods and parameters d. Classes e. Interfaces 3. Text output using System.out.print and Systern.out.println 4. Control a. Method call b. Sequential execution c. Conditional execution d. Iteration e. Recursion 5. Expression evaluation a. Numeric expressions b. String expressions c. Boolean expressions, short-circuit evaluation, De Morgan's law	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use

Program Implementation – Unit 2 (continued)	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Related Vocabulary: constant variable method parameter iteration recursion string Boolean Essential Questions: How to I display messages in Java? How does my program execute? What are the differences and similarities of iteration and recursion? How are numeric, string, and Boolean expressions similar and different?	

Program Analysis – Unit 3

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Testing 1. Development of appropriate test cases, including boundary cases 2. Unit testing 3. Integration testing B. Debugging 1. Error categories: compile-time, run-time, logic 2. Error identification and correction 3. Techniques such as using a debugger, adding extra output statements, or hand tracing code. C. Runtime exceptions D. Program correctness 1. Pre- and Post-conditions 2. Assertions E. Algorithm Analysis 1. Statement execution counts 2. Informal running time comparison F. Numerical representations of integers 1. Representations of non-negative integers in different bases 2. Implications of finite integer bounds <u>Related Vocabulary:</u> runtime errors compile-time errors logic errors exceptions <u>Essential Questions:</u> How can I test and debug efficiently?	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use

Standard Data Structures – Unit 4

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Primitive Data Types (int, Boolean, double) B. Strings C. Classes D. Lists E. Arrays (1-dimensional and 2-dimensional) <u>Related Vocabulary:</u> operator assignment comparison dot notation type <u>Essential Questions:</u> What is a class? How can I store user input? How does an array help me store information?	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use

Standard Operations and Algorithms – Unit 5

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Operations on Data Structures 1. Traversals 2. Insertions 3. Deletions B. Searching 1. Sequential 2. Binary C. Sorting 1. Selection 2. Insertion 3. Merge sort <u>Related Vocabulary:</u> operator assignment comparison dot notation type <u>Essential Questions:</u> What is a class? How can I store user input? How does an array help me store information?	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use

Computing in Context – Unit 6

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. System Reliability B. Privacy C. Legal Issues and Intellectual Property D. Social and Ethical Ramifications of Computer Use <u>Related Vocabulary:</u> cyber ethics reliability privacy intellectual property <u>Essential Questions:</u> What is the importance of system reliability? How does cyber ethics affect programming?	International Society for Technology in Education (ISTE) Standards 1. Empowered Learner 2. Digital Citizen 3. Knowledge Constructor 4. Innovative Designer 5. Computational Thinker 6. Creative Communicator 7. Global Collaborator **1a** - Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes. **3d** - Build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **4a** - Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **4d** - Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **5a** - Formulate problem definitions suited for technology assisted methods such as data analysis, abstract models, and algorithmic thinking in exploring and finding solutions. **5c** - Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving. The students will be able to: • Design, implement, and analyze solutions to problems • Use and implement commonly used algorithms • Develop and select appropriate algorithms and data structures to solve new problems • Write solutions fluently in an object-oriented paradigm • Write, run, test, and debug solutions in the Java programming language, utilizing standard Java library classes and interfaces from the AP Java subset • Read and understand programs consisting of several classes and interacting objects • Read and understand a description of the design and development process leading to such a program • Understand the ethical and social implications of computer use