

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ... →	then the learning events need to ....
Stage 1 – Desired Results		
<p><b>Established Goals:</b> PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>• CG2 – Broaden</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T1 - Use the roles of variables to read and understand programs written in a variety of languages</li> </ul>	
	<b>Meaning</b>	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.01) (S1.01, S8.12)</li> <li>• U1.03 - Programming is a creative endeavor (S5.07, S5.01)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K4.05, K4.01)</li> <li>• U4.02 - Algorithms can be analyzed for efficiency, and appropriate algorithms can be selected based upon efficiency</li> <li>• U4.03 - Empirical analysis of algorithms requires a systematic approach (S5.09, S5.13)</li> <li>• U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (S5.01, S4.01)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09, S5.07)</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K4.05)</li> <li>• U5.06 - Functions with arguments make code modular and reusable (S5.01)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How do computers perform complicated tasks built from simple instructions?</li> <li>• How are variables used in programming?</li> <li>• How do programmers approach a complicated problem?</li> <li>• What role does creativity play in algorithmic programming?</li> <li>• What makes for a good process for collaborative software development?</li> </ul>

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<p>participation in computing</p> <ul style="list-style-type: none"> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>function of their code (S8.02)</p> <ul style="list-style-type: none"> <li>• U7.01 - Mobile and networked computing have transformed commerce, social interactions, news sourcing and dissemination, and culture (K7.02, K7.11, K7.13) (S8.07)</li> <li>• U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing (K1.01)</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.05, S8.01)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)</li> <li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)</li> <li>• U8.05 - How people present themselves affects how their work is received (S8.13, S8.12)</li> <li>• U9.01 - Computer science and information technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals (K9.04)</li> <li>• U9.03 - Computational thinking boosts most career paths (K9.04, K9.06)</li> </ul>	
<h3>Acquisition of Knowledge and Skill</h3>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K1.01 - Describe the role of creativity in designing an attractive, functional, and accessible graphical user interface (U1.01, U7.05)</li> <li>• K4.01 - Describe a computer as responding to input in a deterministic manner that depends only on input and on the computer's state (U4.01)</li> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)</li> <li>• K5.01 - Describe ways to identify the existence and</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>• S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode (U5.02)</li> <li>• S5.01 - Design a program by breaking a large plan into smaller modules (U1.03, U5.02, U5.06)</li> <li>• S5.05 - Use the tools incorporated in an IDE</li> </ul>

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	<p>location of errors in software (U5.03)</p> <ul style="list-style-type: none"> <li>• K7.02 - Identify the decade in which milestones occurred in the development of computing and the Internet (U7.01)</li> <li>• K7.11 - Describe examples in which computation has or will create new societal phenomena and human capabilities to perceive and act upon our environment (U7.01)</li> <li>• K7.13 - Describe examples demonstrating that new ways to collaborate and share information are evolving (U7.01)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.01, U9.03)</li> <li>• K9.06 - Describe how computing is connected to innovations in other fields (U9.03)</li> </ul>	<p>and/or higher-level language to create original programming solutions</p> <ul style="list-style-type: none"> <li>• S5.07 - Create a program by incrementally writing and testing modular code (U1.03, U5.03)</li> <li>• S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03)</li> <li>• S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> <li>• S5.13 - Deduce the value of a variable resulting from execution of particular code (U4.03)</li> <li>• S8.01 - Document a software development process (U8.01)</li> <li>• S8.02 - Document a software product using high-level documentation (U5.07)</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)</li> <li>• S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)</li> <li>• S8.07 - Compare to select from among several tools available for collaboration (U7.01)</li> <li>• S8.08 - Collaborate when programming (U8.01)</li> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)</li> <li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li> </ul>
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If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they ...</b>		
U1.01, U1.03, K1.01, S8.12, S5.05	Express themselves creatively	PT1 - Produce a program to play a game or tell a story
U4.01, U5.04	Use algorithms and operations appropriately	
U5.02, U5.03, S5.07	Decompose problems and maintain persistence	
U5.07, U8.04, U8.05, S1.01, S5.10, S8.01, S8.02, S8.04, S8.13	Document and present their creation	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they ...</b>		
U7.01, U7.05, U9.01, U9.03, K7.02, K7.13, K9.04, K9.06	Describe how computing is changing society and describe how computing is changing most fields of work	OE1 - Write about the impact of computing

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<i>K5.01, S5.01, S5.05, S5.07, S8.04, S8.05, S8.07, S8.08, S8.13</i>	<i>Demonstrate helpful practices when collaborating</i>	<i>OE2 - Collaborate when developing software</i>
<i>U4.02, U4.03, U5.04, K4.01, K4.05, S5.09</i>	<i>Use operations, variables, and algorithms</i>	<i>OE4 - Explain and improve code</i>

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Stage 3 – Learning Plan		
LEARNING EVENTS –		
<i>A1.1.1 - Principles</i>	<i>(U7.01, U9.01, U9.03) (K7.02, K9.04, K9.06, K7.11, K7.13)</i>	
<i>A1.1.2 - Lightbot - Input, State, Output</i>	<i>(U4.01, U5.06) (K4.01)</i>	
<i>A1.1.3 - Scratch Graphics and If-Else Blocks</i>	<i>(U4.02, U4.01) (K5.01) (S8.08)</i>	
<i>A1.1.4 - Scratch Objects and Methods</i>	<i>(U4.01) (S8.08)</i>	
<i>A1.1.5 - Scratch Variable Roles Part I</i>	<i>(U4.03, U4.01) (K4.05) (S8.08, S5.13)</i>	
<i>A1.1.6 - Scratch Iteration and Variable Roles Part II</i>	<i>(U4.03, U4.01) (K4.05) (S8.08, S5.13)</i>	

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<p>B1.1.7 - Scratch Game or Story</p>		<p>(U1.01, U1.03, U4.01, U7.05, U8.04, U8.05, U8.01, U5.04, U5.07, U5.03, U5.02, U8.02) (K1.01) (S1.01, S8.08, S8.13, S8.12, S8.09, S8.07, S5.09, S5.07, S5.05, S5.01, S8.04, S8.05, S8.01, S8.02, S4.01, S5.10)</p>
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If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ... →	then the learning events need to ....
<b>Stage 1 – Desired Results</b>		
<p><b>Established Goals:</b> PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG3 – Give students experience working on real world problems for authentic audiences</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T2 - Develop a computational algorithmic solution in a variety of contexts and disciplines.</li> </ul>	
	<b>Meaning</b>	
<p><b>UNDERSTANDINGS – Students will understand that ...</b></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.03, K1.01) (S1.01, S1.04, S8.12)</li> <li>• U1.03 - Programming is a creative endeavor (S5.07, S5.03, S5.01)</li> <li>• U2.01 - Binary sequences represent digital data (K2.02, K2.03, K2.01, K2.16) (S2.06, S2.07)</li> <li>• U2.06 - The solution to one problem can be applied to another seemingly unrelated problem by identifying and reusing a pattern (S5.03)</li> <li>• U2.08 - Physical systems, like sound or biological molecules, have both digital and analog characteristics</li> <li>• U4.01 - Programs implement algorithms to solve problems (K4.05, K4.06)</li> <li>• U4.03 - Empirical analysis of algorithms requires a systematic approach (S5.09, S5.02, S5.13)</li> </ul>	<p><b>ESSENTIAL QUESTIONS - Students will keep considering ...</b></p> <ul style="list-style-type: none"> <li>• What do programming languages and development environments have in common?</li> <li>• What can be represented by binary data?</li> <li>• What contributes to an effective process for software development?</li> <li>• How can a program be analyzed, understood, and modified?</li> </ul>	

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<p>with the tools necessary for skill acquisition outside the scope of the pathway</p> <ul style="list-style-type: none"> <li>PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>CG2 – Broaden participation in computing</li> <li>CG3 - Develop professional skills</li> <li>CG4 - Excite and enthuse all students about CS</li> <li>CG5 - De-mystify the fundamental black boxes of computing</li> <li>CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool (S5.05, S5.03)</li> <li>U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (K4.06) (S5.01, S4.01, S5.11)</li> <li>U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09, S5.07)</li> <li>U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K4.05) (S2.07)</li> <li>U5.06 - Functions with arguments make code modular and reusable (S5.01, S5.11)</li> <li>U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing (K1.03, K1.01)</li> <li>U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.05, S8.01)</li> <li>U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)</li> <li>U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)</li> <li>U8.05 - How people present themselves affects how their work is received (S8.13, S8.12)</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>K1.01 - Describe the role of creativity in designing an attractive, functional, and accessible graphical user interface (U1.01, U7.05)</li> <li>K1.03 - Describe the role of creativity in designing a mobile application to solve a problem (U1.01, U7.05)</li> <li>K2.01 - Describe the ways in which various types of digital data can be represented in binary (U2.01)</li> <li>K2.02 - Distinguish continuous and discrete</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>S1.04 - Create a graphical user interface (U1.01)</li> <li>S2.06 - Consider implications of converting data from one representation to another, for example</li> </ul>

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	<p>phenomena and identify digital and analog data (U2.01)</p> <ul style="list-style-type: none"> <li>• K2.03 - Describe layers of abstraction that help people represent and use data (U2.01)</li> <li>• K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction</li> <li>• K2.16 - Describe the implications of the limited precision of digital information in applications (U2.01)</li> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)</li> <li>• K4.06 - Recognize events and event-handlers implied by a user interface (U4.01, U5.02)</li> <li>• K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives</li> <li>• K9.06 - Describe how computing is connected to innovations in other fields</li> </ul>	<p>noise or compression (U2.01)</p> <ul style="list-style-type: none"> <li>• S2.07 - Convert a given quantity among bases 2, 10, and 16 (U2.01, U5.04)</li> <li>• S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode (U5.02)</li> <li>• S5.01 - Design a program by breaking a large plan into smaller modules (U1.03, U5.02, U5.06)</li> <li>• S5.02 - Analyze and test code from other people (U4.03)</li> <li>• S5.03 - Extend, or apply to new purpose, code from other people (U1.03, U2.06, U5.01)</li> <li>• S5.05 - Use the tools incorporated in an IDE and/or higher-level language to create original programming solutions (U5.01)</li> <li>• S5.07 - Create a program by incrementally writing and testing modular code (U1.03, U5.03)</li> <li>• S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03)</li> <li>• S5.10 - Create readable code with a combination of documentation and comments</li> <li>• S5.11 - Encapsulate a set of related statements in a function or procedure (U5.02, U5.06)</li> <li>• S5.13 - Deduce the value of a variable resulting from execution of particular code (U4.03)</li> <li>• S8.01 - Document a software development process (U8.01)</li> <li>• S8.02 - Document a software product using high-level documentation</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)</li> <li>• S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)</li> <li>• S8.07 - Compare to select from among several tools available for collaboration</li> <li>• S8.08 - Collaborate when programming (U8.01)</li> </ul>
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# Instructional Design Framework CSE: Unit 1 – Lesson 1



		<ul style="list-style-type: none"> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)</li> <li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li> <li>•</li> </ul>
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<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ....</i>

## Stage 2 – Evidence

Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S) – Students will show that they really understand when they...</b>		
<i>U1.01, U1.03,</i>	<i>Show creativity when solving a problem</i>	<i>PT1 - Identify a problem or need and develop an app to address the problem or need.</i>
<i>K1.01, K1.03</i>	<i>Document a design process and product</i>	
<i>U8.01, U8.02</i>	<i>Collaborate and reflect on collaboration</i>	
<i>U2.06, U4.01, U5.04, K4.06</i>	<i>Design or select and implement algorithms to create an app</i>	
<i>U8.04, U8.05, S5.10</i>	<i>Explain the algorithms used by an app they have developed</i>	
<i>U5.02, U5.03</i>	<i>Present a problem and the progress and next steps during development of a solution</i>	
<i>U5.06, K5.01</i>	<i>Demonstrate problem decomposition, persistence, and iterative development</i>	

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<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U2.01, U2.08, K2.01, K2.02, K2.03, K2.16	Correctly represent numeric, text, and color data	OE1 - Represent numeric, text, and color data with binary sequences, and explain the abstraction represented by using a digital representation
U5.01, K2.04	Describe strengths and weaknesses of tools	OE2 - Contrast development environments and programming languages
U5.06	Discuss modularity and reusability as strategies for handling complexity	OE3 - Explain the abstraction of a function or procedure and its arguments
U7.05	Consider the impact of networked, mobile, and embedded computing	OE4 - Write about future opportunities created by computing
K9.04, K9.06	Consider career opportunities	
K4.05	Identify patterns in which an algorithm uses variables	OE5 - Analyze code

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Stage 3 – Learning Plan		
<i>LEARNING EVENTS – Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A1.2.1 - Bits and Bytes</i>	<i>U5.04, U2.08, K2.02, K2.03, K9.06, K2.16, S2.06, S2.07</i>	<i>U2.01, K2.01</i>
<i>A1.2.2 - Introducing App Inventor</i>	<i>U4.01</i>	
<i>A1.2.3 - Creating An App</i>	<i>U4.01, K4.06</i>	
<i>A1.2.4 - Analyzing A Program</i>	<i>U4.03, U4.01, U5.06, U5.02, K5.01, K4.05, S8.08, S5.02, S4.01, S5.13</i>	
<i>P1.2.5 - Modifying A Program</i>	<i>U4.03, U4.01, U2.06, K9.04, S8.08, S5.09, S5.03</i>	
<i>B1.2.6 - Designing an App</i>		<i>U1.01, U1.03, U4.01, U7.05, U8.04, U8.05, U8.01, U5.01, U5.03, U5.02, U8.02, K1.03, K1.01, K2.04, S1.01, S1.04, S5.10, S8.08, S8.13, S8.12, S8.09, S8.07, S5.07, S5.05, S5.01, S8.04, S8.05, S8.01, S8.02, S4.01, S5.10, S5.11</i>

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## Stage 1 – Desired Results

<p><b>Established Goals:</b> PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T3 - Select and use libraries of code written by other people by referring to documentation</li> <li>• T4 - Develop proficiency learning an unfamiliar programming language</li> </ul>	
	<b>Meaning</b>	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.03 - Programming is a creative endeavor (S5.07, S5.03, S5.01)</li> <li>• U2.01 - Binary sequences represent digital data (K2.03, K2.01, K7.08, K2.16) (S2.06)</li> <li>• U2.02 - Computing relies on layers of abstraction in software (K2.04, K2.16) (S5.11, S5.12)</li> <li>• U2.04 - Abstraction allows for simple utilization of other people's code (S5.04, S5.03)</li> <li>• U2.05 - Solutions to complex problems can be encapsulated in reusable components (K5.03) (S5.11, S5.12)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K5.02, K4.05, K4.01) (S5.12)</li> <li>• U4.02 - Algorithms can be analyzed for efficiency, and appropriate algorithms can be selected based upon efficiency (S4.02)</li> <li>• U4.03 - Empirical analysis of</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• What can be represented by binary data?</li> <li>• How does abstraction make the software development process easier?</li> <li>• What are the practices that lead to effective collaboration?</li> <li>• What role does creativity play in algorithmic programming?</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>algorithms requires a systematic approach (S5.09, S5.08, S5.02, S5.13)</p> <ul style="list-style-type: none"> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool (K5.03, K5.02) (S5.05, S5.04, S5.03, S8.11)</li> <li>• U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (S5.01, S4.01, S5.11)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09, S5.07)</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K5.02, K4.05) (S5.08)</li> <li>• U5.06 - Functions with arguments make code modular and reusable (K5.02) (S5.01, S5.11, S5.12)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code (K5.03)</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.09, S5.06, S5.10)</li> <li>• U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.05, S8.01)</li> <li>• U8.02 - Working in a team requires</li> </ul>	
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)</p> <ul style="list-style-type: none"> <li>• U8.03 - Collaboration allows communities to create software that can impact people's lives (K8.01) (S8.08, S8.03)</li> <li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)</li> <li>• U8.05 - How people present themselves affects how their work is received (S8.10, S8.13, S8.12)</li> <li>• U9.02 - Parallel computing is a quickly evolving field relevant to hardware, software, and users</li> </ul>	
<b>Acquisition of Knowledge and Skill</b>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K2.01 - Describe the ways in which various types of digital data can be represented in binary (U2.01)</li> <li>• K2.03 - Describe layers of abstraction that help people represent and use data (U2.01)</li> <li>• K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction (U2.02)</li> <li>• K4.01 - Describe a computer as responding to input in a deterministic manner that depends only on input and on the computer's state (U4.01)</li> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>• S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02)</li> <li>• S2.06 - Consider implications of converting data from one representation to another, for example noise or compression (U2.01)</li> <li>• S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode (U5.02)</li> <li>• S4.02 - Evaluate a program for efficiency (U4.02)</li> <li>• S5.01 - Design a program by</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>collection (U4.01, U5.04)</p> <ul style="list-style-type: none"> <li>• K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)</li> <li>• K5.02 - Describe the role that functions play in developing software (U4.01, U5.01, U5.04, U5.06)</li> <li>• K5.03 - Distinguish among a variety of educational and reference resources related to code libraries (U2.05, U5.01, U5.07)</li> <li>• K8.01 - Describe a version control system (U7.01, U8.03)</li> <li>• K9.02 - Describe the impact that computing has had in the social sciences, geography, and civics</li> </ul>	<p>breaking a large plan into smaller modules (U1.03, U5.02, U5.06)</p> <ul style="list-style-type: none"> <li>• S5.02 - Analyze and test code from other people (U4.03)</li> <li>• S5.03 - Extend, or apply to new purpose, code from other people (U1.03, U2.04, U5.01)</li> <li>• S5.04 - Explore and use documentation and public information to extend the student's own knowledge of a programming language or to achieve a computational approach to solve a problem (U2.04, U5.01)</li> <li>• S5.05 - Use the tools incorporated in an IDE and/or higher-level language to create original programming solutions (U5.01)</li> <li>• S5.06 - Evaluate programs written by others for readability (U5.08)</li> <li>• S5.07 - Create a program by incrementally writing and testing modular code (U1.03, U5.03)</li> <li>• S5.08 - Identify appropriate boundary conditions for testing a program (U4.03, U5.04)</li> <li>• S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03, U5.08)</li> <li>• S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> <li>• S5.11 - Encapsulate a set of related statements in a function or procedure (U2.02, U2.05, U5.02, U5.06)</li> <li>• S5.12 - Create a function to</li> </ul>
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



- perform a particular calculation from the function's arguments (U2.02, U2.05, U4.01, U5.06)
- S5.13 - Deduce the value of a variable resulting from execution of particular code (U4.03)
  - S7.02 - Work with a group to agree on a policy or protocol (U7.01)
  - S8.01 - Document a software development process (U8.01)
  - S8.03 - Use a version control system (U8.03)
  - S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)
  - S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)
  - S8.07 - Compare to select from among several tools available for collaboration (U7.01)
  - S8.08 - Collaborate when programming (U8.01, U8.03)
  - S8.09 - Collaborate when presenting (U8.01, U8.02)
  - S8.10 - Present original research and research from literature (U8.05)
  - S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience (U5.01)
  - S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)
  - S8.13 - Communicate the

## Instructional Design Framework CSE: Unit 1 – Lesson 1



		progress on a project, including accomplishments and next steps (U8.05)
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ...
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they...</b>		
U1.03, U4.01, U5.04, S5.02, S5.05	Implement an algorithm for complex strategy	<p><i>PT1 - Create a function to implement an algorithm that carries out an intelligent strategy in a multi-player game in which the opponent's psyche must be considered. The algorithm is informed by the game history between the strategy algorithm itself and the opponent.</i></p>
U2.02, U2.05, U5.02, U5.06, U5.08, K5.02, S5.11	Organize code well, with functions to support decomposition, reuse, and abstraction	
U5.03, S5.01, S8.03	Demonstrate persistence and an iterative development process	
U5.08, S4.01, S5.10	Explain a strategy and the algorithm created to implement a strategy	
U8.01, U8.02, S8.08	Effectively collaborate	
K8.01, S8.03	Use an agreed upon process to version control collaborative work	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they</b>		
<i>U2.01, U2.02, K2.01, K2.03</i>	<i>Describe the fetch-execute cycle of one processor core</i>	<i>OE1 - Describe a processor's execution of instructions</i>
<i>U9.02, K4.01</i>	<i>Describe how programs run on a multicore processor</i>	
<i>S4.01, S5.01, S5.02, S5.05, S5.13</i>	<i>Provide corresponding descriptions of an algorithm in natural language, pseudocode, and code</i>	<i>OE2 - Create code</i>
<i>K5.02, S5.11, S5.12</i>	<i>Create modular solutions, demonstrated by creation of functions and problem decomposition</i>	
<i>U5.04, K2.03</i>	<i>Use various data types</i>	
<i>K4.05</i>	<i>Recognize patterns employing variables</i>	<i>OE3 - Analyze and improve other's code</i>
<i>S5.06, S5.09, S5.10</i>	<i>Improve readability</i>	
<i>S5.08</i>	<i>Evaluate boundary conditions</i>	
<i>U8.02, S8.08</i>	<i>Effectiveness of collaborative approach</i>	<i>OE4 - Develop code collaboratively</i>
<i>K5.01, S5.01</i>	<i>Debug and decompose code with persistence</i>	
<i>K8.01, S8.03, S8.07</i>	<i>Agree on and use a version control system</i>	
<i>U8.01</i>	<i>Reflect on collaboration</i>	
<i>U4.02, U4.03, S4.02</i>	<i>Correctly compare two algorithms</i>	<i>OE5 - Compare two algorithms in terms of equivalency and speed</i>
<i>U7.05, K9.02</i>	<i>Show awareness and interest in the impact of computing on careers</i>	<i>OE6 - Describe career opportunities created by or impacted by computing</i>

U8.03	Describe computing work as collaborative	
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
Stage 3 – Learning Plan		
LEARNING EVENTS–		
Activity (A), Project (P), or Problem (B)	Assessment for Learning	Assessment of Learning
A1.3.1 - Instructions as Data	(U4.01, U9.02, U2.01, U2.02) (K2.03, K4.01)	
A1.3.2 - Python Variables and Functions	(U4.01, U5.04, U5.06, U5.02) (K5.02, K4.05) (S8.08, S5.11, S5.12)	
A1.3.3 - Branching and Output	(U4.02, U4.01, U5.04) (K5.02, K5.01) (S8.08, S5.08, S4.02, S5.12)	
A1.3.4 - Nested Branching and Input	(U4.03, U4.01, U5.04) (K5.02, K5.01) (S8.08, S5.08, S5.12)	

# Instructional Design Framework CSE: Unit 1 – Lesson 1



A1.3.5 - Collections with Strings	(U4.03, U4.01, U5.04, U5.08) (K5.02, K5.01, K4.05) (S8.08, S5.08, S5.06, S5.01, S5.11, S5.12, S5.13)	
A1.3.6 - Collections with Tuples and Slicing	(U4.03, U4.01, U5.04, U5.08) (K5.02, K5.01, K4.05) (S8.08, S5.08, S5.06, S5.01, S5.11, S5.12, S5.13)	
A1.3.7 - Iteration with For Loops	(U4.03, U4.01, U5.04, U5.08) (K5.02, K5.01, K4.05) (S8.08, S5.08, S5.06, S5.01, S5.11, S5.12, S5.13)	
A1.3.8 - Iteration with While Loops	(U4.03, U4.01, U5.04, U5.08) (K5.02, K5.01, K4.05) (S8.08, S5.08, S5.06, S5.01, S5.11, S5.12, S5.13)	
A1.3.9 - Tools for Collaboration	(U1.03, U5.03, U7.05, U8.01, U8.02) (K7.04, K8.01) (S8.08, S8.07, S8.03)	
P1.3.10 - Prisoner's Dilemma		(U1.03, U4.03, U4.01, U7.05, U8.03, U8.01, U5.03, U2.05, U8.02) (K8.01, K7.04, K9.02) (S8.08, S8.07, S5.09, S5.05, S5.02, S8.03, S4.01, S5.10)

# Instructional Design Framework

Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ....</i>

## Stage 1 – Desired Results

<p><b>Established Goals:</b> PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul>	Transfer	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T3 - Select and use libraries of code written by other people by referring to documentation</li> <li>• T4 - Develop proficiency learning an unfamiliar programming language</li> </ul>	
	Meaning	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (S1.01, S8.12)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.05)</li> <li>• U1.03 - Programming is a creative endeavor (S5.07, S5.03, S5.01)</li> <li>• U2.01 - Binary sequences represent digital data (K2.03, K2.01, K7.08, K2.16) (S2.06)</li> <li>• U2.02 - Computing relies on layers of abstraction in software (K2.04, K2.16) (S5.11, S5.12)</li> <li>• U2.04 - Abstraction allows for simple utilization of other people's code (S5.04, S5.03)</li> <li>• U2.05 - Solutions to complex problems can be encapsulated in reusable components (K5.03) (S5.11, S5.12)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K5.02, K4.05, K4.01) (S5.12)</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• What can be represented by binary data?</li> <li>• How does abstraction make the software development process easier?</li> <li>• What are the practices that lead to effective collaboration?</li> <li>• What role does creativity play in algorithmic programming?</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool (K5.03, K5.02) (S5.05, S5.04, S5.03, S8.11)</li> <li>• U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (S5.01, S4.01, S5.11)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09, S5.07)</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K5.02, K4.05) (S5.08)</li> <li>• U5.06 - Functions with arguments make code modular and reusable (K5.02) (S5.01, S5.11, S5.12)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code (K5.03)</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.09, S5.06, S5.10)</li> <li>• U7.01 - Mobile and networked computing have transformed commerce, social interactions, news sourcing and dissemination, and culture (K8.01, K7.04) (S7.02, S8.07)</li> <li>• U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a</li> </ul>	
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>result of collaboration (S8.08, S8.09, S8.05, S8.01)</p> <ul style="list-style-type: none"> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)</li> <li>• U8.03 - Collaboration allows communities to create software that can impact people's lives (K8.01) (S8.08, S8.03)</li> <li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)</li> <li>• U8.05 - How people present themselves affects how their work is received (S8.10, S8.13, S8.12)</li> <li>• U9.02 - Parallel computing is a quickly evolving field relevant to hardware, software, and users</li> </ul>	
Acquisition of Knowledge and Skill		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K2.01 - Describe the ways in which various types of digital data can be represented in binary (U2.01)</li> <li>• K2.03 - Describe layers of abstraction that help people represent and use data (U2.01)</li> <li>• K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction (U2.02)</li> <li>• K2.16 - Describe the implications of the limited precision of digital information in applications (U2.01, U2.02)</li> <li>• K4.01 - Describe a computer as</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>• S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02)</li> <li>• S2.06 - Consider implications of converting data from one representation to another, for example noise or compression (U2.01)</li> <li>• S2.10 - Work with a file system tree</li> <li>• S4.01 - Communicate a design for a program using natural</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>responding to input in a deterministic manner that depends only on input and on the computer's state (U4.01)</p> <ul style="list-style-type: none"> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)</li> <li>• K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)</li> <li>• K5.02 - Describe the role that functions play in developing software (U4.01, U5.01, U5.04, U5.06)</li> <li>• K5.03 - Distinguish among a variety of educational and reference resources related to code libraries (U2.05, U5.01, U5.07)</li> <li>• K7.04 - Articulate a range of positions on the question of ownership of bits (U7.01)</li> <li>• K7.05 - Describe what metadata contain and how they can be used</li> <li>• K7.08 - Discuss societal implications of the persistence and the ease of copying digital information (U2.01)</li> <li>• K8.01 - Describe a version control system (U7.01, U8.03)</li> <li>• K9.02 - Describe the impact that computing has had in the social sciences, geography, and civics</li> </ul>	<p>language, diagrams, and pseudocode (U5.02)</p> <ul style="list-style-type: none"> <li>• S4.02 - Evaluate a program for efficiency (U4.02)</li> <li>• S5.01 - Design a program by breaking a large plan into smaller modules (U1.03, U5.02, U5.06)</li> <li>• S5.02 - Analyze and test code from other people (U4.03)</li> <li>• S5.03 - Extend, or apply to new purpose, code from other people (U1.03, U2.04, U5.01)</li> <li>• S5.04 - Explore and use documentation and public information to extend the student's own knowledge of a programming language or to achieve a computational approach to solve a problem (U2.04, U5.01)</li> <li>• S5.05 - Use the tools incorporated in an IDE and/or higher-level language to create original programming solutions (U5.01)</li> <li>• S5.06 - Evaluate programs written by others for readability (U5.08)</li> <li>• S5.07 - Create a program by incrementally writing and testing modular code (U1.03, U5.03)</li> <li>• S5.08 - Identify appropriate boundary conditions for testing a program (U4.03, U5.04)</li> <li>• S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03, U5.08)</li> <li>• S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> </ul>
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



- S5.11 - Encapsulate a set of related statements in a function or procedure (U2.02, U2.05, U5.02, U5.06)
- S5.12 - Create a function to perform a particular calculation from the function's arguments (U2.02, U2.05, U4.01, U5.06)
- S5.13 - Deduce the value of a variable resulting from execution of particular code (U4.03)
- S7.02 - Work with a group to agree on a policy or protocol (U7.01)
- S8.01 - Document a software development process (U8.01)
- S8.03 - Use a version control system (U8.03)
- S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)
- S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)
- S8.07 - Compare to select from among several tools available for collaboration (U7.01)
- S8.08 - Collaborate when programming (U8.01, U8.03)
- S8.09 - Collaborate when presenting (U8.01, U8.02)
- S8.10 - Present original research and research from literature (U8.05)
- S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience (U5.01)

## Instructional Design Framework CSE: Unit 1 – Lesson 1



		<ul style="list-style-type: none"><li>• S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)</li><li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li></ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
		UbD Page 9

## Stage 2 – Evidence

Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S) – Students will show that they really understand when they ...</b>		
U1.01, U1.03, U4.01, U5.01, S4.01, S5.11, S5.12	Create a software solution to a problem	PT1 - Describe an algorithm in natural language, pseudocode, and code that could be used to modify an image. Script the implementation of that algorithm across a set of images.
U5.02, U5.03, S5.01, S5.05, S5.07	Decompose a problem and show persistence while solving the component subproblems	
U5.07, U5.08, S4.01, S5.10, S8.01, S8.03	Document the development of a solution and create readable code	
U8.01, U8.02, U8.03, S7.02, S8.04, S8.05, S8.07, S8.08	Collaborate with team members and reflect upon collaboration	
U1.02, U8.04, U8.05, K4.01, S1.05, S8.09, S8.13	Present a product a development process	
U2.02, U2.04, U2.05, U5.06, K2.03, K2.04, S4.01, S5.03, (and for differentiation by enrichment: K5.02, S2.06, S4.02)	Present abstractions that were created or used	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
K2.03, K2.04	Use UML to describe methods and attributes of a class	OE1 - Discuss and write about abstraction
U2.02, K2.03, K2.04, K5.02	Use prose to describe concepts of class, object, attributes, and methods	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



U2.01, U5.04, K2.01, K2.16	Represent images as RGBpixel arrays	OE2 - Manipulate images using iteration
U4.01, U5.04, K4.05, S1.01	Use lists and arrays as data abstractions	
S2.10	Navigate a file system and examine filenames and metadata	OE3 - Work with file system trees
U1.01, U2.04, U2.05, U5.03	Use an object-oriented API	OE4 - Manipulate images using object-oriented method calls
U5.01, U5.07, K5.03, S5.02, S5.03, S5.04, S5.06	Learn from documentation	
U5.04, U5.06, K4.01, K4.05, S1.01, S5.12, S5.13	Iterate an object.method() call across a list of objects	
U8.02, S7.02	Demonstrate effective teamwork	
K5.01, S5.07, S5.08, S5.09, S5.10, S5.11	Demonstrate helpful programming practices	
K2.01, K7.05	Describe metadata	OE5 - Read, write, and speak about societal issues involving digital data  (Opportunity #1 to create a response to the College Board AP CS Principles Explore Performance Task)
U7.09, S8.10, S8.11, K7.11	Analyze short- and long-term beneficial and harmful impacts of a computing innovation; create a professional technical report and a creative visual artifact about the innovation (Opportunity #1 for CS Principles Explore PT)	
U7.05, K7.04	Argue for greater or lesser property rights	
U7.01, U9.02	Place the present in a historical context of rapid change	
K7.08, K9.02	Describe issues around persistence of data and privacy	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ...</i>
<b>Stage 3 – Learning Plan</b>		
<b>LEARNING EVENTS –</b>		
<i>Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A1.4.1 - Procedural Abstraction</i>	<i>(U4.01, U5.04, U5.02, U2.02) (K5.02)</i>	
<i>A1.4.2 - Images as Files and Objects</i>	<i>(U4.01, U5.04, U2.01) (K2.03, K2.01, K2.04, K2.16, K4.05) (S8.08, S2.06, S2.10, S5.04, S5.13)</i>	
<i>A1.4.3 - Images as Arrays</i>	<i>(U4.01, U5.04, U2.01) (K2.03, K2.01, K2.04, K2.16, K4.05) (S8.08, S2.06, S5.04, S5.13)</i>	
<i>A1.4.4 - Python Imaging Library API</i>	<i>(U4.01, U5.07, U5.06, U5.01, U2.04, U2.05, U2.02) (K5.03, K5.02, K2.03, K2.04, K7.05) (S8.08, S5.05, S5.04, S5.03, S8.11)</i>	
<i>P1.4.5 - Algorithms for Images</i>	<i>(U4.01, U5.07, U5.06, U5.01, U2.04, U2.05, U2.02) (K5.03, K5.02, K2.03, K2.04, K7.05) (S8.08, S5.05, S5.04, S5.03, S8.11)</i>	
<i>A1.4.6 - Digital Property and Forensics</i>	<i>(U7.01) (K7.04, K7.08) (S7.02, S8.10, S8.07, S8.11)</i>	

# Instructional Design Framework CSE: Unit 1 – Lesson 1



B1.4.7 - Image Artist		(U1.01, U1.03, U1.02, U4.01, U8.04, U8.05, U8.01, U5.04, U5.06, U5.03, U8.02) (S1.01, S1.05, S8.08, S8.13, S8.12, S8.09, S5.07, S5.01, S8.04, S8.05, S8.01, S4.01, S5.10)
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
<b>Stage 1 – Desired Results</b>		
<p><b>Established Goals:</b></p> <p>PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T5 - Select tools and use documentation to develop skill with a tool</li> <li>• T6 - Create an effective user interface for a computational problem related to the students' own interests and needs</li> <li>• T7 - Design solutions with human-centric considerations</li> <li>• T8 - Solve problems by breaking them down into modular parts</li> <li>• T9 - Approach problems with persistence, curiosity, and an iterative approach</li> </ul>	
	<b>Meaning</b>	
<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.01) (S1.01, S1.04, S8.12)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.05)</li> <li>• U1.03 - Programming is a creative endeavor (S5.07, S5.03, S5.01)</li> <li>• U2.02 - Computing relies on layers of abstraction in software (K2.04) (S5.11)</li> <li>• U2.04 - Abstraction allows for simple utilization of other people's code (S5.04, S5.03)</li> <li>• U2.05 - Solutions to complex problems can be encapsulated in reusable components (K5.03, K2.10) (S5.11)</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How does abstraction make the software development process easier?</li> <li>• What are the practices that lead to effective collaboration?</li> <li>• What role does creativity play in algorithmic programming?</li> <li>• How is computing affecting the way we live our lives?</li> <li>• How will computing change our world?</li> </ul>	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</p> <ul style="list-style-type: none"> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>• U2.06 - The solution to one problem can be applied to another seemingly unrelated problem by identifying and reusing a pattern (K2.10, K4.02) (S5.03)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K5.02, K4.05, K4.06, K4.02)</li> <li>• U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts (K4.02) (S5.03)</li> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool (K5.03, K5.02) (S5.05, S5.04, S5.03, S8.11)</li> <li>• U5.02 Solutions in a programming language are created by breaking a problem apart into component problems (K4.06) (S5.01, S4.01, S5.11)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09, S5.07)</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K5.02, K4.05) (S5.08)</li> <li>• U5.05 - The user interface of a piece of software can greatly affect how it is used (S1.05, S1.04)</li> <li>• U5.06 - Functions with arguments make code modular and reusable (K5.02) (S5.01, S5.11)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code (K5.03) (S8.02)</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.09, S5.06, S5.10)</li> <li>• U7.03 - Assistive technologies using hardware and software can extend human capabilities (K7.11)</li> <li>• U7.04 - Making information accessible to all people requires attention from a variety of stakeholders (S1.05)</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.05, S8.01)</li> </ul>	
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<ul style="list-style-type: none"><li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)</li><li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)</li><li>• U8.05 - How people present themselves affects how their work is received (S8.13, S8.12)</li><li>• U9.01 - Computer science and information technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals (K9.05, K9.04)</li></ul>	
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## Acquisition of Knowledge and Skill

### *KNOWLEDGE – Students will have the knowledge to...*

- K1.01 - Describe the role of creativity in designing an attractive, functional, and accessible graphical user interface (U1.01)
- K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction (U2.02)
- K2.10 - Describe the model-view-controller pattern and relate to a particular software solution (U2.05, U2.06)
- K4.02 - Recognize that a solution to one problem, such as a particular sorting or optimization task, can be used to solve seemingly dissimilar problems (U2.06, U4.01, U4.04)
- K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)
- K4.06 - Recognize events and event-handlers implied by a user interface (U4.01, U5.02)
- K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)
- K5.02 - Describe the role that functions play in developing software (U4.01, U5.01, U5.04, U5.06)
- K5.03 - Distinguish among a variety of educational and reference resources related to code libraries (U2.05, U5.01, U5.07)
- K7.11 - Describe examples in which computation has or will create new societal phenomena and human capabilities to perceive and act upon our environment (U7.03)
- K8.01 - Describe a version control system
- K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.01)
- K9.05 - Identify fields of computing careers (U9.01)

### *SKILLS – Students will have the skills to...*

- S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)
- S1.04 - Create a graphical user interface (U1.01, U5.05)
- S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02, U5.05, U7.04)
- S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode (U5.02)
- S5.01 - Design a program by breaking a large plan into smaller modules (U1.03, U5.02, U5.06)
- S5.03 - Extend, or apply to new purpose, code from other people (U1.03, U2.04, U2.06, U4.04, U5.01)
- S5.04 - Explore and use documentation and public information to extend the student's own knowledge of a programming language or to achieve a computational approach to solve a problem (U2.04, U5.01)
- S5.05 - Use the tools incorporated in an IDE and/or higher-level language to create original programming solutions (U5.01)
- S5.06 - Evaluate programs written by others for readability (U5.08)
- S5.07 - Create a program by incrementally writing and testing modular code (U1.03, U5.03)
- S5.08 - Identify appropriate boundary conditions for testing a program (U4.03, U5.04)
- S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03, U5.08)
- S5.10 - Create readable code with a combination of documentation and comments (U5.08)

# Instructional Design Framework CSE: Unit 1 – Lesson 1



		<ul style="list-style-type: none"><li>• S5.11 - Encapsulate a set of related statements in a function or procedure (U2.02, U2.05, U5.02, U5.06)</li><li>• S8.01 - Document a software development process (U8.01)</li><li>• S8.02 - Document a software product using high-level documentation (U5.07)</li><li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)</li><li>• S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)</li><li>• S8.07 - Compare to select from among several tools available for collaboration</li><li>• S8.08 - Collaborate when programming (U8.01)</li><li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li><li>• S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience (U5.01)</li><li>• S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)</li><li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li></ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S) – Students will show that they really understand when they...</b>		
<i>U5.04, U2.02, U2.04, U4.01, U4.04, U5.06, K2.04, K2.10, K4.05, S5.03, S5.04</i>	<i>Use operations and data/procedural abstractions</i>	<i>PT1 - Create a user interface with code.</i>
<i>U2.05, U5.01, U5.02, U5.08, K5.02, S1.04, S5.01, S5.05, S5.07, S5.10, S5.11</i>	<i>Create modular, commented code reflecting decomposition</i>	
<i>U1.01, U1.03, U5.03, U5.07, K1.01, K5.01, K8.01, S1.01, S4.01, S5.08, S8.01, S8.02, S8.04</i>	<i>Document a project with iterative cycles of problem definition and creative development with version control</i>	
<i>U8.02, S8.05, S8.07, S8.08</i>	<i>Collaborate</i>	
<i>U8.01, K1.01</i>	<i>Reflect</i>	
<i>U8.04, U8.05, S8.09, S8.12, S8.13</i>	<i>Present</i>	
<i>U1.02, U4.04, U5.05, K4.06, S1.05</i>	<i>Evaluate and suggest improvements that demonstrate knowledge of usability criteria</i>	<i>PT2 - Evaluate a user interface and suggest improvements for usability and accessibility.</i>
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		

## Instructional Design Framework CSE: Unit 1 – Lesson 1



U7.03, K7.11, K9.04	<i>Give examples in which computing extends perception and ability to act</i>	<i>OE1 - Communicate orally and in writing ideas about human-computer interfaces</i>
U7.04, U5.05, K9.04, S1.05	<i>Give examples of ways a user interface excludes people or might be changed to include people</i>	
U9.01, K9.05, K1.01, K9.04	<i>Write about an HCI job</i>	
U4.04, K4.06	<i>Write about events and event handlers that are inferred from a user interface</i>	
U5.01, U5.07, K2.04, K5.01, K5.02, K5.03, S1.01, S1.04, S5.04, S5.03, S5.04, S5.05, S8.11	<i>Fix bugs and use API functions from documentation</i>	<i>OE2 - Modify and create code</i>
U5.04, U4.01, U5.03, U5.04, K4.05, S5.07, S5.08	<i>Appropriately apply operations to object attributes</i>	
U8.01, U8.02, U8.04, U8.05, S5.06, S8.08, S8.12	<i>Collaborate</i>	
U4.01, U5.06, U4.04, K4.05	<i>Iterate a function call, passing the function a variable related to the iteration</i>	
U2.06, K2.10, K4.02, S4.01	<i>Identify the model, view, and controller design elements in an interface</i>	<i>OE3 - Explain an interface and the data behind it using the model-view-controller pattern</i>

Instructional Design Framework			
Stage 1	Stage 2	Stage 3	
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>	
Stage 3 – Learning Plan			
LEARNING EVENTS –			
<i>Activity (A), Project (P), or Problem (B)</i>		<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A1.5.1 - Human-Computer Interaction</i>		<i>U7.03, U7.04, U9.01, U5.05, K9.05, K7.11, K4.06</i>	
<i>A1.5.2 - The API for the Tkinter Canvas</i>		<i>U4.01, U5.04, U5.07, U5.06, K5.03, K5.02, K5.01, K4.05, S5.04</i>	
<i>A1.5.3 - The MVC Pattern with Tkinter</i>		<i>U4.03, U4.01, U4.04, U5.04, U5.07, U5.06, U5.02, U5.08, U2.04, U2.05, U2.06, K5.03, K2.04, K2.10, K4.05, K4.06, K4.02, S8.08, S5.09, S5.08, S8.11</i>	

<p><i>B1.5.4 - Design a Python GUI</i></p>	<p>U1.01, U1.03, U1.02, U9.01, U4.01, U8.04, U8.05, U8.01, U5.05, U5.04, U5.07, U5.01, U5.03, U5.02, U5.08, U2.05, U8.02, K8.01, K1.01, K9.04, K4.06, S1.01, S1.05, S1.04, S8.08, S8.13, S8.12, S8.09, S8.07, S5.07, S5.06, S5.05, S5.04, S5.03, S5.01, S8.04, S8.05, S8.01, S8.02, S4.01, S5.10, S5.11</p>	
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ....</i>
Stage 1 – Desired Results		
<p><b>Established Goals:</b>                      PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T10 - Conduct themselves safely on the Internet in business and personal contexts, with respect to privacy and protection of assets.</li> </ul>	
	<b>Meaning</b>	
<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.01) (S1.01)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.05)</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How does the Internet work?</li> <li>• How can we protect ourselves, our privacy, and our assets when working on the Internet?</li> </ul>	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>will continue to impact other disciplines</p> <ul style="list-style-type: none"> <li>• PG4 – Develop students’ professional skills</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>• U1.03 - Programming is a creative endeavor</li> <li>• U2.01 - Binary sequences represent digital data (K2.03, K2.01) (S2.05)</li> <li>• U2.02 - Computing relies on layers of abstraction in software (K2.04)</li> <li>• U2.03 - Computing relies on abstractions of hardware represented with software (K2.07)</li> <li>• U3.08 - Ethical and societal issues are raised by the impact of Big Data and require attention from many stakeholders</li> <li>• U4.01 - Programs implement algorithms to solve problems (S6.08)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01)</li> <li>• U5.05 - The user interface of a piece of software can greatly affect how it is used (K7.06) (S1.05)</li> <li>• U6.01 - Networked and mobile computing rely on various protocols to provide services (K6.03, K6.06, K6.07, K6.04, K6.05, K6.16) (S6.12, S6.03, S6.06, S6.05)</li> <li>• U6.02 - A variety of languages are used for Web programming, with both overlapping and complementary purposes (K6.07, K6.01) (S1.02, S6.02, S6.01)</li> <li>• U6.03 - The Internet facilitates collaboration (K7.07, K7.11)</li> <li>• U6.04 - Device-to-device communication through the Internet passes through a non-unique route (K6.08, K6.09) (S6.12)</li> <li>• U6.06 - Maintaining a safe presence on the Internet requires attention and knowledge</li> <li>• U6.07 - Cybersecurity depends on hardware and software components, including cryptography (K6.16, K6.13)</li> <li>• U7.01 - Mobile and networked computing have transformed commerce, social interactions, news sourcing and dissemination, and culture (K7.02, K7.07, K7.01, K7.11)</li> <li>• U7.04 - Making information accessible to all people</li> </ul>	<ul style="list-style-type: none"> <li>• How has the Internet affected society?</li> </ul>
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# Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>requires attention from a variety of stakeholders (K7.07, K7.14, K7.06) (S1.05)</p> <ul style="list-style-type: none"> <li>• U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing (K1.01)</li> <li>• U7.07 - Networked infrastructure affects and is affected by commercial and governmental structures and policies</li> <li>• U7.08 - Scalability is an important consideration for distributed solutions</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09)</li> <li>• U9.02 - Parallel computing is a quickly evolving field relevant to hardware, software, and users</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K1.01 - Describe the role of creativity in designing an attractive, functional, and accessible graphical user interface (U1.01, U7.05)</li> <li>• K2.01 - Describe the ways in which various types of digital data can be represented in binary (U2.01)</li> <li>• K2.03 - Describe layers of abstraction that help people represent and use data (U2.01)</li> <li>• K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction (U2.02)</li> <li>• K2.07 - Describe an abstraction of hardware (U2.03)</li> <li>• K2.12 - Identify the relationship among nodes in a tree, as applied to the DOM in a Web page</li> <li>• K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)</li> <li>• K5.03 - Distinguish among a variety of educational and reference resources related to code libraries</li> <li>• K6.01 - Identify syntactic elements of HTML and</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>• S1.02 - Design, create, and publish a basic web page referencing a style sheet (U6.02)</li> <li>• S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02, U5.05, U7.04)</li> <li>• S2.05 - Calculate time, file size, and bandwidth given two of the three (U2.01)</li> <li>• S2.10 - Navigate a file system tree</li> <li>• S6.01 - Connect the rendering of a Web page with corresponding elements of HTML and CSS source code and with client browser settings (U6.02)</li> <li>• S6.02 - Identify HTML, CSS, JavaScript, PHP, or SQL as an appropriate language for a particular task (U6.02)</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>CSS (U6.02)</p> <ul style="list-style-type: none"> <li>• K6.03 - Describe the hierarchical nature of the domain name system and IPv4 and IPv6 numbering systems (U6.01)</li> <li>• K6.04 - Describe the dependence of DNS on certificate authorities (U6.01)</li> <li>• K6.05 - Describe abstractions that enable the Internet to function, including IP addressing and domain name service (U6.01)</li> <li>• K6.06 - Describe the purpose and general nature of protocols that enable the Internet to function, including DNS, TCP/IP, SMTP, and HTTP protocols (U6.01)</li> <li>• K6.07 - Describe the governance of the Internet and the organizations that develop and maintain relevant standards (U6.01, U6.02)</li> <li>• K6.08 - Identify examples of redundancy and autonomy in the physical and software systems of the Internet (U6.04)</li> <li>• K6.09 - Explain how redundancy and autonomy make the systems of the Internet scalable (U6.04)</li> <li>• K6.13 - Explain an encryption system (U6.07)</li> <li>• K6.16 - Describe the combination of encryption protocols with other protocols to provide secure transfer of information (U6.01, U6.07)</li> <li>• K7.01 - Characterize the size, cost, and speed of computational processing as changing exponentially (U7.01)</li> <li>• K7.02 - Identify the decade in which milestones occurred in the development of computing and the Internet (U7.01)</li> <li>• K7.05 - Describe what metadata contain and how they can be used</li> <li>• K7.06 - Distinguish content from style and explain how accessibility requires a separation of these concerns (U5.05, U7.04)</li> <li>• K7.07 - Analyze access to the Internet and to data among people in different countries, and connect to measures of health and wealth (U6.03, U7.01, U7.04)</li> </ul>	<ul style="list-style-type: none"> <li>• S6.03 - Use appropriate tools to manage files on a server permitting FTP (U6.01)</li> <li>• S6.05 - Use appropriate tools to observe bandwidth and latency (U6.01)</li> <li>• S6.06 - Analyze a URL to identify protocol, the host and domain names, the directory path, the filename, and the query string content, and describe the information implied about the nature of the requested content and its publisher (U6.01)</li> <li>• S6.08 - Contrast search results provided by competing search algorithms to identical queries (U4.01)</li> <li>• S6.12 - Use appropriate tools to observe IP addressing, IP routing, and DNS resolution (U6.01, U6.04)</li> <li>• S8.08 - Collaborate when programming (U8.01)</li> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.10 - Present original research and research from literature</li> <li>• S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience</li> </ul>
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



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|--|---|--|
|  | <ul style="list-style-type: none"><li>• K7.11 - Describe examples in which computation has or will create new societal phenomena and human capabilities to perceive and act upon our environment (U6.03, U7.01)</li><li>• K7.14 - Contrast the patterns of inequity characterizing the personal computing revolution and the current mobile computing revolution (U7.04)</li><li>• K9.06 - Describe how computing is connected to innovations in other fields</li><li>• K9.07 - Describe how specific career fields, e.g. biology and marketing, have changed profoundly as a result of automated collection and processing of data</li></ul> |  |
|--|---|--|

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ...</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they ...</b>		
U1.01, U2.02, U6.01, U6.02, S1.02, S6.01, S6.02, S8.08	Use HTML tags	PT1 - Create a small set of linked web pages.
U1.02, U6.01, U6.02, U7.04, S1.01, S1.02	Apply CSS styles	
U6.01, S2.10, S6.03	Navigate a remote file system through a command line interface	
K5.03, K6.01	Use reference materials to learn a language	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U7.07, U7.08, U9.02, K6.07, K6.08, K6.09	Describe distributed computing	OE1 - Describe the impact and pace of change caused by networked computing
U1.01, U1.02, U1.03, U3.08, U6.03, K7.07, K9.06, S8.09, S8.10	Describe beneficial and harmful impacts of a computing innovation	
U7.01, U7.05, K7.02, K7.11, K7.14, K7.01, K9.07	Describe the rate at which the impacts of computing have been and are developing	
U5.03, S2.05, S6.05, S8.11	Use tools to investigate DNS, TCP/IP, bandwidth, and latency	OE2 - Analyze a network connection
U6.06, U6.07, S6.06	Infer information from a URL	OE3 - Assess the reliability of a web page

## Instructional Design Framework CSE: Unit 1 – Lesson 1



S8.11	<i>Infer information about author and audience from a web page's content</i>	
S6.08	<i>Skillfully construct a search engine query</i>	<i>OE4 - Relate search engine results to both the query and the search engine</i>
S6.08	<i>Describe results as affected by censorship, optimization tactics, and engine algorithms</i>	
K2.07	<i>Describe the processor, storage, RAM, and NIC among the hardware components of a computer</i>	<i>OE5 - Describe hardware components of a computer</i>
U2.01, U6.01, U6.04, K2.04, K6.03, K6.05, K6.06	<i>Describe the role of TCP/IP in retrieving a web page</i>	<i>OE6 - Explain protocols by which entering a URL in a browser results in a rendered page</i>
U6.01, U6.04, K2.12, K6.03, K6.05, K6.06	<i>Describe the role of DNS in retrieving a web page</i>	
U2.02, U2.03, U4.01, U6.01, K2.03	<i>Generalize the concept of a "protocol" and relate to abstraction</i>	
U6.07, K6.04, K6.13, K6.16	<i>Explain encryption, including the use of paired key authentication</i>	
U6.02, K1.01, K5.01, K6.01, K7.05, K7.06, S6.01, S6.02	<i>Create examples in the languages of HTML and CSS</i>	
U7.04, K7.06, S1.05	<i>Relate HTML and CSS to accessibility</i>	

# Instructional Design Framework

Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>

## Stage 3 – Learning Plan

**LEARNING EVENTS –**

<i>Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A2.1.1 - The Rise of the Internet</i>	<i>(U7.07, U7.08, U7.01, U7.05, U9.02, U6.03) (K7.02, K6.03, K7.07, K9.07, K7.14, K7.01, K9.06, K7.11) (S8.10, S8.09, S8.11)</i>	
<i>A2.1.2 - Your Favorite Web Page</i>	<i>(U1.02, U7.07, U7.04, U4.01, U5.05) (K1.01, K6.08, K6.09, K6.06, K7.05) (S1.05, S6.08, S6.06)</i>	
<i>A2.1.3 - Protocols and Bandwidth</i>	<i>(U7.07, U7.08, U6.04, U2.01, U2.02, U2.03, U6.01) (K6.03, K6.08, K6.09, K6.06, K6.07, K2.07, K7.01, K6.05) (S6.12, S2.05, S6.03, S6.06, S6.05)</i>	
<i>A2.1.4 - HTML and CSS</i>		<i>(U1.01, U1.03, U8.01, U5.03, U8.02, U2.01, U6.02) (K1.01, K6.06, K6.07, K5.03, K5.01, K6.01, K2.03, K2.04, K7.06, K2.12) (S1.02, S1.01, S8.08, S6.02, S6.03, S6.01)</i>
<i>A2.1.5 - Secure Protocols</i>	<i>(U4.01, U3.08, U6.04, U6.06, U6.07) (K6.06, K6.04, K6.16, K6.13)</i>	

# Instructional Design Framework

Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ....</i>

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## Stage 1 – Desired Results

<p><b>Established Goals:</b> PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG3 – Give students experience working on real world problems for authentic audiences</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of</li> </ul>	Transfer	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T10 - Conduct themselves safely on the Internet in business and personal contexts, with respect to privacy and protection of assets.</li> <li>• T11 - Create interactive web sites to meet their individual needs and interests</li> </ul>	
	Meaning	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.01) (S1.01, S8.12)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.05)</li> <li>• U1.03 - Programming is a creative endeavor (S1.03, S5.03)</li> <li>• U2.06 - The solution to one problem can be applied to another seemingly unrelated problem by identifying and reusing a pattern (K2.10, K4.02) (S5.03)</li> <li>• U3.01 - Data can be structured to facilitate use (K3.02, K2.12, K7.05)</li> <li>• U3.06 - The size of a data set affects how the data can be used (K3.05)</li> <li>• U3.07 - Collecting and managing data raises technical issues regarding storage, access, durability, privacy, and security (K3.05, K7.05)</li> <li>• U4.01 - Programs implement</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How does the Internet work?</li> <li>• How can we protect ourselves, our privacy, and our assets when working on the Internet?</li> <li>• How has the Internet affected society?</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>the pathway</p> <ul style="list-style-type: none"> <li>PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>CG2 – Broaden participation in computing</li> <li>CG3 - Develop professional skills</li> <li>CG4 - Excite and enthuse all students about CS</li> <li>CG5 - De-mystify the fundamental black boxes of computing</li> <li>CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>algorithms to solve problems (K5.02, K4.05, K4.06, K4.02)</p> <ul style="list-style-type: none"> <li>U4.03 - Empirical analysis of algorithms requires a systematic approach (S5.09, S5.02)</li> <li>U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts (K4.02) (S5.03)</li> <li>U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (K4.06) (S4.01)</li> <li>U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (K5.01) (S5.09)</li> <li>U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K5.02, K3.03, K4.05)</li> <li>U5.05 - The user interface of a piece of software can greatly affect how it is used (K7.06) (S1.05)</li> <li>U5.06 - Functions with arguments make code modular and reusable (K5.02)</li> <li>U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code (K5.03)</li> <li>U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.09)</li> <li>U6.01 - Networked and mobile computing rely on various protocols to provide services (S6.03)</li> <li>U6.02 - A variety of languages are used for Web programming, with both overlapping and</li> </ul>	
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



- complementary purposes (K6.01, K6.02) (S1.03, S6.10, S6.02)
- U6.03 - The Internet facilitates collaboration
  - U6.05 - The information and processing power on any networked device can be accessed by potentially hostile parties
  - U6.06 - Maintaining a safe presence on the Internet requires attention and knowledge (S6.09, S6.07)
  - U7.04 - Making information accessible to all people requires attention from a variety of stakeholders (K7.06) (S1.05)
  - U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing (K1.01)
  - U7.08 - Scalability is an important consideration for distributed solutions (K3.05)
  - U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.05)
  - U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.05)
  - U8.03 - Collaboration allows communities to create software that can impact people's lives (K8.01) (S8.08, S8.03)
  - U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (S8.12)
  - U8.05 - How people present themselves affects how their work is received (S8.10, S8.13, S8.12)

## Instructional Design Framework CSE: Unit 1 – Lesson 1



- U9.01 - Computer science and information technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals (K9.05, K9.04)
- U9.03 - Computational thinking boosts most career paths (K9.07, K9.04)

### Acquisition of Knowledge and Skill

*KNOWLEDGE – Students will have the knowledge to...*

- K1.01 - Describe the role of creativity in designing an attractive, functional, and accessible graphical user interface (U1.01, U7.05)
- K2.03 - Describe layers of abstraction that help people represent and use data
- K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction
- K2.10 - Describe the model-view-controller pattern and relate to a particular software solution (U2.06)
- K2.12 - Identify the relationship among nodes in a tree, as applied to the DOM in a Web page (U3.01)
- K3.02 - Describe the structure of a relational database (U3.01)
- K3.03 - Describe how mathematical functions and algorithms can be applied to a data set to construct a derived data set (U5.04)
- K3.05 - Describe the reasons for the rise in non-relational databases (U3.06, U3.07, U7.08)
- K4.02 - Recognize that a solution to

*SKILLS – Students will have the skills to...*

- S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)
- S1.03 - Create and publish a basic web page containing JavaScript (U1.03, U6.02)
- S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02, U5.05, U7.04)
- S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode (U5.02)
- S5.02 - Analyze and test code from other people (U4.03)
- S5.03 - Extend, or apply to new purpose, code from other people (U1.03, U2.06, U4.04)
- S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03, U5.08)
- S6.02 - Identify HTML, CSS, JavaScript, PHP, or SQL as an appropriate language for a particular task (U6.02)

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>one problem, such as a particular sorting or optimization task, can be used to solve seemingly dissimilar problems (U2.06, U4.01, U4.04)</p> <ul style="list-style-type: none"> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)</li> <li>• K4.06 - Recognize events and event-handlers implied by a user interface (U4.01, U5.02)</li> <li>• K5.01 - Describe ways to identify the existence and location of errors in software (U5.03)</li> <li>• K5.02 - Describe the role that functions play in developing software (U4.01, U5.04, U5.06)</li> <li>• K5.03 - Distinguish among a variety of educational and reference resources related to code libraries (U5.07)</li> <li>• K6.01 - Identify syntactic elements of HTML and CSS (U6.02)</li> <li>• K6.02 - Identify syntactic elements of JavaScript, PHP, and SQL (U6.02)</li> <li>• K7.05 - Describe what metadata contain and how they can be used (U3.01, U3.07)</li> <li>• K7.06 - Distinguish content from style and explain how accessibility requires a separation of these concerns (U5.05, U7.04)</li> <li>• K8.01 - Describe a version control system (U8.03)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.01, U9.03)</li> <li>• K9.05 - Identify fields of computing</li> </ul>	<ul style="list-style-type: none"> <li>• S6.03 - Use appropriate tools to manage files on a server permitting FTP (U6.01)</li> <li>• S6.07 - Describe the digital footprint left behind and analyze the implications for privacy that result from various actions conducted in a Web browser, including DNS requests, content requests, third-party content requests, cookies, and cached content (U6.06)</li> <li>• S6.09 - Identify vulnerabilities to social engineering, including phishing and the delivery of viruses through various filetypes, and respond appropriately (U6.06)</li> <li>• S6.10 - Identify an appropriate language for serving a particular purpose in web serving, including tasks appropriate to client-side and server-side scripting (U6.02)</li> <li>• S8.03 - Use a version control system (U8.03)</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)</li> <li>• S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)</li> <li>• S8.08 - Collaborate when programming (U8.01, U8.03)</li> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.10 - Present original research and research from literature (U8.05)</li> </ul>
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>careers (U9.01)</p> <ul style="list-style-type: none"><li>• K9.07 - Describe how specific career fields, e.g. biology and marketing, have changed profoundly as a result of automated collection and processing of data (U9.03)</li></ul>	<ul style="list-style-type: none"><li>• S8.12 - Communicate an idea for a product that solves a problem or expresses creativity (U1.01, U8.04, U8.05)</li><li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li></ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ...</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they...</b>		
<i>U1.01, U1.03, U5.02, U5.05, K6.01, U7.04, K1.01, K7.06, S4.01, S6.02</i>	<i>Design an appealing and usable interface</i>	<i>PT1 - Create a data-driven website.</i>
<i>U6.01, U6.02, K2.12, K4.06, K5.01, K5.02, K6.02, K7.05, S1.03, S6.03</i>	<i>Explore HTML5 and JavaScript functionality to develop the interface</i>	
<i>U2.06, U3.01, U3.06, U3.07, U4.04, U5.04, U5.06, U6.05, K2.03, K3.02, K3.03, K5.01, K6.02</i>	<i>Use a relational database and create SQL queries to develop the interface</i>	
<i>U4.01, U5.08, K4.05, K5.03, K6.02, S5.02, S5.03, S5.09</i>	<i>Explore a variation in PHP code to develop the interface</i>	
<i>U5.03, U6.03, U8.01, U8.02, U8.04, K8.01, S8.04, S8.05</i>	<i>Collaborate to create a program using a blend of web client-side and web server-side code</i>	
<i>U1.02, U5.07, U8.05, K9.04, S1.01, S8.09, S8.12, S8.13</i>	<i>Present the design for a solution to a client's need</i>	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U6.06, U7.05, U8.01, U9.01, K9.04, K9.05, K9.07, S8.10	Describe possible career paths in CS, IT, database management, and web development	OE1 - Describe CS, IT, and Web developer roles and the human creativity that produces the Web
U8.03, K9.07	Describe the Internet's governance	
S1.03, S4.01, S5.02, S5.03, S5.09, S6.03	Use JavaScript	OE2 - Create a web page
K2.04, K2.10, K2.12, K4.06, K6.01, K6.02, K7.05, K7.06, S1.05, S6.02	Describe how HTML, CSS, JavaScript produce a rendered page	OE3 - Analyze a web page
U7.08, K6.02, S6.10 For enrichment: K3.05	Distinguish the roles and mechanics of server-side and client-side scripting	
S6.07, S6.09	Describe a footprint left behind by a user during Web browsing	OE4 - Describe your digital footprint
U4.04, K4.02, K4.05, K5.02	Recognize patterns using variables	OE5 - Analyze code
U4.03	Compare the time efficiencies of two programming approaches to a problem	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>

## Stage 3 – Learning Plan

LEARNING EVENTS –		
<i>Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A2.2.1 - HTML5 and JavaScript</i>	<i>(U1.01, U1.03, U4.01, U5.04, U5.06, U6.01, U6.02) (K1.01, K5.03, K5.02, K6.01, K2.04, K9.05, K6.02, K7.06, K2.12, K4.06) (S1.03, S1.01, S1.05, S8.08, S6.10, S6.02, S6.03, S5.03)</i>	
<i>A2.2.2 - Introducing PHP</i>	<i>(U4.03, U4.01, U5.04, U5.07, U5.08, U6.01, U6.02) (K5.02, K5.01, K6.02, K4.05, K4.06) (S1.01, S6.09, S8.08, S6.10, S6.02, S6.03, S5.03, S5.02, S6.07)</i>	
<i>A2.2.3 - Databases and SQL</i>	<i>(U7.08, U4.01, U4.04, U3.07, U3.06, U3.01, U5.04, U2.06, U6.02) (K2.03, K2.04, K9.05, K6.02, K3.05, K3.03, K3.02, K2.10, K7.05, K4.02) (S8.08, S6.02, S6.03, S5.03)</i>	
<i>P2.2.4 - Dynamic Data-Driven Design</i>		<i>(U1.01, U1.03, U1.02, U9.01, U4.01, U7.05, U8.04, U8.05, U8.03, U8.01, U5.05, U5.04, U5.03, U5.02, U8.02, U6.01) (K8.01, K1.01, K9.04) (S1.01, S1.05, S8.08, S8.13, S8.12, S8.09, S6.10, S6.02, S6.03, S5.09, S5.03, S8.04, S8.05, S8.03, S4.01)</i>
<i>A2.2.5 - Career Fields of CS and IT</i>	<i>(U7.04, U9.01, U8.03, U9.03, U6.05, U6.03, U6.06) (K1.01, K9.07, K9.05, K9.04) (S8.10)</i>	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
<b>Stage 1 – Desired Results</b>		
<p><b>Established Goals:</b></p> <p>PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T10 - Conduct themselves safely on the Internet in business and personal contexts, with respect to privacy and protection of assets.</li> </ul>	
	<b>Meaning</b>	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U3.07 - Collecting and managing data raises technical issues regarding storage, access, durability, privacy and security</li> <li>• U3.08 - Ethical and societal issues are raised by the impact of Big Data and require attention from many stakeholders</li> <li>• U4.01 - Programs implement algorithms to solve problems (S6.08)</li> <li>• U4.02 - Algorithms can be analyzed for efficiency, and appropriate algorithms can be selected based upon efficiency (K4.04)</li> <li>• U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts</li> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K3.03)</li> <li>• U6.03 - The Internet facilitates collaboration</li> <li>• U6.04 - Device-to-device communication through</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• What is the nature of attack and defense in cybersecurity?</li> <li>• How can we protect ourselves, our privacy, and our assets when working on the Internet?</li> <li>• How has the Internet affected society?</li> </ul>

# Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>students with necessary computational background as citizens, employees, and consumers</p> <ul style="list-style-type: none"> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>the Internet passes through a non-unique route</p> <ul style="list-style-type: none"> <li>• U6.05 - The information and processing power on any networked device can be accessed by potentially hostile parties (K6.14, K6.11)</li> <li>• U6.06 - Maintaining a safe presence on the Internet requires attention and knowledge (K6.14, K6.11, K6.12) (S6.09, S6.11, S6.07, S6.04)</li> <li>• U6.07 - Cybersecurity depends on hardware and software components, including cryptography (K6.16, K6.11, K6.10, K6.13, K6.12) (S6.11)</li> <li>• U7.01 - Mobile and networked computing have transformed commerce, social interactions, news sourcing and dissemination, and culture (S7.02)</li> <li>• U7.02 - Computing is having profound impacts on individual privacy (S7.02)</li> <li>• U7.04 - Making information accessible to all people requires attention from a variety of stakeholders</li> <li>• U7.07 - Networked infrastructure affects and is affected by commercial and governmental structures and policies (S7.02)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships</li> <li>• U9.03 - Computational thinking boosts most career paths (K9.04, K9.06, K9.02, K3.04)</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K3.03 - Describe how mathematical functions and algorithms can be applied to a data set to construct a derived data set (U5.04)</li> <li>• K3.04 - Identify the relationship between parallel computation and computationally intensive tasks like simulation, modeling, and analysis of large data sets (U9.03)</li> <li>• K4.04 - Estimate the time for an algorithm to operate on a data set, given the algorithm's running time on another data set and the algorithm's complexity in big-O notation (U4.02)</li> <li>• K6.07 - Describe the governance of the Internet and</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S2.06 - Consider implications of converting data from one representation to another, for example noise or compression</li> <li>• S6.04 - Analyze the security of situations in which a user is prompted to follow a link, download content, or provide information in email and Web forms (U6.06)</li> <li>• S6.06 - Analyze a URL to identify protocol, the host and domain names, the directory path, the filename, and the query string content, and describe the information implied about the nature of the requested content and its</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>the organizations that develop and maintain relevant standards</p> <ul style="list-style-type: none"> <li>• K6.10 - Explain the role of prime numbers and tractability in encryption (U6.07)</li> <li>• K6.11 - Describe the mechanism of any particular cyber attack (U6.05, U6.06, U6.07)</li> <li>• K6.12 - Identify measures that contribute to an effective defense from any particular cyber attack (U6.06, U6.07)</li> <li>• K6.13 - Explain an encryption system (U6.07)</li> <li>• K6.14 - Identify the roles of software developers, government, industry, employees, standards bodies, consumers, and citizens in securing information and processing power (U6.05, U6.06)</li> <li>• K6.16 - Describe the combination of encryption protocols with other protocols to provide secure transfer of information (U6.07)</li> <li>• K9.01 - Describe codes of ethics and professional conduct for cybersecurity professionals</li> <li>• K9.02 - Describe the impact that computing has had in the social sciences, geography, and civics (U9.03)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.03)</li> <li>• K9.05 - Identify fields of computing careers</li> <li>• K9.06 - Describe how computing is connected to innovations in other fields (U9.03)</li> </ul>	<p>publisher</p> <ul style="list-style-type: none"> <li>• S6.07 - Describe the digital footprint left behind and analyze the implications for privacy that result from various actions conducted in a Web browser, including DNS requests, content requests, third-party content requests, cookies, and cached content (U6.06)</li> <li>• S6.09 - Identify vulnerabilities to social engineering, including phishing and the delivery of viruses through various filetypes, and respond appropriately (U6.06)</li> <li>• S6.11 - Use appropriate tools and techniques to implement defensive cyber measures (U6.06, U6.07)</li> <li>• S7.02 - Work with a group to agree on a policy or protocol (U7.01, U7.02, U7.07)</li> </ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they ...</b>		
U6.06, K6.12, K6.14, K6.16, S6.04, S6.06, S6.07, S6.09, S6.11	Identify cyber defense measures to take when using a browser and when using email	PT1 - Protect oneself online
U3.07, U6.04, U6.05, U6.06, U6.07, K6.11, K6.12, K6.14	Relate design properties of operating systems, the Internet, and Web and email services to vulnerabilities and defenses	
U6.06, K6.14, K9.01, S7.02	Describe the boundary between ethical behavior and unethical hacking and describe consequences for unethical hacking	
K9.04, K9.05	Describe career opportunities helping securing people's cyber systems	
U5.01, U5.03, U5.04, U6.07, U8.02, K6.11, K6.13, K9.01, S6.06, S7.02	Succeed in a national capture-the-flag competition	PT2 - Reverse-engineer code, decrypt data, and identify functionality and disfunctionality of code not overtly stated by another programmer

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they ...</b>		
U4.01, U4.02, U5.04, U8.02	Compare algorithms theoretically and make empirical measurements	OE1 - Compare two algorithms
U4.02, K3.03, K3.04,	Relate algorithms and empirical data to orders of time complexity	
Enrichment: K4.04	Enrichment: Relate the comparison to P/NP, computability, NP Complete problems	
Enrichment: U4.01, U4.04, U6.07, K3.03, K3.04, K6.07, K6.13, K6.16, S2.06	Enrichment: Explain the mathematical procedure and relate the size of the prime numbers to the time required for brute force decryption	OE2 - Enrichment: Explain RSA encryption
U3.07, U6.03, U6.05, U6.06, U7.01, U7.02, U7.04, U7.07, U9.03, K6.07, K6.14, K9.02, K9.04, K9.06	Describe consequences of networked computing for privacy, law enforcement, and democracy	OE3 - Describe how networked computing impacts government
U7.09, S8.10, S8.11, K7.11	Analyze short- and long-term beneficial and harmful impacts of a computing innovation; create a professional technical report and a creative visual artifact about the innovation (Opportunity #2 for CS Principles Explore PT)	(Opportunity #2 to create a response to the College Board AP CS Principles Explore Performance Task)

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
<b>Stage 3 – Learning Plan</b>		
<b>LEARNING EVENTS –</b>		
<i>Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
<i>A2.3.1 - The Vulnerable User</i>	<i>(U7.02, U9.03, U6.04, U6.05, U6.06, U6.07) (K6.14, K6.11, K6.12) (S6.09, S6.11, S6.06, S6.04)</i>	
<i>A2.3.2 - Security by Encryption</i>	<i>(U4.02, U4.01, U4.04, U5.04, U6.07) (K3.04, K3.03, K6.16, K6.10, K6.13, K4.04) (S2.06)</i>	
<i>A2.3.3 - World Security, World Democracy</i>		<i>(U7.07, U7.04, U7.01, U3.08, U3.07, U6.03, U6.06) (K6.07, K9.04, K9.06, K9.02) (S7.02, S6.07)</i>
<i>P2.3.4 - The Heist</i>		<i>(U4.01, U5.04, U5.01, U5.03, U8.02, U6.07) (K9.01, K9.05, K6.14, K6.11, K6.13, K6.12)</i>

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ... →	then the learning events need to ....
<b>Stage 1 – Desired Results</b>		
<p><b>Established Goals:</b>                      PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T13 -- Analyze and visualize data related to any discipline or regarding any question.</li> </ul>	
	<b>Meaning</b>	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.02 - Computational artifacts can be evaluated (S1.06)</li> <li>• U2.01 - Binary sequences represent digital data (K2.02, K2.03, K7.08, K2.16)</li> <li>• U3.01 - Data can be structured to facilitate use (K3.01) (S3.07)</li> <li>• U3.03 - Analysis of data can be automated (K3.03) (S3.05, S3.07, S3.03, S3.08, S5.12)</li> <li>• U3.04 - Data visualizations are important tools for discovering and communicating knowledge (S8.06, S3.05, S3.04, S3.03, S3.08)</li> <li>• U3.05 - The human brain and today's computers have complementary strengths for analyzing data (S3.04, S3.07, S3.08)</li> <li>• U3.06 - The size of a data set affects how the data can be used (K4.04)</li> <li>• U3.07 - Collecting and managing data raises technical issues regarding storage, access, durability, privacy, and security (K7.08)</li> <li>• U3.08 - Ethical and societal issues are raised by the impact of Big Data and require attention from many stakeholders (K7.09)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K2.08, K4.05) (S5.12)</li> <li>• U4.02 - Algorithms can be analyzed for efficiency, and appropriate algorithms can be selected based</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How will computation impact fields other than computing itself?</li> <li>• How will computation impact society?</li> <li>• How can patterns be discovered in data?</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>computational background as citizens, employees, and consumers</p> <ul style="list-style-type: none"> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>upon efficiency (K4.04) (S4.02)</p> <ul style="list-style-type: none"> <li>• U4.03 - Empirical analysis of algorithms requires a systematic approach (S5.09, S5.13)</li> <li>• U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts (K2.08)</li> <li>• U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (S5.11)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach (S5.09)</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K3.03, K4.05)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.09, S5.10)</li> <li>• U6.03 - The Internet facilitates collaboration (K7.07)</li> <li>• U6.05 - The information and processing power on any networked device can be accessed by potentially hostile parties</li> <li>• U7.01 - Mobile and networked computing have transformed commerce, social interactions, news sourcing and dissemination, and culture (K7.07) (S8.07)</li> <li>• U7.02 - Computing is having profound impacts on individual privacy (K7.09)</li> <li>• U7.04 - Making information accessible to all people requires attention from a variety of stakeholders (K7.07, K7.14)</li> <li>• U7.08 - Scalability is an important consideration for distributed solutions (K4.04)</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.06)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention</li> </ul>	
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	<p>to interpersonal relationships (S8.06)</p> <ul style="list-style-type: none"> <li>U9.01 - Computer science and information technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals (K9.05, K9.04)</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>K1.02 - Describe the role of creativity in producing data visualizations</li> <li>K2.02 - Distinguish continuous and discrete phenomena and identify digital and analog data (U2.01)</li> <li>K2.03 - Describe layers of abstraction that help people represent and use data (U2.01)</li> <li>K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction</li> <li>K2.08 - Distinguish deterministic and randomized models and describe the role of Monte Carlo techniques (U4.01, U4.04)</li> <li>K2.16 - Describe the implications of the limited precision of digital information in applications (U2.01)</li> <li>K3.03 - Describe how mathematical functions and algorithms can be applied to a data set to construct a derived data set (U3.03, U5.04)</li> <li>K3.04 - Identify the relationship between parallel computation and computationally intensive tasks like simulation, modeling, and analysis of large data sets</li> <li>K3.06 - Identify data visualizations as an important tool for communication</li> <li>K4.04 - Estimate the time for an algorithm to operate on a data set, given the algorithm's running time on another data set and the algorithm's complexity in big-O notation (U3.06, U4.02, U7.08)</li> <li>K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page</li> <li>S1.06 - Analyze a computational artifact for correctness (U1.02)</li> <li>S3.03 - Represent and understand phenomena by identifying relationships among data (U3.03, U3.04)</li> <li>S3.04 - Identify the appropriate type of basic visualization appropriate to a particular data set (U3.04, U3.05)</li> <li>S3.05 - Use appropriate tools to construct a scatter plot, histogram, pie chart, or compound bar graph (U3.03, U3.04)</li> <li>S3.07 - Use appropriate tools to create new data sets derived from other data sets (U3.01, U3.03, U3.05)</li> <li>S3.08 - Use appropriate tools to describe a linear relationship (or lack thereof) inferred from data (U3.03, U3.04, U3.05)</li> <li>S4.02 - Evaluate a program for efficiency (U4.02)</li> <li>S5.09 - Improve readability, efficiency, or correctness of code from other people (U4.03, U5.03, U5.08)</li> <li>S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> <li>S5.11 - Encapsulate a set of related statements in a function or procedure (U5.02)</li> <li>S5.12 - Create a function to perform a particular calculation from the function's arguments</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>collection (U4.01, U5.04)</p> <ul style="list-style-type: none"> <li>• K7.07 - Analyze access to the Internet and to data among people in different countries, and connect to measures of health and wealth (U6.03, U7.01, U7.04)</li> <li>• K7.08 - Discuss societal implications of the persistence and the ease of copying digital information (U2.01, U3.07)</li> <li>• K7.09 - Articulate a range of positions on questions related to privacy with respect to Big Data (U3.08, U7.02)</li> <li>• K7.14 - Contrast the patterns of inequity characterizing the personal computing revolution and the current mobile computing revolution (U7.04)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.01)</li> <li>• K9.05 - Identify fields of computing careers (U9.01)</li> <li>• K9.06 - Describe how computing is connected to innovations in other fields</li> <li>• K9.07 - Describe how specific career fields, e.g. biology and marketing, have changed profoundly as a result of automated collection and processing of data</li> </ul>	<p>(U3.03, U4.01)</p> <ul style="list-style-type: none"> <li>• S5.13 - Deduce the value of a variable resulting from execution of particular code (U4.03)</li> <li>• S8.06 - Collaborate when collecting and analyzing data to answer a question (U3.04, U8.01, U8.02)</li> <li>• S8.07 - Compare to select from among several tools available for collaboration (U7.01)</li> <li>• S8.08 - Collaborate when programming (U8.01)</li> <li>• S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience</li> </ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they...</b>		
U6.03, K2.02, K2.03, S8.11	Identify and describe a data set that could support a rich investigation	PT1 - Apply data collection and data visualization to an area of interest to a team
K3.06, S1.01, S3.04, S3.05	Visualize data	
U8.02, U9.01, S3.03	Ask insightful questions that seek connections among many significant attributes	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U3.04, K1.02, S1.01, S3.04, S3.05	Create visualizations	OE1 - Visualize data that are provided
U1.02, U3.04, U3.05, K3.06, S1.06	Analyze visualizations for clarity, correctness, and usability	
U3.04, K2.03	Interact with a data visualization to explore data	
U2.01, U3.03, U4.01, U4.02, U4.04, U5.02, U5.03, U5.04, U5.07, U5.08, U8.01, U8.02, K2.04, K3.01, K3.03, K4.05, S3.07, S5.09, S5.10, S5.11, S5.12, S5.13, S8.06, S8.07, S8.08	Automate the manipulation of numeric and string data in a programming language	OE2 - Collaboratively transform, clean, select, and sort data that are provided

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<i>U3.03, U5.02, U5.03, U5.04, K3.01, K3.03, S3.07, S5.12, S5.13, S8.07</i>	<i>Automate the manipulation of numeric and string data in a spreadsheet</i>	
<i>U3.01, K3.01, S3.03</i>	<i>Structure and interpret the structure of data provided</i>	
<i>U3.03, K2.03, K2.16</i>	<i>Describe data</i>	
<i>U3.08, U6.05, U7.01, U7.02, U7.04, K7.07, K7.08, K7.09, K7.14, K9.06</i>	<i>Describe societal issues raised by digital data</i>	<p><i>OE3 - Describe the impact of digital data on society</i></p> <p><i>(Opportunity #3 to create a response to the College Board AP CS Principles Explore Performance Task)</i></p>
<i>U7.01, U9.01, K9.04, K9.05, K9.06, K9.07</i>	<i>Describe how Big Data are affecting career fields and describe career opportunities related to data</i>	
<i>U3.06, U3.07, U7.02, U7.04, U7.08, K3.04</i>	<i>Describe technical issues related to Big Data</i>	
<i>U7.09, S8.10, S8.11, K7.11</i>	<i>Analyze short- and long-term beneficial and harmful impacts of a computing innovation; create a professional technical report and a creative visual artifact about the innovation (Opportunity #3 for CS Principles Explore PT)</i>	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ...

## Stage 3 – Learning Plan

LEARNING EVENTS –		
Activity (A), Project (P), or Problem (B)	Assessment for Learning	Assessment of Learning
A3.1.1 - Time Series and Trends	(U1.02, U9.01, U4.03, U4.01, U3.04, U3.03, U8.01, U5.04, U5.03, U5.08, U8.02) (K2.03, K3.06, K3.01, K3.03) (S1.01, S1.06, S8.08, S5.09, S8.06, S3.04, S3.03, S5.10, S5.11, S5.12, S5.13)	
A3.1.2 - Issues with Data	(U7.02, U7.01, U9.01, U3.08, U3.07, U3.06, U3.05, U6.05) (K9.04, K7.09, K7.08)	
A3.1.3 Big Data and Parallel Processing	(U7.08, U4.02, U4.01, U4.04, U3.06, U3.04, U3.03, U2.01) (K2.03, K2.04, K3.04, K3.06, K3.01, K3.03, K4.04) (S1.01, S1.06, S8.06, S3.05, S3.04, S3.03, S3.08, S4.02)	
A3.1.4 - Pie Charts and Bar Graphs	(U1.02, U7.04, U9.01, U3.05, U3.04, U6.03) (K1.02, K2.02, K7.07, K9.07, K7.14, K9.05, K9.04, K9.06, K3.06, K3.01) (S1.01, S1.06, S8.07, S8.06, S3.05, S3.04, S8.11)	
A3.1.5 Histograms and Distributions	(U4.01, U3.05, U3.03, U3.01) (K2.03, K3.01, K3.03, K2.16, K4.05) (S8.06, S3.07, S3.03, S5.12)	

# Instructional Design Framework CSE: Unit 1 – Lesson 1



B3.1.6 Datify Your Interest		U3.04, U9.03, U3.06, U6.03, U7.01, U7.08, U9.01) (S3.03, S3.02) (K7.12, K3.06, K3.01, K3.03)
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
Stage 1 – Desired Results		
<p><b>Established Goals:</b>                      PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and</li> </ul>	<b>Transfer</b>	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T13 - Analyze and visualize data related to any discipline or regarding any question.</li> </ul>	
	<b>Meaning</b>	
<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.02) (S1.01)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.06, S1.05)</li> <li>• U1.03 - Programming is a creative endeavor</li> <li>• U2.08 - Simulation and modeling can help us understand, communicate about, and predict natural phenomena</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How has computation changed biology?</li> <li>• How will computation impact fields other than computing itself?</li> <li>• How will computation impact society?</li> </ul>	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>will continue to impact other disciplines</p> <ul style="list-style-type: none"> <li>• PG4 – Develop students’ professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers</li> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>• U3.01 - Data can be structured to facilitate use (K3.01, K3.02, K2.12, K7.05) (S3.07)</li> <li>• U3.02 - Our capabilities to collect, store, and process data are changing at profound rates (S8.06, S3.02)</li> <li>• U3.03 - Analysis of data can be automated (K3.03) (S8.14, S3.10, S3.05, S3.07, S3.06, S3.03, S3.09, S5.12)</li> <li>• U3.04 - Data visualizations are important tools for discovering and communicating knowledge (S8.10, S3.10, S8.06, S3.05, S3.04, S3.06, S3.03, S3.09)</li> <li>• U3.05 - The human brain and today's computers have complementary strengths for analyzing data (S3.10, S3.04, S3.07, S3.06, S3.09)</li> <li>• U3.06 - The size of a data set affects how the data can be used</li> <li>• U3.07 - Collecting and managing data raises technical issues regarding storage, access, durability, privacy, and security (K7.05)</li> <li>• U3.08 - Ethical and societal issues are raised by the impact of Big Data and require attention from many stakeholders (K7.09)</li> <li>• U4.01 - Programs implement algorithms to solve problems (K4.05) (S5.12)</li> <li>• U4.02 - Algorithms can be analyzed for efficiency, and appropriate algorithms can be selected based upon efficiency (K4.03)</li> <li>• U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts (K4.03)</li> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool</li> <li>• U5.02 - Solutions in a programming language are created by breaking a problem apart into component problems (S5.11)</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K3.03, K4.05)</li> </ul>	
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# Instructional Design Framework CSE: Unit 1 – Lesson 1



	<ul style="list-style-type: none"> <li>• U5.06 - Functions with arguments make code modular and reusable (S5.11, S5.12)</li> <li>• U5.07 - Programmers create high-level documentation to communicate the purpose and function of their code</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.10)</li> <li>• U6.03 - The Internet facilitates collaboration (S3.02)</li> <li>• U7.03 - Assistive technologies using hardware and software can extend human capabilities</li> <li>• U7.05 - New opportunities for human creativity and innovation exist because of networked, mobile, and embedded computing</li> <li>• U7.06 - Crowdsourcing identifies new problems and provides new solutions (S7.01)</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.06, S8.05)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.04, S8.06, S8.05)</li> <li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner (K3.06)</li> <li>• U8.05 - How people present themselves affects how their work is received (S8.10, S8.14, S8.13)</li> <li>• U9.03 - Computational thinking boosts most career paths (K9.07, K9.04, K9.02, K3.04, K4.03)</li> </ul>	
Acquisition of Knowledge and Skill		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K1.02 - Describe the role of creativity in producing data visualizations (U1.01)</li> <li>• K2.01 - Describe the ways in which various types of digital data can be represented in binary</li> <li>• K2.02 - Distinguish continuous and discrete phenomena and identify digital and analog data</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>• S1.05 - Analyze a computational artifact for usability with a specific audience in mind (U1.02)</li> </ul>

# Instructional Design Framework CSE: Unit 1 – Lesson 1



	<ul style="list-style-type: none"> <li>• K2.03 - Describe layers of abstraction that help people represent and use data</li> <li>• K2.04 - Identify layers of abstraction used in programming languages and describe advantages and disadvantages inherent in working at a high level of abstraction</li> <li>• K2.12 - Identify the relationship among nodes in a tree, as applied to the DOM in a Web page (U3.01)</li> <li>• K3.01 - Relate the categorical or quantitative nature of data to the operations and visualizations that are appropriate (U3.01)</li> <li>• K3.02 - Describe the structure of a relational database (U3.01)</li> <li>• K3.03 - Describe how mathematical functions and algorithms can be applied to a data set to construct a derived data set (U3.03, U5.04)</li> <li>• K3.04 - Identify the relationship between parallel computation and computationally intensive tasks like simulation, modeling, and analysis of large data sets (U9.03)</li> <li>• K3.06 - Identify data visualizations as an important tool for communication (U8.04)</li> <li>• K4.03 - Describe a data structure, such as a tree, and describe an algorithmic problem and multiple solutions concerning that data structure (U4.02, U4.04, U9.03)</li> <li>• K4.05 - Recognize common patterns employing variables, including value accumulation, list aggregation, and iteration across the elements of a collection (U4.01, U5.04)</li> <li>• K7.03 - Describe examples of how location-aware computing is transforming infrastructure</li> <li>• K7.05 - Describe what metadata contain and how they can be used (U3.01, U3.07)</li> <li>• K7.09 - Articulate a range of positions on questions related to privacy with respect to Big Data (U3.08)</li> <li>• K7.10 - Describe examples of crowdsourcing being used for large data set collection or collective biological processing power</li> <li>• K7.12 - Describe examples demonstrating that the</li> </ul>	<ul style="list-style-type: none"> <li>• S1.06 - Analyze a computational artifact for correctness (U1.02)</li> <li>• S2.02 - Propose a method for simulating a natural phenomenon of interest</li> <li>• S2.03 - Identify quantities relevant to a phenomenon and explain the implications of abstracting to a particular model that accounts for some parameters and ignores others</li> <li>• S2.04 - Manipulate the parameters of a simulation to identify how the parameters affect the behavior being modeled</li> <li>• S2.06 - Consider implications of converting data from one representation to another, for example noise or compression</li> <li>• S3.01 - Interpret data and data visualizations to reach conclusions about a model's behavior</li> <li>• S3.02 - Access public information and computational resources to answer questions regarding published data (U3.02, U6.03)</li> <li>• S3.03 - Represent and understand phenomena by identifying relationships among data (U3.03, U3.04)</li> <li>• S3.04 - Identify the appropriate type of basic visualization appropriate to a particular data set (U3.04, U3.05)</li> <li>• S3.05 - Use appropriate tools to construct a scatter plot, histogram, pie chart, or compound bar graph (U3.03, U3.04)</li> <li>• S3.06 - Use appropriate tools to represent geographic data (U3.03, U3.04, U3.05)</li> <li>• S3.07 - Use appropriate tools to create new data sets derived from other data sets (U3.01, U3.03, U3.05)</li> <li>• S3.09 - Use appropriate tools to visualize linked data (U3.03, U3.04, U3.05)</li> <li>• S3.10 - Use appropriate tools to detect clusters in multi-variable data (U3.03, U3.04, U3.05)</li> <li>• S4.01 - Communicate a design for a program using natural language, diagrams, and pseudocode</li> </ul>
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## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>Internet has profoundly altered the way that scientists collaborate, publish, and access each other's work</p> <ul style="list-style-type: none"> <li>• K8.01 - Describe a version control system</li> <li>• K9.02 - Describe the impact that computing has had in the social sciences, geography, and civics (U9.03)</li> <li>• K9.04 - Describe career-oriented opportunities to use computational skills to positively affect people's lives (U9.03)</li> <li>• K9.07 - Describe how specific career fields, e.g. biology and marketing, have changed profoundly as a result of automated collection and processing of data (U9.03)</li> </ul>	<ul style="list-style-type: none"> <li>• S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> <li>• S5.11 - Encapsulate a set of related statements in a function or procedure (U5.02, U5.06)</li> <li>• S5.12 - Create a function to perform a particular calculation from the function's arguments (U3.03, U4.01, U5.06)</li> <li>• S6.04 - Analyze the security of situations in which a user is prompted to follow a link, download content, or provide information in email and Web forms</li> <li>• S7.01 - Use appropriate tools to crowdsource data production (U7.06)</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation (U8.02)</li> <li>• S8.05 - Collaborate effectively with others when managing a project (U8.01, U8.02)</li> <li>• S8.06 - Collaborate when collecting and analyzing data to answer a question (U3.02, U3.04, U8.01, U8.02)</li> <li>• S8.08 - Collaborate when programming (U8.01)</li> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.10 - Present original research and research from literature (U3.04, U8.05)</li> <li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps (U8.05)</li> <li>• S8.14 - Present a plan for producing knowledge (U3.03, U8.05)</li> </ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ...</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S)– Students will show that they really understand when they...</b>		
<i>U5.02, U5.03, U5.08, S5.09, S5.10, S5.11, K7.05</i>	<i>Document an iterative process, breaking the investigation into smaller tasks.</i>	<i>PT1 - Explore and analyze data to investigate a cluster of questions on a topic of interest.</i>
<i>U2.01, U3.01, U3.04, U3.05, U4.01, U4.04, U5.04, S2.06, S3.03, S3.04, S3.05, S3.07, S3.08, S5.12, S5.13, S8.11</i>	<i>Explore and analyze data.</i>	
<i>U3.03, U3.06, U4.02, U4.03, U7.08, S4.02</i>	<i>Show awareness of scalability to larger data when choosing tools and algorithms.</i>	
<i>U6.03, U8.01, U8.02, S8.06, S8.07, S8.08</i>	<i>Collaborate when collecting, exploring and analyzing data and when presenting results.</i>	
<i>U1.02, U5.07, U9.01, S1.01</i>	<i>Present knowledge gained using prose and visualizations</i>	

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U2.07, S2.02, S2.03, S2.04, S3.04	Create a model incorporating randomness that abstracts a measured phenomenon.	OE1 - Abstract real phenomena with a model that incorporates randomness.
	Produce and analyze Monte Carlo simulation results.	
S3.01, S3.02	Compare differences in the proportions or means of two samples to variability implicit within the samples.	OE2 - Improve accuracy when informally inferring patterns (and the lack thereof) in bivariate data.
	Recognize linear correlation and lack thereof.	
U5.04, S3.09	Manipulate and visualize linked data.	OE3 - Describe operations that can be performed with linked data.
U5.04, S3.04	Manipulate and visualize GIS data.	OE4 - Manipulate geographic data. Describe operations that can be performed on GIS data, visualize GIS data, and describe opportunities presented by GIS data.
U7.01, U7.02, U7.04, K7.10, K7.12, K9.02, K9.04, K9.05, K9.06, K9.07	Describe impact of GIS data.	
S1.01, S2.02, S8.06, S8.07, S8.11, S3.04	Manipulate and visualize genomic data.	OE5 - Manipulate genomic data. Describe operations that can be performed on genomic data, visualize genomic data, and describe opportunities and challenges presented by genomic data.
U3.08, U6.05, U7.02, K7.09, K7.13, K9.03, K9.04, K9.05, K9.06	Describe opportunities and challenges of genomic data.	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
Stage 3 – Learning Plan		
LEARNING EVENTS –		
Activity (A), Project (P), or Problem (B)	Assessment for Learning	Assessment of Learning
<i>A3.2.1 - Inferential Statistics</i>	U1.02, U2.04, U2.05, U2.07, U3.03, U3.04, U5.04, S1.01, S2.01, S2.02, S2.03, S2.04, S3.01, S3.02, S3.03, S3.05, S3.07, K2.03, K2.05, K2.06, K2.08, K3.01, K3.03	
<i>A3.2.2 - Image Data</i>	U3.03, U3.05, U3.06, U4.01, 0, K3.04, K4.03	
<i>A3.2.3 - Linked Data</i>	U5.05, S3.04, S3.09, K4.03	
<i>A3.2.4 - Geographic Data</i>	U1.02, U2.04, U2.05, U3.01, U5.01, U6.03, S3.04, S3.06, K3.01, K3.06, K7.03	
<i>A3.2.5 Considering Gattaca</i>	U3.02, U3.03, U3.08, U7.02, 0, K7.04, K7.09	
<i>P3.2.6 Genomic Data (Optional)</i>	U2.04, U2.08, U3.02, U3.03, U4.04, U5.01, U6.03, U7.09, U9.01, S3.02, S3.04, S3.07, K2.03, K3.03, K3.04, K4.02, K4.03, K7.10	
<i>B3.2.7 - Investigating with Data</i>		U1.01, U1.02, U1.03, U2.01, U2.02, U2.04, U2.05, U3.01, U3.03, U3.04, U3.06, U3.07, U4.01, U4.02, U5.01, U5.02, S1.01, S2.06, S3.02, S3.03, S3.04, S3.05, S3.06, S3.07, S3.08, S3.10, S5.10, K1.02, K2.01, K2.03, K3.03, K3.06, K4.05, K5.02

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
Stage 1 – Desired Results		
<p><b>Established Goals:</b>                      PLTW Goals:</p> <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> <p>Pathway Goals:</p> <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> <p>Course Goals:</p> <ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway</li> </ul>	Transfer	
	<p><i>Students will be able to independently use their learning to ...</i></p> <ul style="list-style-type: none"> <li>• T14 -- Use modeling and simulation to understand a physical, biological, or social phenomenon.</li> </ul>	
	Meaning	
	<p><i>UNDERSTANDINGS – Students will understand that ...</i></p> <ul style="list-style-type: none"> <li>• U1.02 - Computational artifacts can be evaluated</li> <li>• U2.01 - Binary sequences represent digital data</li> <li>• U2.03 - Computing relies on abstractions of hardware represented with software</li> <li>• U2.07 - Simulation and modeling can help us understand, communicate about, and predict natural phenomena</li> <li>• U2.08 - Physical systems, like sound or biological molecules, have both digital and analog characteristics</li> <li>• U3.02 - Our capabilities to collect, store, and process data are changing at profound rates</li> <li>• U3.03 - Analysis of data can be automated</li> <li>• U3.04 - Data visualizations are important tools for discovering and communicating knowledge</li> <li>• U4.01 - Programs implement algorithms to solve problems</li> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions</li> <li>• U7.06 - Crowdsourcing identifies new problems and provides new solutions</li> </ul>	<p><i>ESSENTIAL QUESTIONS - Students will keep considering ...</i></p> <ul style="list-style-type: none"> <li>• How are simulations created from models?</li> <li>• How are simulation models similar to and different from reality?</li> <li>• How are modeling and simulation impacting other creative fields?</li> </ul>

# Instructional Design Framework CSE: Unit 1 – Lesson 1



<p>while equipping all students with necessary computational background as citizens, employees, and consumers</p> <ul style="list-style-type: none"> <li>• CG2 – Broaden participation in computing</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<ul style="list-style-type: none"> <li>• U7.09 - Computing is rapidly and profoundly changing science and engineering</li> <li>• U9.02 - Parallel computing is a quickly evolving field relevant to hardware, software, and users</li> <li>• U9.03 - Computational thinking boosts most career paths</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>• K2.02 - Distinguish continuous and discrete phenomena and identify digital and analog data</li> <li>• K2.05 - Describe any simulation as abstracting some aspects of a model while ignoring other details</li> <li>• K2.06 - Describe any simulation as relying on assumptions, some of which can be parameterized, with conclusions applicable to a range of parameter values</li> <li>• K2.07 - Describe an abstraction of hardware</li> <li>• K2.08 - Distinguish deterministic and randomized models and describe the role of Monte Carlo techniques</li> <li>• K2.09 - Recognize that chaotic and periodic behavior can be exhibited by both deterministic and randomized models</li> <li>• K2.11 - Discrete, continuous, and agent-based models using digital computation rely on discrete calculations</li> <li>• K2.14 - Describe some of the major applications of simulation</li> <li>• K2.15 - Identify landmarks in hardware development such as tubes, transistors, and VLSI, as well as developments such as optoelectronics, nanotechnology, and quantum computing</li> <li>• K2.16 - Describe the implications of the limited precision of digital information in applications</li> <li>• K2.17 - Describe the abstraction of a logic gate and explain how complex logic functions can be constructed from NAND gates</li> <li>• K3.04 - Identify the relationship between parallel computation and computationally intensive tasks like</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>• S1.06 - Analyze a computational artifact for correctness</li> <li>• S2.01 - Identify and explain some of the assumptions made by a particular model</li> <li>• S2.03 - Identify quantities relevant to a phenomenon and explain the implications of abstracting to a particular model that accounts for some parameters and ignores others</li> <li>• S2.04 - Manipulate the parameters of a simulation to identify how the parameters affect the behavior being modeled</li> <li>• S2.08 - Compare hardware and software manipulations that produce similar outcomes</li> <li>• S2.09 - Construct a circuit including discrete components and semiconductor chips from a symbolic diagram</li> <li>• S3.01 - Interpret data and data visualizations to reach conclusions about a model's behavior</li> <li>• S3.03 - Represent and understand phenomena by identifying relationships among data</li> <li>• S5.06 - Evaluate programs written by others for readability</li> <li>• S5.08 - Identify appropriate boundary conditions for testing a program</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation</li> <li>• S8.10 - Present original research and research from literature</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>simulation, modeling, and analysis of large data sets</p> <ul style="list-style-type: none"><li>• K3.06 - Identify data visualizations as an important tool for communication</li><li>• K7.01 - Characterize the size, cost, and speed of computational processing as changing exponentially</li><li>• K7.03 - Describe examples of how location-aware computing is transforming infrastructure</li><li>• K7.10 - Describe examples of crowdsourcing being used for large data set collection or collective biological processing power</li><li>• K7.11 - Describe examples in which computation has or will create new societal phenomena and human capabilities to perceive and act upon our environment</li></ul>	<ul style="list-style-type: none"><li>• S8.11 - Distinguish sources of information and comment on the information's reliability and intended audience</li></ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ...</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S) – Students will show that they really understand when they...</b>		
U2.01, U2.03, S2.09	<i>Create a meaningful circuit from discrete electronic components and explain the nature of its binary digital behavior.</i>	<i>PT1 - Design and implement a problem's solution close to the semiconductor level to produce output based upon processed input</i>
U2.03, U5.04, S2.08, K2.07	<i>Relate the hardware solution to an abstraction independent of hardware particulars</i>	
U2.07, U3.04, K2.08, K2.09, K3.06	<i>Identify patterns in transient, steady state, oscillating, and/or chaotic behavior</i>	<i>PT2 - When provided a model and simulation, explore the simulation's parameter space and draw conclusions from the data produced</i>
U2.07, U3.03, U3.04, U4.01, U5.01, S1.06, S2.04, S3.01, S3.03, S5.08, K2.06	<i>Explore a model's behavior across its parameter space and identify regions of parameter space with distinct behavior</i>	
U2.08, S1.06, S2.01, S2.03, S5.06, K2.02, K2.05, K2.06, K2.08, K2.11, K2.16	<i>Identify the details parameterized in a particular model, identify some details which were abstracted away, and explain the possible implications of these decisions</i>	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<i>U2.03, K2.15, K2.17</i>	<i>Relate transistors, integrated circuits, gates, and assembly language instructions.</i>	<i>OE1 - Describe how software interfaces with hardware</i>
<i>U3.02, U7.06, U7.09, U9.02, U9.03, S8.04, S8.10, S8.11, K2.14, K3.04, K7.01, K7.03, K7.10, K7.11</i>	<i>Analyze short- and long-term beneficial and harmful impacts of a computing innovation</i>	<i>OE2 - Analyze the impact of some innovation involving distributed computing, parallel computing, high performance computing, modeling and simulation, and crowd sourcing</i>
<i>S8.10</i>	<i>Create a professional technical report on the impacts of a computing innovation.</i>	<i>(Opportunity #4 to create a response to the College Board AP CS Principles Explore Performance Task)</i>
<i>U3.02, U7.06, U7.09, U9.02, S8.04</i>	<i>Present a creative visual artifact about the beneficial or harmful effects of a computing innovation (Opportunity #4 for CS Principles Explore PT)</i>	
<i>U1.02, U2.07, U3.04, K3.06</i>	<i>Interpret a time-series visualization of simulation results.</i>	<i>OE3 - Interpret the results of a simulation from a visualization.</i>

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ...</i>
Stage 3 – Learning Plan		
LEARNING EVENTS –		
Activity (A), Project (P), or Problem (B)	Assessment for Learning	Assessment of Learning
Activity 4.1.1 Computing Impacts All Fields		U3.02, U7.06, U7.09, U9.02, U9.03, S8.04, S8.10, S8.11, K2.14, K3.04, K7.01, K7.03, K7.10, K7.11
Activity 4.1.2 Basic Control Circuits	U2.01, U2.03, U5.04, S2.08, S2.09, K2.07, K2.15, K2.17	
Activity 4.1.3 Introducing Simulations	U2.07, U2.08, U3.03, U3.04, U4.01, U5.01, K2.02, K2.05, K2.06, K2.08, K2.09, K2.11, K2.16, K3.06, S1.06, S2.01, S2.03, S2.04, S3.01, S3.03, S5.06, S5.08	
Activity 4.1.4 Varying Parameters		U1.02, U2.07, U3.04, K3.06
Activity 4.1.5 Assumptions, Abstractions, and Ethics	U2.08, S1.06, S2.01, S2.03, S5.06, K2.02, K2.05, K2.06, K2.08, K2.11, K2.16	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
If the desired end result is for learners to ... →	then you need evidence of the learners' ability to ...→	then the learning events need to ....
<b>Stage 1 – Desired Results</b>		
<b>Established Goals:</b> PLTW Goals: <ul style="list-style-type: none"> <li>• PLTWG1- Develop students' professional skills</li> <li>• PLTWG2- Engage students in problem-based learning</li> <li>• PLTWG3- Enthuse students about CSTEM</li> </ul> Pathway Goals: <ul style="list-style-type: none"> <li>• PG1 – Develop computational thinking</li> <li>• PG2 – Illuminate the ways that CS has impacted and will continue to impact other disciplines</li> <li>• PG4 – Develop students' professional skills</li> <li>• PG5 – Provide students with the tools necessary for skill acquisition outside the scope of the pathway</li> <li>• PG6 – Increase student interest in and self-efficacy in computing</li> </ul> Course Goals:	<b>Transfer</b>	
	<i>Students will be able to independently use their learning to ...</i> <ul style="list-style-type: none"> <li>• T15 - Understand and communicate about real systems by abstracting and simulating them and interpreting the results</li> <li>• T16 - Contrast the assumptions and predictive power of simulations</li> </ul>	
	<b>Meaning</b>	
	<i>UNDERSTANDINGS – Students will understand that ...</i> <ul style="list-style-type: none"> <li>• U1.01 - Computing fosters creative expression, sometimes resulting in artifacts (K1.02) (S1.01)</li> <li>• U1.02 - Computational artifacts can be evaluated (S1.06)</li> <li>• U1.03 - Programming is a creative endeavor (S5.03)</li> <li>• U2.01 - Binary sequences represent digital data</li> <li>• U2.02 - Computing relies on layers of abstraction in software (K2.04, K2.05, K2.16) (S5.12)</li> <li>• U2.04 - Abstraction allows for simple utilization of other people's code</li> <li>• U2.06 - The solution to one problem can be applied to another seemingly unrelated problem by identifying and reusing a pattern (K2.10) (S5.03)</li> <li>• U2.07 - Simulation and modeling can help us understand, communicate about, and predict natural phenomena (K2.08, K2.09, K2.06, K2.13, K2.14) (S2.02, S2.03, S2.01, S2.04, S3.01)</li> <li>• U2.09 - Intelligent behavior emerges from networked</li> </ul>	<i>ESSENTIAL QUESTIONS - Students will keep considering ...</i> <ul style="list-style-type: none"> <li>• How has computation affected our ability to predict the future?</li> <li>• How has computation affected our ability to experience virtual phenomena?</li> <li>• How has simulation changed the design process in engineering and other creative fields?</li> </ul>

## Instructional Design Framework CSE: Unit 1 – Lesson 1



<ul style="list-style-type: none"> <li>• CG1 – Provide an effective entry point for students in a computational pathway while equipping all students with necessary computational background as citizens, employees, and consumers (a la CSTA 3A standards)</li> <li>• CG2 – Broaden participation in computing (a la CSP framework)</li> <li>• CG3 - Develop professional skills</li> <li>• CG4 - Excite and enthuse all students about CS</li> <li>• CG5 - De-mystify the fundamental black boxes of computing</li> <li>• CG6 - Equip students to navigate an ever-changing digital landscape</li> </ul>	<p>collections of simple algorithms (K2.13, K2.14)</p> <ul style="list-style-type: none"> <li>• U3.01 - Data can be structured to facilitate use</li> <li>• U3.03 - Analysis of data can be automated</li> <li>• U3.04 - Data visualizations are important tools for discovering and communicating knowledge</li> <li>• U3.05 - The human brain and today's computers have complementary strengths for analyzing data</li> <li>• U4.01 - Programs implement algorithms to solve problems (K2.08, K5.02) (S5.12)</li> <li>• U4.03 - Empirical analysis of algorithms requires a systematic approach (S5.02)</li> <li>• U4.04 - A given algorithmic problem with standard solutions can be applied in diverse contexts</li> <li>• U5.01 - Creating solutions with computation requires exploring the tools available, selecting an appropriate tool, and gaining expertise with the tool</li> <li>• U5.03 - Creating solutions with computation requires a persistent, iterative problem-solving approach</li> <li>• U5.04 - Programming requires an understanding of mathematical operations and data abstractions (K5.02, K3.03)</li> <li>• U5.05 - The user interface of a piece of software can greatly affect how it is used</li> <li>• U5.08 - Programmers must prioritize making their code well-documented and readable for it to be maintained (S5.10)</li> <li>• U7.09 - Computing is rapidly and profoundly changing science and engineering (K9.04, K2.13, K2.14)</li> <li>• U8.01 - Computing artifacts and programs can be higher quality as a result of collaboration (S8.08, S8.09, S8.06)</li> <li>• U8.02 - Working in a team requires effective communication, clear responsibilities, and attention to interpersonal relationships (S8.09, S8.06)</li> <li>• U8.04 - Creative ideas and technical solutions must be communicated in a clear and concise manner</li> <li>• U8.05 - How people present themselves affects how their work is received</li> <li>• U9.01 - Computer science and information</li> </ul>	
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	<p>technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals</p> <ul style="list-style-type: none"> <li>U9.03 - Computational thinking boosts most career paths (K9.08, K9.07, K9.04, K9.06, K3.04, K2.14)</li> </ul>	
<h2>Acquisition of Knowledge and Skill</h2>		
	<p><i>KNOWLEDGE – Students will have the knowledge to...</i></p> <ul style="list-style-type: none"> <li>K2.05 - Describe any simulation as abstracting some aspects of a model while ignoring other details (U2.02)</li> <li>K2.06 - Describe any simulation as relying on assumptions, some of which can be parameterized, with conclusions applicable to a range of parameter values (U2.07, U2.08)</li> <li>K2.08 - Distinguish deterministic and randomized models and describe the role of Monte Carlo techniques (U2.07, U4.01)</li> <li>K2.09 - Recognize that chaotic and periodic behavior can be exhibited by both deterministic and randomized models (U2.07)</li> <li>K2.11 - Discrete, continuous, and agent-based models using digital computation rely on discrete calculations</li> <li>K2.13 - Give examples of synergetic properties that can emerge from real or simulated collections of independent agents</li> <li>K2.14 - Describe some of the major applications of simulation (U2.07, U2.09, U7.09, U9.03)</li> <li>K2.16 - Describe the implications of the limited precision of digital information in applications</li> <li>K3.03 - Describe how mathematical functions and algorithms can be applied to a data set to construct a derived data set (U5.04)</li> <li>K3.04 - Identify the relationship between parallel computation and computationally intensive tasks like simulation, modeling, and analysis of large data sets</li> <li>K3.06 - Identify data visualizations as an important tool for communication</li> <li>K4.01 - Describe a computer as responding to input</li> </ul>	<p><i>SKILLS – Students will have the skills to...</i></p> <ul style="list-style-type: none"> <li>S1.01 - Create a visual artifact of a computational process, such as an image or screenshot of a user interface or web page (U1.01)</li> <li>S1.06 - Analyze a computational artifact for correctness (U1.02)</li> <li>S2.01 - Identify and explain some of the assumptions made by a particular model (U2.07)</li> <li>S2.02 - Propose a method for simulating a natural phenomenon of interest (U2.07, U5.02)</li> <li>S2.03 - Identify quantities relevant to a phenomenon and explain the implications of abstracting to a particular model that accounts for some parameters and ignores others (U2.07, U2.08)</li> <li>S2.04 - Manipulate the parameters of a simulation to identify how the parameters affect the behavior being modeled (U2.07)</li> <li>S3.01 - Interpret data and data visualizations to reach conclusions about a model's behavior (U2.07)</li> <li>S3.03 - Represent and understand phenomena by identifying relationships among data</li> <li>S3.04 - Identify the appropriate type of basic visualization appropriate to a particular data set</li> <li>S3.08 - Use appropriate tools to describe a linear relationship (or lack thereof) inferred from data</li> <li>S5.01 - Design a program by breaking a large plan into smaller modules</li> <li>S5.02 - Analyze and test code from other</li> </ul>

# Instructional Design Framework CSE: Unit 1 – Lesson 1



	<p>in a deterministic manner that depends only on input and on the computer's state</p> <ul style="list-style-type: none"> <li>• K5.03 - Distinguish among a variety of educational and reference resources related to code libraries</li> <li>• K8.01 - Describe a version control system</li> </ul>	<p>people (U4.03)</p> <ul style="list-style-type: none"> <li>• S5.07 - Create a program by incrementally writing and testing modular code</li> <li>• S5.10 - Create readable code with a combination of documentation and comments (U5.08)</li> <li>• S8.01 - Document a software development process</li> <li>• S8.02 - Document a software product using high-level documentation</li> <li>• S8.03 - Use a version control system</li> <li>• S8.04 - Effectively manage a project, including planning and time management, team norming and load balancing, file/revision management, and documentation</li> <li>• S8.05 - Collaborate effectively with others when managing a project</li> <li>• S8.06 - Collaborate when collecting and analyzing data to answer a question (U3.02, U8.01, U8.02)</li> <li>• S8.09 - Collaborate when presenting (U8.01, U8.02)</li> <li>• S8.13 - Communicate the progress on a project, including accomplishments and next steps</li> <li>• S8.14 - Present a plan for producing knowledge</li> </ul>
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Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ...→</i>	<i>then the learning events need to ....</i>
Stage 2 – Evidence		
Code	Evaluative Criteria	Performance Task (PT) or Other Evidence (OE)
<b>PERFORMANCE TASK(S) – Students will show that they really understand when they...</b>		
U1.02, U2.02, U2.04, U3.05, U4.01, U5.04, S1.06, S5.02	<i>Explain the use of algorithms and abstraction in a program.</i>	PT1 - Present the abstractions, algorithms, and mathematical concepts used by a development team to strategically satisfy a purpose  (Opportunity to create a response to the College Board AP CS Principles Create Performance Task)
U5.10, U5.03, U8.01, U8.02, U8.04, K8.01, S1.01, S8.01, S8.02, S8.03, S8.04, S8.05, S8.09, S8.13	<i>Present a development process by which a program was collaboratively developed for a purpose.</i>	
U1.01, U1.03, U2.06, U4.04, K5.03, S5.01, S5.07	<i>Use mathematics and logic concepts, abstraction, and algorithms creatively and effectively.</i>	
U5.08, S5.10, S8.02	<i>Create readable code.</i>	
<b>OTHER EVIDENCE – Students will show they have achieved Stage 1 goals when they...</b>		
U5.05, U7.09, U9.01, U9.03	<i>Describe how a program can impact people</i>	OE1 - Envision positive and negative impacts of a program.

## Instructional Design Framework CSE: Unit 1 – Lesson 1



U2.09, K2.13	<i>Identify emergence of phenomena in agent-based modeling and distributed computing.</i>	OE2 - Give examples of emergent phenomena
U3.01, U3.03, U3.04, U3.05, K3.03, K3.04, S1.01, S1.06, S2.04, S3.01, S3.03, S3.08, S8.06	<i>Interpret the results of a simulation</i>	OE3 - Analyze the results of a simulation and describe how the discrete nature of digital data affects simulation
U2.01, U2.07, U4.03, U4.04, K2.06, K2.11, K4.01, S2.01, S2.02, S2.03	<i>Describe the algorithm of a simulation in which continuous time and space are modeled with a finite number of discrete intervals</i>	
U2.07, K2.05, K2.08, K2.09, K2.16, S2.01, S2.03	<i>Given a model for a phenomenon with fractal or chaotic behavior, relate the validity of the simulation results to the precision of the model's mesh, parameters, and initial conditions</i>	
U2.07, U7.09, K2.14, K3.04	<i>Explain why high performance computing can extend the validity of modeling and simulation</i>	

Instructional Design Framework		
Stage 1	Stage 2	Stage 3
<i>If the desired end result is for learners to ... →</i>	<i>then you need evidence of the learners' ability to ... →</i>	<i>then the learning events need to ....</i>
Stage 3 – Learning Plan		
<i>Activity (A), Project (P), or Problem (B)</i>	<i>Assessment for Learning</i>	<i>Assessment of Learning</i>
A4.2.1 – Emergent Behavior	(U1.02, U2.01, U2.06, U2.07, U2.09, U3.01, U3.04, U4.01, U4.04) (K2.08, K2.09, K2.13, K4.01, K9.03)(S2.04, S5.02, S8.06)	
A4.2.2 – Neural Networks	(U1.02, U2.01, U2.07, U2.09, U4.03, U5.04) (K2.05, K2.06, K3.03, K4.01) (S1.06, S2.01, S2.03, S2.04)	
P4.2.3 – Modifying a Simulations Assumptions	(U1.02, U2.02, U2.04, U2.07, U3.04, U3.05, U5.03, U5.05, U8.01, U8.02, U8.04, U8.05) (K2.05, K2.06, K2.08, K2.13, K3.03, K3.06, K5.03, K8.01) (S1.01, S1.06, S2.01, S2.02, S2.03, S2.04, S3.01, S3.03, S3.04, S8.01, S8.02, S8.03, S8.04, S8.05, S8.06, S8.09, S8.13, S8.14)	
A4.2.4 – Beauty In Chaos And Fractals	(U1.01, U1.03, U2.07, U2.09, U7.09,) (K2.05, K2.06, K2.13, K2.14, K3.03, ) (S1.01, S2.01, S2.03, S2.04)	
P4.2.5 – Computer Science Principles		(U1.01, U2.02, U2.04, U3.01, U3.03, U3.04, U4.01, U4.03, U4.04, U5.01, U5.04, U5.08, U7.09, U8.01, U8.05, U9.01,

# Instructional Design Framework CSE: Unit 1 – Lesson 1



		U9.03) (S5.01, S5.07, S5.10, S8.04, S8.09)
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