SAMPLE SYLLABUS #1

AP® Computer Science Principles

Curricular Requirements

CR1	The teacher and students have access to college-level computer science resources, in print or electronic format.	*See page:* 2
CR2	The course provides opportunities to develop student understanding of the required content outlined in each of the big ideas described in the AP Course and Exam Description.	*See page:* 2
CR3	The course provides opportunities to develop student understanding of the big ideas, as outlined in the AP Course and Exam Description (CED).	*See pages:* 2, 3, 4, 5
CR4	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 1: Computational Solution Design, as outlined in the AP Course and Exam Description.	*See page:* 6
CR5	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 2: Algorithms and Program Development, as outlined in the AP Course and Exam Description.	*See page:* 3
CR6	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 3: Abstraction in Program Development, as outlined in the AP Course and Exam Description.	*See page:* 3
CR7	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 4: Code Analysis, as outlined in the AP Course and Exam Description.	*See page:* 3
CR8	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 5: Computing Innovations, as outlined in the AP Course and Exam Description.	*See page:* 6
CR9	The course provides opportunities for students to develop the skills related to Computational Thinking Practice 6: Responsible Computing, as outlined in the AP Course and Exam Description.	*See page:* 3
CR10	The course provides a minimum of three opportunities for students to investigate different computing innovations.	*See pages:* 2, 4, 5
CR11	Students are provided at least 9 hours of dedicated class time to complete the AP Create Performance Task.	*See page:* 6

Advanced Placement Computer Science Principles Sample Syllabus #1

AP® Computer Science Principles is an introductory computing course. The major areas of the course are organized around five big ideas. These big ideas are:

- Creative Development (CRD)
- Data (DAT)
- Algorithms and Programming (AAP)
- Computing Systems and Networks (CSN)
- Impact of Computing (IOC)

Programming Language and Environments: Students will use block coding in blockly and trinket.io. They will also learn Python using trinket.io and EarSketch.

Resources:

Dale, N., and J. Lewis. (2016). *Computer Science Illuminated*. 6th ed. Boston: Jones and Bartlett Publishers. **CR1**

Articles and videos will be used throughout the year as well.

CR1
The syllabus must list a college-level resource, which may include a computer science textbook, website, article, or video.

Course Outline **CR2**

Unit	Topics/Activities	Big Ideas
Unit 1 Intro to Computer Science and Algorithms	▪ What is computer science and why should we study it? (Videos, discussion, readings, blogs) ▪ Intro to Collaboration (Pogil Activity) ▪ Computing Innovations (Drones, Self-Driving Cars, selections from students) ▪ Algorithms (Video, PB&J, Guide Leading Blind, Flowcharts, Robot Game, CSP's Got Game! Pseudocode, Efficiency, Relationship to Computer Programs ▪ *CS Illuminated* Chapter 1	CRD, AAP, IOC
Unit 1 Activity for Computing Innovations (IOC) (Computing Innovation 1, Prompt A) **CR3** **CR10** Students discuss with a partner what they know about drones at this time. They are then given an article to read about privacy and discuss drones again. They then watch a video about the use of drones in the Mara Elephant Project in Kenya and look at other resources. For homework they write a half-page response about the use of drones in the world today and note the positive and negative impacts drones have on society.		
Unit 1 Activity for Algorithms **(AAP) (P2)** **CR3** Students are given a task to create a set of instructions to give to a "guide" to help a "visually impaired" person get from "home" to "work" to "lunch" and then back "home." In groups of 2 or 3, students write detailed instructions to direct a "blind" person from one location to another and then another in Google Docs. They test their instructions within the group and then print out and share the instructions with another group. The designated guide will read instructions EXACTLY as they are written and the designated blind person will do EXACTLY what the instructions say to do. The recorder will take notes about any issues observed from this activity. Groups will discuss the experience with the entire class. For homework, students will rewrite the algorithm based on the feedback and experience of the activity.		

CR2
The syllabus must include an outline of course content by unit or module using any organizational approach with the associated big idea(s) to demonstrate the inclusion of required course content. The outline must include labeling of all big ideas.

CR3
The syllabus must include at least five activities, each of which is explicitly related to one or more of the five big ideas. Each big idea must be included in at least one activity. Each activity must be labeled with the related big idea(s).

Unit 2 Programming	▪ Introduction to Block Programming (Blockly, Trinket) and then cover topics in Python (Trinket) ▪ Intro to Pair Programming ▪ Basic Sequential Programming Steps ▪ Variables ▪ Conditionals and Loops ▪ Strings and Lists ▪ Basic Functions Intro ▪ Using Code Written by Others ▪ Computing Innovations ▪ *CS Illuminated* Chapter 7	CRD, AAP, IOC

Unit 2 Activity Coding a Work of Art (AAP)

Part 1 **(P3)**

Students will be writing the code using blocks or Python to create a picture of their choosing. The code must include the following;

- Function for a regular polygon
- At least two functions that create something other than a basic shape (not a square, rectangle, circle …) These functions may use other functions such as a rectangle or a polygon
- At least three colors
- At least one loop
- At least one shaped filled with color

Part 2 **(P3, P6)** **CR9**

Now find a picture using Turtle graphics that was made by someone else. Incorporate the code from that picture to enhance your own creation. You MUST appropriately acknowledge the code from someone else that you are adding to your program. Be sure to give credit with all necessary information in your program documentation.

Unit 2 Activity Guess the Secret Number Game

Part 1 **(AAP, CRD) (P2)** **CR3** **CR5**

Consider the following scenario where a computer randomly generates a number from 1 up to, but not including, 20. The user guesses a number.

- If the guess is correct, the game prints out "You guessed correctly!"
- If the guess is not correct, the computer prompts the user to guess a higher number if their guess was too low and a lower number if their guess was too high.
- This will continue until they guess the correct number.
- When the user guesses correctly on the first try they score 5 points, second try 4 points, third try 3 points, fourth try 2 points, fifth try 1 point, and sixth or greater tries 0 points.
    1. Create a flowchart for the algorithm of the game.
    2. Write the code for the game in Trinket based on your flowchart.

Part 2 **(AAP) (P3, P4)** **CR6** **CR7**

1. Test your program by including print statements to track all aspects of the game and run your program several times.
2. Determine a part of the code that would make the program easier to read by creating one or more functions. Update your code with the function(s).
3. Write a paragraph that explains how the code works and how the functions are procedural abstractions that manage the complexity of the program.

CR9
The syllabus must include a description of an activity or series of activities in which students contribute to an inclusive, safe, collaborative, or ethical computing culture. Each activity must be labeled with the related practice.

CR5
The syllabus must include a description of an activity or series of activities in which students develop **and** implement algorithms. Each activity must be labeled with the related practice.

CR6
The syllabus must include a description of an activity or series of activities in which students develop programs that incorporate abstractions. Each activity must be labeled with the related practice.

CR7
The syllabus must include a description of an activity or series of activities in which students evaluate **and** test programs or algorithms. Each activity must be labeled with the related practice.

Unit 3 Abstraction and Digital Data	Unit 3 ▪ Abstraction (Numbers Systems, Procedural Abstraction) ▪ Binary, Octal, Hexadecimal Numbers (Cisco Game, Unplugged Binary Intro, Conversion Worksheets, Decoding Message using ASCII table, Programming Base Conversions) ▪ Digital Information ▪ How Does Data Travel ▪ Bytes, Files Sizes and Storage ▪ Text and Image Compression (programming with compression algorithms and strings) ▪ Steganography ▪ Computing Innovation ▪ *CS Illuminated* Chapters 2 and 3	CRD, DAT, AAP, IOC

Unit 3 Activity Sending Secret Message and Encryption Group Activity (DAT) (P5, P6) **CR3**

- Students will work in groups of 5. Each group of students will create a secret message and break the message into 5 parts, one per member. Each person in the group will encrypt to binary a part of the message and save the binary message as the group# and part#. Example: group1_part1 group1_part2.
- Decipher each group's messages. Each group member will decipher a part of the message. Group member 1 will decipher all part1 from each group.
- Have the groups exchange messages as follows:

  Group 1 and Group 2

  Group 3 and Group 4

  Group 5 and Group 6
- Groups will put the message together and write it on a notecard. Give it back to the Group that sent the message to see if it is correct.

Unit 3 Activity for Computing Innovations (CRD, IOC) (P5) (Computing Innovation 2, Prompts A, B, C) **CR10**

Students will be given the following directions:

You must work in a group of size 3. Go over the Computing Innovations Graphic Organizers from the first quarter. From your computing innovations on the graphic organizers, choose one innovation to explore for this project. Keep in mind that you will need to answer the following questions about the innovation.

A. Indicate the name of the computing innovation and provide a clear, detailed description of its intended purpose (such as the problem that the computing innovation solved, the opportunity that the computing innovation created, or the discovery that the computing innovation made possible). In your description, include both how the computing innovation functions and how the computing innovation is used.

B. Describe in detail how the computing innovation consumes data (as input), produces data (as output), and/or transforms data.

C. Describe at least one data storage concern, data privacy concern, or data security concern related to the computing innovation.

D. Explain a benefit the computing innovation has had, or has the potential to have, on society, economy, or culture.

E. Explain a harmful effect the computing innovation has had, or has the potential to have, on society, economy, or culture.

Each person in your group must investigate these questions. The group should then compile and organize the information to decide on the best responses for each prompt. You must present the information you gather in a 1–3 minute video. Each person must turn in a list of 1–3 online sources used to answer the prompts. At least one source must have been created in the past six months. For each source, include the permanent URL, identify the author, title, source, the date you retrieved the source and, if possible, the date the reference was written or posted.

The videos will be viewed and critiqued by the class. Based on the results of the rubrics and comments, you will have one additional week to revise your final project.

CR10

The syllabus must explicitly identify and describe a minimum of three activities addressing different computing innovations. Within these three activities, students are required to address the following prompts at least once:

a. Explain beneficial and harmful effects of at least one computing innovation on society, economy, or culture.

b. Identify the data used in at least one computing innovation and explain how the data is consumed, produced, or transformed by the given computing innovation.

c. Identify data privacy, security, or storage concerns for at least one computing innovation.

For each activity, use the label Computing Innovation 1, 2, or 3 to identify the activity, and use the label A, B, or C to identify the prompt(s).

Unit 4 The Internet and Security	▪ Internet Exploration ▪ Internet Protocol ▪ Routers, Redundancy, and Packets (program to illustrate routers paths or how routers learn) ▪ DNS in the Real World ▪ Levels of Abstraction (DNS-TCP-IP-Physical Internet) ▪ Cybersecurity ▪ Cryptography and Encryption (program to encrypt/decrypt messages) ▪ Computing Innovations ▪ *CS Illuminated* Chapters 15, 16, and 17	CRD, AAP, CSN, IOC

Unit 4 Activity for How the Internet Works (CSN) (P5) **CR3**

The class will use various physical items to replicate how information is transmitted from sender to receiver through the internet. There should be desks to represent the computers, routers, and destination sites, all attached by wires. Every desk should be supplied with binder clips that can be attached to the wires for sending the packet paper slips and initial request slips. Computers 1–3 have requests for images and send requests out to routers. Routers must determine the best path to destinations and route request to the next set of routers (assume only one message can be sent on a wire at a time). Destinations accept the request and determine what picture should be sent and where it should be sent. Destinations break up pictures into packets and send back to requesting computers using only one wire at a time through a series of routers. Once the portion of the picture is received by the receiving computer, it is placed in the appropriate space in the grid, and an acknowledgement of the receipt of this first packet is sent back to destination. This continues until all parts of the message/picture (packets) arrive at the requesting computer. Note: The routers must always ensure that the quickest path is utilized (as there may be other network traffic or a line that is not currently working that may require a new path to be used that was not used previously). Multiple computers and destinations should run simultaneously.

Unit 4 Activity for Global Impact (IOC) (P5) (Computing Innovation 3, Prompt A) **CR10**

Students will work in groups of four to investigate the internet as a computing innovation. They will be given one of the following questions:

- Has the internet increased freedom around the world?
- Does crowdsourcing benefit society?
- Is social media beneficial or harmful?

A sheet of paper will be divided into four sections. In the top left section one person writes their opinion and why they think that way. The paper is passed to the right and the next person in the top right section reads the partner's response and adds another reason that supports what the partner wrote. The paper is passed to the right and the third person in the bottom left section writes a reason that might be used to argue against what is written in the boxes above. The paper is passed to the right once again and the fourth person reads what is written in all three boxes and gives their own opinion and reason in the last box.

Unit 4 Activity Encryption/Decryption Code Tracing (AAP, IOC) (P2, P4, P6)

Students will be given a hard copy of a program that has functions for encryption and decryption that they have not programmed. Students will then create a message to send and use the code to encrypt the message by hand. They will exchange the messages with a partner and each will use the program to decrypt the message received by hand. They will compare their encrypted messages and what the sender intended to send. If the messages do not match, they will trace the code to see where the error(s) was made.

Unit 5 Simulations	▪ Simulation (program to solve or illustrate a problem) ▪ Parallel and Distributed Computing ▪ Searching and Sorting Algorithms ▪ Computing Innovations ▪ *CS Illuminated* Chapters 13 and 14	CRD, DAT, AAP, CSN, IOC

Unit 5 Activity for Programming with Data (AAP) (P1, P2, P3)

Students will create an audio representation of a data set of their choice. Each student's project must include the following requirements:

- Create a list of data between 20 and 50 data points (Provide the source and context of your data.)
- Loop to access each data point
- Conditional statements to determine what is played based on the data
- Music must play for no less than 50 measures and no more than 100 measures
- Must use at least one function to determine song
- Must use FitMedia
- Must use at least one setEffect
- Must have at least 3 sounds and each sound must be on its own track

Unit 5 Activity for Sorting Algorithms (AAP, CRD) (P1) **CR4**

Work in groups of four. Eight objects, each with a hidden number, will form a list that needs to be sorted in ascending order. The numbers will only be visible to one person called the "controller." Everyone else will then give commands to the controller and attempt to sort the list. However, the controller can only be asked certain specific questions, like comparing two objects by their numerical value, and may only obey certain instructions, like moving an object to a new position or swapping two objects. Determine an algorithm for sorting the objects in ascending order. Groups will exchange algorithms to determine if they will work correctly.

Each group will answer the following discussion questions:

- Did the algorithm you wrote work correctly? If not, what was the problem(s)?
- What algorithms did you use within your sorting algorithm?
- Which group(s) had the most efficient algorithm? How will the size of the data set affect the efficiency?
- Explain how collaboration enabled your group to optimize the algorithm.

Unit 5 Activity for Data (DAT, CRD) (P5, P6)

Collaborate with a partner to explore given datasets and choose one to explore further.

- Explore the dataset using formulas and/or highlighting and manipulations.
- Experiment with different chart types for visualizing that data. Use the Data Visualization 101 guide for ideas.
- Discuss with a partner what is seen in each chart. Have any interesting patterns appeared?
- Choose the two visualizations that were the most interesting or insightful.
- Provide a brief description of the dataset.
- Describe the trend, pattern, or relationship found within the data. How is it shown in the visualization?
- Come up with a possible story or explanation for the trend described. Make sure to note any assumptions made in this interpretation of the data.

Unit 6	CS Principles Performance Task Create **CR11** Students are given 15 class periods (50 minutes), which is at least 9 hours of class time to complete the AP Create Performance Task.	CRD, AAP

NOTE: Bi-weekly debates will be conducted throughout the year on various computing innovations. A moderator will introduce the innovation and describe its function and purpose. The pro side will focus on the transformation/use of data and the beneficial effects of the innovation. The con side will focus on security/storage issues and the harmful effects of the innovation. **(IOC) (P5)** **CR8**

CR4
The syllabus must include a description of an activity or series of activities in which students design or evaluate computational solutions for a purpose. Each activity must be labeled with the related practice.

CR11
The syllabus must include an explicit statement that students are provided with at least nine (9) hours of class time to complete the AP Create Performance Task.

CR8
The syllabus must include a description of an activity or series of activities in which students investigate computing innovations. Each activity must be labeled with the related practice.

Alignment to Topic Questions

Throughout each unit, **Topic Questions** will be provided to help students check their understanding. The Topic Questions are especially useful for confirming understanding of difficult or foundational topics before moving on to new content or skills that build upon prior topics. Topic Questions can be assigned before, during, or after a lesson, and as in-class work or homework. Students will get rationales for each Topic Question that will help them understand why an answer is correct or incorrect, and their results will reveal misunderstandings to help them target the content and skills needed for additional practice.

Students will be assigned Topic Questions aligned to the learning objectives and skills in this unit:

Unit	Big Ideas	Learning Objective and Skill	Topic Questions
Unit 1 Intro to Computer Science and Algorithms	CRD	CRD-1.A(1.C), CRD-1.B(1.C), CRD-1.C(1.C),	Topic 1.1
		CRD-2.A(1.A)	Topic 1.2
		CRD-2.I.a(4.C), CRD-2.I.b(4.C), CRD-2.J(4.C)	Topic 1.4
	AAP	AAP-2.A(2.A)	Topic 3.3
		AAP-2.G(2.A)	Topic 3.6
		AAP-2.J(2.A)	Topic 3.8
		AAP-2.L(1.D), AAP-2.M.a(2.A), AAP-2.M.b(2.B)	Topic 3.9
		AAP-4.A.a(1.D), AAP-4.A.b(1.D), AAP-4.B	Topic 3.17
	CSN	CSN-1.A(5.A)	Topic 4.1
	IOC	IOC-1.A(5.C), IOC-1.B(5.C)	Topic 5.1
		IOC-1.C(5.C), IOC-1.D(5.E)	Topic 5.2
		IOC-1.F(5.E)	Topic 5.5
Unit 2 Programming	CRD	CRD-2.B(4.A), CRD-2.C(3.A), CRD-2.D(3.A)	Topic 1.2
		CRD-2.E(1.B), CRD-2.F(1.B), CRD-2.G(4.A), CRD-2.H(1.C)	Topic 1.3
		CRD-2.I.a(4.C), CRD-2.I.b(4.C), CRD-2.J(4.C)	Topic 1.4
	AAP	AAP-1.A(3.A), AAP-1.B(4.B)	Topic 3.1
		AAP-1.C(3.A), AAP-1.D.a(3.B), AAP-1.D.b(3.C)	Topic 3.2
		AAP-2.B(2.B), AAP-2.C(4.B)	Topic 3.3
		AAP-2.D(4.B)	Topic 3.4
		AAP-2.E.a(2.B), AAP-2.E.b(4.B), AAP-2.F.a(2.B), AAP-2.F.b(4.B)	Topic 3.6
		AAP-2.H.a(2.B), AAP-2.H.b(4.B)	Topic 3.6
		AAP-2.I.a(2.B), AAP-2.I.b(4.B)	Topic 3.7

Unit	Big Ideas	Learning Objective and Skill	Topic Questions
		AAP-2.K.a(2.B), AAP-2.K.b(4.B)	Topic 3.8
		AAP-2.N.a(2.B), AAP-2.N.b(4.B), AAP-2.O.a(2.B), AAP-2.O.b(4.B)	Topic 3.10
		AAP-3.A.a(3.B), AAP-3.A.b(4.B)	Topic 3.12
		AAP-3.B(3.C), AAP-3.C(3.B)	Topic 3.13
		AAP-3.D(2.B)	Topic 3.14
		AAP-3.E.a(2.B), AAP-3.E.b(4.B)	Topic 3.15
	IOC	IOC-1.F(5.E)	Topic 5.5
Unit 3 Abstraction and Digital Data	DAT	DAT-1.A(3.C), DAT-1.B(1.D), DAT-1.C.a(2.B), DAT-1.C.b(2.B)	Topic 2.1
		DAT-1.D(1.D)	Topic 2.2
		DAT-2.B(5.B)	Topic 2.3
		DAT-2.D(2.B), DAT-2.E(5.B)	Topic 2.4
Unit 4 The Internet and Security	CSN	CSN-1.A(5.A), CSN-1.B(5.A), CSN-1.C(5.A), CSN-1.D(5.A)	Topic 4.1
		CSN-1.E.a(1.D), CSN-1.E.b(5.A), CSN-1.E.c(1.D)	Topic 4.2
		CSN-2.A.a(1.D), CSN-2.A.b(1.D), CSN-2.B(1.D)	Topic 4.3
	IOC	IOC-2.A(5.D), IOC-2.B(5.E), IOC-2.C(5.E)	Topic 5.6
Unit 5 Simulations	DAT	DAT-2.A(5.B), DAT-2.C(5.D)	Topic 2.3
	AAP	AAP-2.P.a(1.D), AAP-2.P.b(1.A)	Topic 3.11
		AAP-3.F.a(1.A), AAP-3.F.b(1.D)	Topic 3.16
	CSN	CSN-2.A.a(1.D), CSN-2.A.b(1.D), CSN-2.B(1.D)	Topic 4.3
	IOC	IOC-1.E(1.C)	Topic 5.4