Skills for Innovation Skillset Competency Profile

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Digital Promise®
Accelerating Innovation in Education

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Competency Profiles

These competency profiles are designed to be used in the development of learning pathways. To find out more about the Intel Skills for Innovation Skillset Competency Profile and creating learning pathways around the Skills for Innovation framework, read Skills for Innovation Learning Pathways.

Acknowledgements

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Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Simulation and Modeling		
Exploring Phenomena Using Models Interact with various physical and/or computational models that represent real-world systems to understand that systems are made of smaller parts.	• Exploring a physical or computational model. • Identifying the smaller parts of a system represented by a physical or computational model. • Explaining a system using a physical or computational model.	**C3 Framework for Social Studies State Standards** • D4.2.K-2. Construct explanations using correct sequence and relevant information. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.LS2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). **Obtaining, Evaluating, and Communicating Information:** • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.
Creating Computational Models and Creating 3D Models With teacher or peer support, create physical models of real-world systems, objects, or locations.	• Representing relationships between smaller parts of a real-world system, object, or location in a physical model with the support of a teacher or peers.	**C3 Framework for Social Studies State Standards** • D4.2.K-2. Construct explanations using correct sequence and relevant information. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). • Develop a simple model based on evidence to represent a proposed object or tool. **Constructing Explanations and Designing Solutions:** • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. **Obtaining, Evaluating, and Communicating Information:** • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Assessing Models Compare a physical or computational model to the real-world system it represents to notice similarities and differences.	• Considering how a physical or computational model represents a real-world system. • Identifying similarities and differences between a physical or computational model and the real-world system it represents.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • Common Core English Language Arts Anchor Standards • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Next Generation Science Standards** **Developing and Using Models:** • Distinguish between a model and the actual object, process, and/or events the model represents

K-2 Simulation and Modeling Aligned Starter Pack Lessons
Agriculture: Farm to Table **(Humanities: Social Studies)** Demonstrate the importance of food production and agriculture in ensuring a sustainable community through game-based learning. Citybuilding for Sustainability **(Humanities: Geography)** Build a liveable city with the resources provided in this game-based activity. My 3D Volcano **(Humanities: Geography)** Have fun demonstrating the various layers of a volcano by creating a 3D model. Orbital Simulation **(STEM: Physics)** Gather data about Earth and produce an animation demonstrating planetary movements around the Sun. VR Science Museum **(STEM: Biology)** Create a virtual reality simulation of a science museum featuring the diversity of living things.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Programming and Coding		
Defining Procedures as Algorithms Develop an algorithm that decomposes a simple problem or task into smaller parts and uses precise statements.	• Decomposing a simple problem or task. • Identifying essential steps to solve a simple problem or complete a simple task. • Refining language within steps to be precise.	**C3 Framework for Social Studies State Standards** • D4.2.K-2. Construct explanations using correct sequence and relevant information. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1A-AP-08 Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks. (P4.4) • 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. (P3.2) • 1A-AP-12 Develop plans that describe a program's sequence of events, goals, and expected outcomes. (P5.1, P7.2) **Next Generation Science Standards** **Asking Question and Defining Problems:** • Define a simple problem that can be solved through the development of a new or improved object or tool.
Programming Use a basic visual programming environment (e.g., Scratch Jr.) or tactile programming tool (e.g., Kibo, Bee Bot, Code-a-Pillar) to automate a basic procedure.	• Planning code with physical or written tools (e.g., graphic organizers, sequenced cards/ manipulatives). • Writing an algorithm in a language understandable by a computer using a basic visual programming environment or tactile tool. • Creating a basic procedure for a computer or computational tool to carry out.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1A-CS-01 Select and operate appropriate software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use. (P1.1) • 1A-AP-08 Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks. (P4.4) • 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem. (P5.2) • 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. (P3.2) • 1A-AP-12 Develop plans that describe a program's sequence of events, goals, and expected outcomes. (P5.1, P7.2) **Next Generation Science Standards** **Constructing Explanations and Designing Solutions:** • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
Testing and Debugging Understand that outcomes of an algorithm can be used to determine if there are errors in the algorithm and iteratively refine to fix errors.	• Observing outputs that are different than intended. • Discussing how an outcome is similar or different than intended. • Making iterative changes to fix errors.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1A-CS-03 Describe basic hardware and software problems using accurate terminology. (P6.2, P7.2) • 1A-AP-14 Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops. (P6.2)

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

K-2 Programming and Coding Aligned Starter Pack Lessons
Orbital Simulation **(STEM: Physics)** Gather data about Earth and produce an animation demonstrating planetary movements around the Sun. Plant Food **(STEM: Biology)** Create an animated story using block programming to demonstrate the process of photosynthesis. Robot Geometry **(STEM: Mathematics)** Learn how to program a virtual robot that can move in different geometrical shapes. Storytelling with Scratch **(Language Arts: Language)** Explore how coding can be used to create an animated story. Water Cycle **(STEM: Biology)** Demonstrate the water cycle by animating the process using block programming.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Data Science		
Collecting Data Collect numerical data by categorizing objects and sorting them into groups.	• Grouping objects based on shared characteristics. • Counting objects categorized within the same groups.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. **Analyzing and Interpreting Data:** • Record information (observations, thoughts, and ideas). **Using Mathematics and Computational Thinking:** • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Analyzing Data As a class, discuss patterns and relationships in basic numerical data sets, categories, or groups.	• Recognizing patterns across objects/data within a group or category. • Drawing conclusions about basic numerical data, categories, or groups.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. **Using Mathematics and Computational Thinking:** • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Evaluating Data Identify data points that don't follow a predicted or identified pattern. Consider questions that arise based on the data set.	• Identifying data points that are unexpected based on identified patterns. • Asking questions about data that is being analyzed.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Next Generation Science Standards** **Engaging in Argument From Evidence:** • Analyze why some evidence is relevant to a scientific question and some is not.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Communicating Data Create a basic visualization (e.g., bar graph) visualizing data and describe the patterns in the visualization.	• Designing a basic visualization of data. • Describing patterns in data represented by the data visualization orally or in writing.	**C3 Framework for Social Studies State Standards** • D4.1.K-2. Construct an argument with reasons. • D4.2.K-2. Construct explanations using correct sequence and relevant information. • D4.3.K-2. Present a summary of an argument using print, oral, and digital technologies. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. • CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 1A-DA-06 Collect and present the same data in various visual formats. (P7.1, P4.4) • 1A-DA-07 Identify and describe patterns in data visualizations, such as charts or graphs, to make predictions. (P4.1) **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Use and share pictures, drawings, and/or writings of observations. **Obtaining, Evaluating, and Communicating Information:** • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

K-2 Data Science Aligned Starter Pack Lessons
Citybuilding for Sustainability **(Humanities: Geography)** Build a liveable city with the resources provided in this game-based activity.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Artificial Intelligence and Machine Learning		
Investigating Artificial Intelligence and Machine Learning Systems Locate sensors on phones, computers, robots, and other technological devices, and identify what the sensors allow the technology to perceive.	• Finding different types of sensors on phones, computers, robots, and other technological devices. • Identifying the purpose and function of different types of sensors.	**Computer Science Teachers Association** • 1A-CS-02 Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware). (P7.2)
Training Artificial Intelligence and Machine Learning Algorithms Label a set of objects or pictures with features that could be used to classify them.	• Identifying features of objects or pictures that could be used to classify them (e.g., color, shape). • Sorting objects or pictures based on features that could be used to classify them. • Labeling features of objects or pictures to classify them.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Record information (observations, thoughts, and ideas).
Assessing and Auditing Artificial Intelligence and Machine Learning Systems Discuss the ways that AI and Machine Learning technologies can be inaccessible to some people (e.g., only understanding English). With peer and/or teacher support, develop an ethical matrix for a simple algorithm solving a problem or completing a task to identify who the algorithm affects and related values. Discuss how these values might be similar or different across groups.	• Explaining inequities that arise when AI/ML technologies are inaccessible to some people. • Explaining and discussing how and why values for an algorithm are different for different people.	**C3 Framework for Social Studies State Standards** • D2.Civ.10.K-2. Compare their own point of view with others' perspectives. • D4.1.K-2. Construct an argument with reasons. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. **Computer Science Teachers Association** • 1A-CS-01 Select and operate appropriate software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use. (P1.1) **Next Generation Science Standards** **Constructing Explanations and Designing Solutions:** • Generate and/or compare multiple solutions to a problem **Obtaining, Evaluating, and Communicating Information:** • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design.

Grades K-2: By the end of Grade 2, what will ALL students know and be able to do?

K-2 Artificial Intelligence and Machine Learning Aligned Starter Pack Lessons
Are You Happy? **(Language Arts: Language)** Use natural language processing to create a machine that can detect emotion through spoken text. Green Screen Newscast **(Language Arts: Language)** Make use of a green screen and fundamental video editing skills to put together an engaging newscast.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Simulation and Modeling		
Exploring Phenomena Using Models Manipulate a participatory simulation and/or computational model to set up multiple and different scenarios to answer a driving question.	• Identifying a question to explore using a participatory simulation or computational model. • Setting up multiple different scenarios to collect data from a participatory simulation and/or computational model. • Using data collected from a participatory simulation and/or computational model to support a claim about a real-world system.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 1B-DA-07 Use data to highlight or propose cause- and-effect relationships, predict outcomes, or communicate an idea. (P7.1) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Creating Computational Models With teacher or peer support, develop or modify a participatory simulation or computational model that represents a real-world system.	• Representing relationships between smaller parts of a real world system in a participatory simulation and/or computational model with the support of a teacher or peers. • Identifying different parts of a real world system that a participatory simulation and/or computational model is representing. • Defining relationships between different parts of a real world system.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • Common Core English Language Arts Anchor Standards • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 1B-AP-11 Decompose (break down) problems into smaller, manageable sub-problems to facilitate the program development process. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Creating 3D Models Create 2D or 3D physical models representing a real-world system, object, or location.	• Defining relationships between different parts of a real-world system, object, or location. • Representing relationships between smaller parts of a real-world system, object, or location in a 2D or 3D physical model. • Identifying different parts of a real-world system, object, or location that a 2D or 3D physical model is representing.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
Assessing Models Compare a participatory simulation or computational model that is used or developed to the real-world system it represents to notice similarities and differences.	• Testing and debugging a participatory simulation and/or computational model. • Considering how a participatory simulation and/or computational model represents a real-world system. • Identifying similarities and differences between a participatory simulation and/or computational model and the real world system it represents.	**C3 Framework for Social Studies State Standards** • D4.4.3-5. Critique arguments. • D4.5.3-5. Critique explanations. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 1B-AP-15 Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. (P6.1, P6.2) **Next Generation Science Standards** **Developing and Using Models:** • Identify limitations of models. **Analyzing and Interpreting Data:** • Use data to evaluate and refine design solutions.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

3–5 Simulation and Modeling Aligned Starter Pack Lessons
Agriculture: Farm to Table **(Humanities: Social Studies)** Demonstrate the importance of food production and agriculture in ensuring a sustainable community through game-based learning. Citybuilding for Sustainability **(Humanities: Geography)** Build a liveable city with the resources provided in this game-based activity. Catapult Toss **(STEM: Physics)** Create a catapult game which uses projectiles with different properties for launches. My 3D Volcano **(Humanities: Geography)** Have fun demonstrating the various layers of a volcano by creating a 3D model. Orbital Simulation **(STEM: Physics)** Gather data about Earth and produce an animation demonstrating planetary movements around the Sun. VR Science Museum **(STEM: Biology)** Create a virtual reality simulation of a science museum featuring the diversity of living things.

Competency	Look Fors	Aligned Standards
Programming and Coding		
Defining Procedures as Algorithms Develop an algorithm that decomposes a complex problem, process, or task into smaller parts and uses precise statements.	• Decomposing a complex problem or task. • Identifying essential steps to solve a complex problem or complete a complex task. • Refining language within steps to be precise.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1B-AP-10 Create programs that include sequences, events, loops, and conditionals. (P5.2) • 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process. (P3.2)
Programming Use a block-based programming language to automate a procedure that solves a problem/ completes a task.	• Planning code with physical or written tools (e.g., graphic organizers, sequenced cards/ manipulatives, flow charts). • Writing an algorithm in a block-based language understandable by a computer. • Creating a procedure for a computer to carry out.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1B-AP-10 Create programs that include sequences, events, loops, and conditionals. (P5.2) • 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process. (P3.2)
Testing and Debugging Use intermediate results to help find and fix errors, not only in what is incorrect within an algorithm but also what might be missing.	• Discussing how an outcome is similar or different than intended. • Making iterative changes to fix errors. • Running small parts of a program to find and fix errors. • Considering not only what is incorrect within an algorithm, but also what is missing.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 1B-CS-03 Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies. (P6.2) • 1B-AP-15 Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. (P6.1, P6.2)

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

3–5 Programming and Coding Aligned Starter Pack Lessons
Coding Algorithms **(STEM: Mathematics)** Learn about algorithms and how they can be applied to computer programs such as Python. Music Through Coding **(Humanities: Music)** Create a music machine by coding a simple score using a coding platform. Orbital Simulation **(STEM: Physics)** Gather data about Earth and produce an animation demonstrating planetary movements around the Sun. Plant Food **(STEM: Biology)** Create an animated story using block programming to demonstrate the process of photosynthesis. Robot Geometry **(STEM: Mathematics)** Learn how to program a virtual robot which can move in different geometrical shapes. Storytelling with Scratch **(Language Arts: Language)** Explore how coding can be used to create an animated story. Water Cycle **(STEM: Biology)** Demonstrate the water cycle by animating the process using block programming.

Competency	Look Fors	Aligned Standards
Data Science		
Collecting Data Collect numerical data using computational tools (e.g. probes, sensor).	• Using computational tools to collect data that can be quantified.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing Data Use computational tools to manipulate, organize, and reveal patterns and relationships within data.	• Using computational tools to manipulate data with data moves (Erickson et al., 2019). • Describing relationships between variables. • Drawing conclusions about the relationship between variables in a numerical data set.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Computer Science Teachers Association** • 1B-DA-07 Use data to highlight or propose cause- and-effect relationships, predict outcomes, or communicate an idea. (P7.1) **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. **Using Mathematics and Computational Thinking:** • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Evaluating Data Identify data points that don't follow a predicted or identified pattern. Consider questions that arise based on the data set.	• Identifying data points that are unexpected based on identified patterns. • Asking questions about data that is being analyzed.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Evaluate appropriate methods and/or tools for collecting data.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Communicating Data Create a data visualization with 2+ variables illustrating patterns and relationships from a data set. Describe the data to a target audience.	• Designing a visual representation of data. • Discussing affordances and disaffordances of visualization methods. • Describing patterns in data represented by the data visualization orally or in writing. • Connecting data to real-world phenomena and concepts. • Making a data-supported claim or argument.	**C3 Framework for Social Studies State Standards** • D3.4.3-5. Use evidence to develop claims in response to compelling questions. • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. • CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 1B-DA-06 Organize and present collected data visually to highlight relationships and support a claim. (P7.1) **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. **Obtaining, Evaluating, and Communicating Information:** • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

3–5 Data Science Aligned Starter Pack Lessons
Citybuilding for Sustainability **(Humanities: Geography)** Build a liveable city with the resources provided in this game-based activity.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Artificial Intelligence and Machine Learning		
Investigating Artificial Intelligence and Machine Learning Systems Experiment with AI/ML systems such as generative AI, Generative Adversarial Networks, speech to text, natural language processing programs, etc. Discuss instances where the systems perform well and where systems struggle to interact naturally. Investigate how computers perceive different types of information and identify differences between human sensing and computer perception (e.g., lack of taste, images perceived as pixels, words as sounds, touch as haptics).	• Creating artifacts using a variety of AI/ML systems. • Asking questions about how AI/ML systems work based on experiences with them. • Discussing instances when systems struggle to interact naturally with humans and/or use human language incorrectly. • Discussing how computer sensing is similar to and different from human sensing. • Explaining how computers perceive and process different types of information.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 1B-CS-01 Describe how internal and external parts of computing devices function to form a system. (P7.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions about what would happen if a variable is changed. **Constructing Explanations and Designing Solutions:** • Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Training Artificial Intelligence and Machine Learning Algorithms Train an existing machine learning classification model (e.g., Teachable Machine, Machine Learning for Kids) using a database of images or sounds. Test the model and discuss its accuracy.	• Developing a set of training data. • Inputting training data into an existing machine learning classification model. • Testing a student-trained model and discussing the accuracy of the model.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning.

Grades 3-5: By the end of Grade 5, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Assessing and Auditing Artificial Intelligence and Machine Learning Systems Examine a labeled data set to determine if features of the data set or the selected labels could lead to bias. Develop an ethical matrix for a complex algorithm solving a problem or completing a task to identify who the algorithm affects and related values. Discuss how these values might be similar or different across groups.	• Discussing if the category labels used on a data set are inclusive of all identities (e.g., gender identities, racial identities). • Analyzing a labeled data set to determine if it has a balanced representation of all categories. • Identifying missing labels or features of data that could cause bias. • Creating an ethical matrix identifying who a complex algorithm affects and what their values are. • Analyzing how values for an algorithm are different for different people. • Discussing how algorithms align or do not align with different people on the ethical matrix. • Talking to people who might use an algorithm or program to learn about their needs and wants.	**C3 Framework for Social Studies State Standards** • D4.2.3-5. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning, and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 1B-AP-13 Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. (P1.1, P5.1) • 1B-IC-19 Brainstorm ways to improve the accessibility and usability of technology products for the diverse needs and wants of users. (P1.2) • 1B-IC-20 Seek diverse perspectives for the purpose of improving computational artifacts. (P1.1) **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Use data to evaluate and refine design solutions.

3–5 Artificial Intelligence and Machine Learning Aligned Starter Pack Lessons
Are You Happy? **(Language Arts: Language)** Use natural language processing to create a machine that can detect emotion through spoken text. Green Screen Newscast **(Language Arts: Language)** Make use of a green screen and fundamental video editing skills to put together an engaging newscast. Invisible Animals **(STEM: Biology)** Use computer vision to create a digital octopus that camouflages itself to match its background.

Competency	Look Fors	Aligned Standards
Simulation and Modeling		
Exploring Phenomena Using Models Manipulate a computational model to set up multiple and different scenarios to answer a driving question.	• Identifying a question to explore using a computational model. • Setting up multiple different scenarios to collect data from a computational model. • Using data collected from a computational model to support a claim about a real-world system.	**C3 Framework for Social Studies State Standards** • D4.2.6-8. Construct explanations using reasoning,correct sequence, examples, and details with relevant information and data, while acknowledging the strengths and weaknesses of the explanations. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. **Developing and Using Models:** • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. **Planning and Carrying Out Investigations:** • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

Competency	Look Fors	Aligned Standards
Creating Computational Models Develop or modify a computational model based on mathematical relationships between key components of a real-world system.	• Representing relationships between smaller parts of a real-world system in a computational model. • Identifying different parts of a real-world system that a computational model is representing.	**C3 Framework for Social Studies State Standards** D4.3.6-8. Present adaptations of arguments and explanations on topics of interest to others to reach audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 2-DA-09 Refine computational models based on the data they have generated. (P5.3, P4.4) • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. **Constructing Explanations and Designing Solutions:** • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Competency	Look Fors	Aligned Standards
Creating 3D Models Develop or modify a 3D model based on spatial relationships between key components of a real-world system, object, or location.	• Defining different parts of a real-world system, object, or location. • Representing relationships between smaller parts of a real-world system, object, or location in a digital 3D model. • Identifying different parts of a real-world system, object, or location that a 3D model is representing. • Creating an accurate representation of a real-world system, object, or location using appropriate scaling and dimensions.	**C3 Framework for Social Studies State Standards** D4.3.6-8. Present adaptations of arguments and explanations on topics of interest to others to reach audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. • Common Core Standards for Mathematical Practice • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. **Constructing Explanations and Designing Solutions** • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Assessing Models Compare a computational model that is used or developed to the real-world system it represents to notice: similarities and differences, explicit decisions made about what is included and excluded in the model and other choices made by the creator, and areas where creator bias could affect the model.	• Testing and debugging a computational model. • Considering how a computational model represents a real-world system. • Identifying similarities and differences between a computational model and the real-world system it represents. • Identifying creator decisions made when developing a computational model (e.g., what is included and excluded). • Considering bias in the outputs of a computational model.	**C3 Framework for Social Studies State Standards** • D3.2.6-8. Evaluate the credibility of a source by determining its relevance and intended use. • D4.4.6-8. Critique arguments for credibility. • D4.5.6-8. Critique the structure of explanations. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 2-DA-09 Refine computational models based on the data they have generated. (P5.3, P4.4) • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) • 2-IC-21 Discuss issues of bias and accessibility in the design of existing technologies. (P1.2) **Next Generation Science Standards** **Developing and Using Models:** • Evaluate limitations of a model for a proposed object or tool. **Engaging in Argument From Evidence:** • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

6–8 Simulation and Modeling Aligned Starter Pack Lessons

3D Repair **(STEM: Physics)**
Explore how physics can be applied to 3D models which are printed to repair broken parts in simple machines.

Rapid Prototyping **(STEM: Physics)**
Apply the concept of center of gravity to create a useful tool using 3D modeling software and a 3D printer.

Roller Coaster Physics **(STEM: Physics)**
Create simulations of roller coasters within safety limits for G-forces.

Saltwater Circuit **(STEM: Physics)**
Plan and design a saltwater circuit using Tinkercad to demonstrate how one works.

Terrain Visualization **(Humanities: Geography)**Generate 3D city models using GIS software to better understand how city planners use data for planning.

Virtual Tourism **(Humanities: Social Studies)**
Create a virtual reality tour of a local attraction using an online 3D creation tool.

Wrecking Ball Physics **(STEM: Physics)**
Investigate how energy is conserved using 3D Rigidbody simulations of wrecking balls.

Writing Braille **(Language Arts: Language)**
Learn to translate written language to Braille, which can be etched in wood using a laser cutter.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Programming and Coding		
Defining Procedures as Algorithms Develop an algorithm that decomposes a complex problem, process, or task into smaller parts and uses precise statements. Develop an algorithm that uses conditional logic to produce different outputs.	• Decomposing a complex problem or task. • Identifying essential steps to solve a complex problem or complete a complex task. • Refining language within steps to be precise. • Using conditional logic to produce different outputs of an algorithm.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 2-AP-10 Use flowcharts and/or pseudocode to address complex problems as algorithms. (P4.4, P4.1) • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2)
Programming Use a block-based programming language to automate a procedure that solves a problem/ completes a task. Use a text-based programming language to automate a procedure that solves a problem/ completes a task.	• Planning code with physical or written tools (e.g., graphic organizers, sequenced cards/ manipulatives, flow charts). • Writing an algorithm in a block-based or text language understandable by a computer. • Creating a procedure for a computer to carry out.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 2-AP-12 Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. (P5.1, P5.2) • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **Constructing Explanations and Designing Solutions:** • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.
Testing and Debugging Strategically choose methods (e.g., using intermediate results, reproduce errors) to find and fix errors in a purposeful order (e.g., in order they are reported by a compiler) to get expected results.	• Discussing how an outcome is similar or different than intended. • Purposefully and strategically selecting the most effective methods to fix errors. • Fixing errors in a logical and purposeful order.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Collect data about the performance of a proposed object, tool, process or system under a range of conditions. **Constructing Explanations and Designing Solutions:** • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

6–8 Programming and Coding Aligned Starter Pack Lessons
Beef or Beans (STEM: Biology) Harness the power of data visualization to meet the world's growing needs for food. **Better Sensing Makes Good Sense (Social Studies)** Explore how mobile apps are designed to help translate images to speech to aid the visually impaired. **Coding Macbeth (Language Arts: Language)** Create a chatbot which is able to respond in the way Lady Macbeth does. **Motion Behavior Robots (STEM: Biology)** Create step-by-step motion instructions for robots in real-time physics simulations. **Volume Change (STEM: Mathematics)** Create a virtual game that tests the concept of surface area and volume of 3D figures. **Water Pollution (STEM: Biology)** Investigate the effects of water pollution and propose solutions using Scratch to demonstrate your ideas.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Data Science		
Collecting Data Collect data that can be automated and recorded through computational tools (e.g. probes, sensor).	• Using computational tools to collect data that can be quantified. • Automating data collection and recording using computational tools.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 2-CS-02 Design projects that combine hardware and software components to collect and exchange data. (P5.1) • 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3) **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing Data Use computational tools to manipulate, organize, and reveal patterns and relationships within complex or large data sets.	• Using computational tools to manipulate complex or large data sets with data moves (Erickson et al., 2019). • Describing relationships between variables in a complex or large data set. • Drawing conclusions about the relationship between variables in a complex or large numerical data set.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Computer Science Teachers Association** • 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3) **Next Generation Science Standards** **Analyzing and Interpreting Data:** • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. **Using Mathematics and Computational Thinking:** • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. **Constructing Explanations and Designing Solutions:** • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Evaluating Data Identify data points that don't follow a predicted or identified pattern. Consider questions that arise based on the data set. Evaluate data for trustworthiness and potential biases.	• Identifying data points that are unexpected based on identified patterns. • Asking questions about data that is being analyzed. • Considering if/how data sources are comparable. • Identifying bias in data collection and reporting. • Questioning the origins, history, and intents of a data set and/or the people who collected it.	**C3 Framework for Social Studies State Standards** • D3.2.6-8. Evaluate the credibility of a source by determining its relevance and intended use. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that challenge the premise(s) of an argument or the interpretation of a data set. **Planning and Carrying Out Investigations:** • Evaluate the accuracy of various methods for collecting data. **Analyzing and Interpreting Data:** • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).

6–8 Data Science Aligned Starter Pack Lessons
Beef or Beans **(STEM: Biology)** Harness the power of data visualization to meet the world's growing needs for food. Climate Anomalies **(Humanities: Geography)** Analyze the impact of climate change through the use of GIS. History and Uses of Democracy **(Humanities: History)** Explore how democracy has evolved since ancient times and uncover insights from data derived from the UK EU referendum results. Income Gap **(Humanities: Social Studies)** Use statistical analysis to explore income inequality in a population. Investigating Wildfires **(STEM: Chemistry)** Investigate the conditions that lead to wildfires and use GIS to identify patterns in the location of wildfires in Indonesia. Mapping Foot to Food **(Humanities: Geography)** Learn how urban planners use variable constraining to reduce food deserts and improve access to farmers' markets using maps. Mining Words **(Language Arts: Language)** Explore how people leave behind a digital footprint through text mining using Python programming. Rising Seas **(Humanities: Geography)** Learn about the threat of forced migration from rising sea levels due to climate change and visualize areas at risk.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Communicating Data Create a data visualization with 2+ variables illustrating patterns and relationships from a data set. Describe the data to a target audience. Consider creative visualizations of data and design features for a particular audience.	• Designing a visual representation of data. • Discussing affordances and disaffordances of visualization methods. • Describing patterns in data represented by the data visualization orally or in writing. • Connecting data to real-world phenomena and concepts. • Making a data-supported claim or argument. • Selecting design features to communicate to a particular audience.	**C3 Framework for Social Studies State Standards** • D4.2.6-8. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data, while acknowledging the strengths and weaknesses of the explanations. • D4.3.6-8. Present adaptations of arguments and explanations on topics of interest to others to reach audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. • CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Next Generation Science Standards** **Engaging in Argument From Evidence:** • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **Obtaining, Evaluating, and Communicating Information:** • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Artificial Intelligence and Machine Learning		
Investigating Artificial Intelligence and Machine Learning Systems Experiment with AI/ML systems such as generative AI, Generative Adversarial Networks, speech to text, natural language processing programs, etc. Discuss instances where the systems perform well and where systems struggle to interact naturally. Investigate how computers perceive different types of information and identify differences between human sensing and computer perception (e.g., lack of taste, images perceived as pixels, words as sounds, touch as haptics). Investigate deep learning models such as unsupervised neural networks.	• Systematically exploring and experimenting with a variety of AI/ML systems, including deep learning models, and producing artifacts. • Asking questions about how AI/ML systems work based on experiences with them and exploring the AI/ML systems to answer those questions. • Discussing instances when systems struggle to interact naturally with humans and/or use human language incorrectly. • Discussing how computer sensing is similar to and different from human sensing. • Explaining how computers perceive and process different types of information.	**C3 Framework for Social Studies State Standards** • D4.2.6-8. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data, while acknowledging the strengths and weaknesses of the explanations. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. **Computer Science Teachers Association** • 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. **Planning and Carrying Out Investigations:** • Collect data about the performance of a proposed object, tool, process or system under a range of conditions. **Analyzing and Interpreting Data:** • Analyze and interpret data to provide evidence for phenomena. • Constructing Explanations and Designing Solutions • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing. **Engaging in Argument From Evidence:** • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

Grades 6-8: By the end of Grade 8, what will ALL students know and be able to do?

Competency	Look Fors	Aligned Standards
Training Artificial Intelligence and Machine Learning Algorithms Program sensors within a computing tool to respond to an environment or activity. Develop a real-world data set that is ready to be used to train a supervised learning model. Develop a chatbot. Train an existing machine learning model using a database of images or sounds. Test the model and discuss its accuracy.	• Writing an algorithm that uses sensors to respond to an environment or activity. • Compiling and labeling a data set appropriate for training a supervised learning model. • Planning, coding, testing, and debugging a chat bot algorithm. • Inputting training data into an existing machine learning model. • Testing a student-trained model and discussing the accuracy of the model.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Computer Science Teachers Association** • 2-AP-11 Create clearly named variables that represent different data types and perform operations on their values. (P5.1, P5.2) • 2-AP-12 Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. (P5.1, P5.2) • 2-AP-13 Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2) • 2-AP-17 Systematically test and refine programs using a range of test cases. (P6.1) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **Constructing Explanations and Designing Solutions:** • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Competency	Look Fors	Aligned Standards
Assessing and Auditing Artificial Intelligence and Machine Learning Systems Examine a labeled data set to determine if features of the data set or the selected labels could lead to bias. Evaluate impacts of AI/ML on the environment and natural world. Create a data visualization of bias in terms of gender, age, ethnicity, or other demographic categories within an existing training data set.	• Discussing if the category labels used on a data set are inclusive of all identities (e.g., gender identities, racial identities). • Analyzing a labeled data set to determine if it has a balanced representation of all categories. • Identifying missing labels or features of data that could cause bias. • Investigating and discussing the impact of AI/ML on the environment and the natural world. • Systematically collecting data about features of an existing training data, specifically representation of people across gender, age, ethnicity, and other demographic categories. • Developing a data visualization of the representation of people across gender, age, ethnicity, and other demographic categories within a training data set. • Analyzing the data visualization to identify patterns in representation or lack of representation based on gender, age, ethnicity, and other demographic categories.	**C3 Framework for Social Studies State Standards** • D2.Geo.4.6-8. Explain how cultural patterns and economic decisions influence environments and the daily lives of people in both nearby and distant places. • D3.2.6-8. Evaluate the credibility of a source by determining its relevance and intended use. • D4.2.6-8. Construct explanations using reasoning, correct sequence, examples, and details with relevant information and data, while acknowledging the strengths and weaknesses of the explanations. • D4.3.6-8. Present adaptations of arguments and explanations on topics of interest to others to reach audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 2-CS-01 Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices. (P3.3) • 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3) • 2-IC-21 Discuss issues of bias and accessibility in the design of existing technologies. (P1.2) **Next Generation Science Standards** Planning and Carrying Out Investigations: • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. Analyzing and Interpreting Data: • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Analyze and interpret data to provide evidence for phenomena. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. Engaging in Argument From Evidence: • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

6–8 Artificial Intelligence and Machine Learning Aligned Starter Pack Lessons
Coding Macbeth (Language Arts: Language) Create a chatbot which is able to respond in the way Lady Macbeth does. **Eyes on Wildlife (STEM: BIology)** Learners will create a motion detection algorithm using their webcam and learn how it can be applied to wildlife conservation. **Robot Conversations (Language Arts: Language)** Create a chatbot capable of identifying simple, complex, and compound sentences. **Robotic Simulation (STEM: Physics)** Explore how robotic simulations can be designed in virtual environments to reduce the cost of prototyping. **Time to Log Out (Humanities: Social Studies)** Combat cyberaddiction by developing a program that can measure how long someone spends in front of a computer.

Competency	Look Fors	Aligned Standards
Simulation and Modeling		
Exploring Phenomena Using Models Manipulate a computational model to set up multiple and different scenarios to answer a driving question. Identify mathematical relationships between parts of a computational model.	• Identifying a question to explore using a computational model. • Setting up multiple different scenarios to collect data from a computational model. • Using data collected from a computational model to support a claim about a real-world system. • Identifying mathematical relationships between parts of a computational model and making predictions about how the model will behave with different inputs.	**C3 Framework for Social Studies State Standards** • D4.2.9-12. Construct explanations using sound reasoning, correct sequence (linear or non-linear), examples, and details with significant and pertinent information and data, while acknowledging the strengths and weaknesses of the explanation given its purpose (e.g., cause and effect, chronological, procedural, technical). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. **Developing and Using Models:** • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. **Using Mathematics and Computational Thinking:** • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. **Constructing Explanations and Designing Solutions:** • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. *Continued on next page*

Competency	Look Fors	Aligned Standards
		Engaging in Argument From Evidence: • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. **Using Mathematics and Computational Thinking:** • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. **Constructing Explanations and Designing Solutions:** • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. **Engaging in Argument From Evidence:** • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
Creating Computational Models Develop or modify a computational model based on mathematical relationships between key components of a real-world system.	• Representing relationships between smaller parts of a real-world system in a computational model. • Identifying different parts of a real-world system that a computational model is representing. • Defining relationships between different parts of a real-world system. • Automating relationships between parts of a real-world system with a flowchart or programming/modeling software.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 3A-DA-12 Create computational models that represent the relationships among different elements of data collected from a phenomenon or process. (P4.4) • 3A-AP-13 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests. (P5.2) • 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. (P5.2) • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system. **Using Mathematics and Computational Thinking:** • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

Competency	Look Fors	Aligned Standards
Creating 3D Models Develop or modify a 3D model based on spatial relationships between key components of a real-world system, object, or location.	• Defining different parts of a real-world system, object, or location. • Representing relationships between smaller parts of a real-world system, object, or location in a digital 3D model. • Identifying different parts of a real-world system, object, or location that a 3D model is representing. • Creating an accurate representation of a real-world system, object, or location using appropriate scaling and dimensions.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2) **Next Generation Science Standards** **Developing and Using Models:** • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system.

Competency	Look Fors	Aligned Standards
Assessing Models Compare a computational model that is used or developed to the real-world system it represents to notice: similarities and differences, explicit decisions made about what is included and excluded in the model and other choices made by the creator, and areas where creator bias could affect the model.	• Testing and debugging a computational model. • Considering how a computational model represents a real-world system. • Identifying similarities and differences between a computational model and the real-world system it represents. • Identifying creator decisions made when developing a computational model (e.g., what is included and excluded). • Considering bias in the outputs of a computational model.	**C3 Framework for Social Studies State Standards** • D4.4.9-12. Critique the use of claims and evidence in arguments for credibility. **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Computer Science Teachers Association** • 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible. (P6.3) • 3A-IC-25 Test and refine computational artifacts to reduce bias and equity deficits. (P1.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. **Developing and Using Models:** • Design a test of a model to ascertain its reliability. **Planning and Carrying Out Investigations:** • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. **Using Mathematics and Computational Thinking:** • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world.

9–12 Simulation and Modeling Aligned Starter Pack Lessons
Architecture of Wind **(STEM: Physics)** Learn how architects test to see if the tall buildings they are designing will be able to withstand strong winds. Da Vinci Bridge **(STEM: Physics)** Reconstruct the historical Da Vinci bridge without nails or ropes using laser cutting. Fire Simulator **(STEM: Chemistry)** Generate fire particle simulations using 3D modeling software. Anatomy of Safety **(Humanities: Social Studies)** Learn how to use 3D game engines to discover potential danger zones or fall areas for senior citizens. Saucy Viscosity **(STEM: Chemistry)** Experience the process of generating water simulations through the use of 3D modeling software. Gears in Motion **(STEM: Physics)** Learn about how gears, as a form of rotary machine mechanics, provide mechanical advantages. Static Stress Testing **(STEM: Physics)** Learn how to stress test models in simulations and identify the weak points of various models.

Competency	Look Fors	Aligned Standards
Programming and Coding		
Defining Procedures as Algorithms Develop an algorithm that decomposes a complex problem, process, or task into smaller parts and uses precise statements. Develop an algorithm that uses conditional logic to produce different outputs. Develop multiple algorithms that process in parallel. Identify the most efficient procedure to solve a problem/complete a task.	• Decomposing a complex problem or task. • Identifying essential steps to solve a complex problem or complete a complex task. • Refining language within steps to be precise. • Using conditional logic to produce different outputs of an algorithm. • Writing multiple algorithms that produce intended outcomes when run in parallel. • Considering efficiency when writing an algorithm.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2)
Programming Use a block-based programming language to automate a procedure that solves a problem/completes a task. Use a text-based programming language to automate a procedure that solves a problem/completes a task.	• Planning code with physical or written tools (e.g., graphic organizers, sequenced cards/manipulatives, flowcharts). • Writing an algorithm in a block-based or text language understandable by a computer. • Creating a procedure for a computer to carry out.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 3A-AP-13 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests. (P5.2) • 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. (P5.2) • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2) • 3A-AP-18 Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. (P5.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations. **Using Mathematics and Computational Thinking:** • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. **Constructing Explanations and Designing Solutions:** • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Competency	Look Fors	Aligned Standards
Testing and Debugging Strategically choose methods (e.g., using intermediate results, reproduce errors) to find and fix errors in a purposeful order (e.g., the order they are reported by a compiler) to get expected results.	• Discussing how an outcome is similar or different than intended. • Purposefully and strategically selecting the most effective methods to fix errors. • Fixing errors in a logical and purposeful order.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible. (P6.3)

9–12 Programming and Coding Aligned Starter Pack Lessons

Benford's Law **(STEM: Mathematics)**
Create a computational experiment using the Monte Carlo Method and Markov Chain to solve complex problems.

Big O Notation **(STEM: Mathematics)**
Learn about Big O Notation and how it is used in coding to explain the complexity of an algorithm.

Diversity of Flowers **(STEM: Biology)**
Investigate how diversity enables flowers to adapt to their environment and create a machine learning model to classify irises.

Microcontroller Robot **(STEM: Physics)**
Learn the basics of robotics and create a functional self-initiated floor cleaner robot.

Competency	Look Fors	Aligned Standards
Data Science		
Collecting Data Collect data that can be automated and recorded through computational tools (e.g. probes, sensor).	• Using computational tools to collect data that can be quantified. • Automating data collection and recording using computational tools.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Computer Science Teachers Association** • 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. (P5.2) **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing Data Use computational tools to manipulate, organize, and reveal patterns and relationships within complex or large data sets. Develop a rule or formula to describe how one variable is related to another or make predictions.	• Using computational tools to manipulate complex or large data sets with data moves (Erickson et al., 2019). • Describing relationships between variables in a complex or large data set. • Drawing conclusions about the relationship between variables in a complex or large numerical data set. • Developing a rule or formula describing how one variable is related to another. • Using data to make predictions.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP4 Model with mathematics. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Next Generation Science Standards** **Planning and Carrying Out Investigations:** • Select appropriate tools to collect, record, analyze, and evaluate data. **Analyzing and Interpreting Data:** • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. **Using Mathematics and Computational Thinking:** • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Competency	Look Fors	Aligned Standards
Evaluating Data Identify data points that don't follow a predicted or identified pattern. Consider questions that arise based on the data set. Evaluate data for trustworthiness and potential biases.	• Identifying data points that are unexpected based on identified patterns. • Asking questions about data that is being analyzed. • Considering if/how data sources are comparable. • Identifying bias in data collection and reporting. • Questioning the origins, history, and intents of a data set and/or the people who collected it.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP6 Attend to precision. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. **Planning and Carrying Out Investigations:** • Select appropriate tools to collect, record, analyze, and evaluate data. **Analyzing and Interpreting Data:** • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

9–12 Data Science Aligned Starter Pack Lessons

Benford's Law **(STEM: Mathematics)**
Create a computational experiment using the Monte Carlo Method and Markov Chain to solve complex problems.

Causes of Genocides **(Humanities: History)**
Investigate the causes of genocides through data wrangling to prepare data for trend and correlation analysis.

Clean Water **(Humanities: Geography)**
Investigate the relationship between a lack of access to good sanitation and child mortality using Gapminder.

Happy Countries **(Humanities: Economics)**
Investigate the factors behind a country's happiness rating through statistical analysis.

Healthy Diet for All **(STEM: Biology)**
Explore the impact of malnutrition and perform statistical analysis to understand and address the problem of malnutrition in a community.

Internet of Weather **(Geography)**
Create a weather detector using a microcontroller to perform advanced weather analysis.

Language of Populism **(Language Arts: Language)**
Learn about features of language used by populist politicians and analyze word length in political speeches.

Mathematics of Pandemics **(STEM: Mathematics)**
Experience how data modeling helps researchers better understand virus behavior and the spread of a pandemic.

Pollution: Costs & Causes **(Humanities: Economics)**
Examine the effects of pollution on a community using pattern recognition through GIS.

Safe Transit **(Humanities: Geography)**
Investigate and analyze road safety in cities using scatter plots and correlation coefficients.

Storyboarding with Data **(Language Arts: Language)**
Build a storyboard using data to convey a point of view in an argumentative essay.

Urbanization **(Humanities: Social Studies)**
Investigate the impact of urbanization and present findings in an interactive 3D space.

Competency	Look Fors	Aligned Standards
Communicating Data Create a data visualization with 2+ variables illustrating patterns and relationships from a data set. Describe the data to a target audience. Consider creative visualizations of data and design features for a particular audience.	• Designing a visual representation of data. • Discussing affordances and disaffordances of visualization methods. • Describing patterns in data represented by the data visualization orally or in writing. • Connecting data to real-world phenomena and concepts. • Making a data-supported claim or argument. • Selecting design features to communicate to a particular audience.	**C3 Framework for Social Studies State Standards** • D4.2.9-12. Construct explanations using sound reasoning, correct sequence (linear or non-linear), examples, and details with significant and pertinent information and data, while acknowledging the strengths and weaknesses of the explanation given its purpose (e.g., cause and effect, chronological, procedural, technical). • D4.3.9-12. Present adaptations of arguments and explanations that feature evocative ideas and perspectives on issues and topics to reach a range of audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence. • CCSS.ELA-LITERACY.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. • CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 3A-DA-11 Create interactive data visualizations using software tools to help others better understand real-world phenomena. (P4.4) **Next Generation Science Standards** **Obtaining, Evaluating, and Communicating Information:** • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Competency	Look Fors	Aligned Standards
Artificial Intelligence and Machine Learning		
Investigating Artificial Intelligence and Machine Learning Systems Experiment with AI/ML systems such as generative AI, Generative Adversarial Networks, speech to text, natural language processing programs, etc. Discuss instances where the systems perform well and where systems struggle to interact naturally. Explain how perception is integrated into algorithms and used in everyday life, and discuss equity issues that arise with the use of sensors that work differently on different people. Investigate deep learning models such as unsupervised neural networks.	• Systematically exploring and experimenting with a variety of AI/ML systems, including deep learning models, and producing artifacts. • Asking questions about how AI/ML systems work based on experiences with them and exploring the AI/ML systems to answer those questions. • Identifying instances when systems struggle to interact naturally with humans and/or use human language incorrectly, and offering suggested improvements to support natural interaction. • Identifying instances where perception is integrated into algorithms used in everyday life. • Discussing equity issues that arise when sensors that work differently on different people are used within algorithms used in everyday life.	**C3 Framework for Social Studies State Standards** • D4.2.9-12. Construct explanations using sound reasoning, correct sequence (linear or non-linear), examples, and details with significant and pertinent information and data, while acknowledging the strengths and weaknesses of the explanation given its purpose (e.g., cause and effect, chronological, procedural, technical). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. **Computer Science Teachers Association** • 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible. (P6.3) • 3A-IC-24 Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. (P1.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. **Planning and Carrying Out Investigations:** • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. **Engaging in Argument From Evidence:** • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

Competency	Look Fors	Aligned Standards
Training Artificial Intelligence and Machine Learning Algorithms Program sensors within a computing tool to respond to an environment or activity. Develop a real-world data set that is ready to be used to train a supervised learning model. Develop a chatbot. Train an existing machine learning model using a database of images or sounds. Test the model and discuss its accuracy.	• Writing an algorithm that uses sensors to respond to an environment or activity. • Compiling and labeling a data set appropriate for training a supervised learning model. • Planning, coding, testing, and debugging a chatbot algorithm. • Inputting training data into an existing machine learning classification model. • Testing a student-trained model and discussing the accuracy of the model.	**Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Computer Science Teachers Association** • 3A-AP-13 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests. (P5.2) • 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions. (P5.2) • 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. (P3.2) • 3A-AP-18 Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs. (P5.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations. **Constructing Explanations and Designing Solutions:** • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Competency	Look Fors	Aligned Standards
Assessing and Auditing Artificial Intelligence and Machine Learning Systems Evaluate and audit an existing AI/ML system to determine what biases exist within the system and offer potential strategies to create a more equitable AI/ML system. Evaluate impacts of AI/ML on the environment and natural world. Create a data visualization of bias in terms of gender, age, ethnicity, or other demographic categories within an existing training data set. Identify when different types of AI and Machine Learning (e.g., supervised, unsupervised, reinforced learning) are the most appropriate option to perform a task or solve a problem.	• Systematically experimenting with an existing AI/ML system to collect data about how well the system works when presented with a testing data set diverse across gender, age, ethnicity, and other demographic categories. • Analyzing data from an existing AI/ML system to determine whether the system works equitably across genders, ages, ethnicities, and other demographic categories. • Brainstorming strategies to update and improve an existing, inequitable AI/ML system to work equitably across gender, age, ethnicity, and other demographic categories. • Investigating and discussing the impact of AI/ML on the environment and the natural world. • Systematically collecting data about features of an existing training data set, specifically representation of people across gender, age, ethnicity, and other demographic categories. • Developing a data visualization of the representation of people across gender, age, ethnicity, and other demographic categories within a training data set.	**C3 Framework for Social Studies State Standards** • D2.Geo.5.9-12. Evaluate how political and economicdecisions throughout time have influenced cultural and environmental characteristics of various places and regions. • D2.Geo.6.9-12. Evaluate the impact of human settlement activities on the environmental and cultural characteristics of specific places and regions. • D4.2.9-12. Construct explanations using sound reasoning, correct sequence (linear or non-linear), examples, and details with significant and pertinent information and data, while acknowledging the strengths and weaknesses of the explanation given its purpose (e.g., cause and effect, chronological, procedural, technical). • D4.3.9-12. Present adaptations of arguments and expla-nations that feature evocative ideas and perspectives on issues and topics to reach a range of audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary). **Common Core Standards for Mathematical Practice** • CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. • CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. • CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. • CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. • CCSS.MATH.PRACTICE.MP6 Attend to precision. • CCSS.MATH.PRACTICE.MP7 Look for and make use of structure. • CCSS.MATH.PRACTICE.MP8 Look for and express regularity in repeated reasoning. **Common Core English Language Arts Anchor Standards** • CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. • CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. • CCSS.ELA-LITERACY.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. • CCSS.ELA-LITERACY.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. **Computer Science Teachers Association** • 3A-DA-11 Create interactive data visualizations using software tools to help others better understand real-world phenomena. (P4.4) • 3A-AP-21 Evaluate and refine computational artifacts to make them more usable and accessible. (P6.3) • 3A-IC-24 Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. (P1.2) • 3A-IC-25 Test and refine computational artifacts to reduce bias and equity deficits. (P1.2) **Next Generation Science Standards** **Asking Questions and Defining Problems:** • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. *Continued on next page*

Competency	Look Fors	Aligned Standards
	• Analyzing the data visualization to identify patterns in representation or lack of representation based on gender, age, ethnicity, and other demographic categories. • Discussing examples of when different types of AI/ML (e.g., supervised, unsupervised, reinforced learning) are the most appropriate option to perform a task or solve a problem.	**Engaging in Argument From Evidence:** • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. **Obtaining, Evaluating, and Communicating Information:** • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

9–12 Artificial Intelligence and Machine Learning Aligned Starter Pack Lessons

AI Role Playing (Language Arts: Language)
Experience game-based learning in creative writing using an AI Dungeon to simulate text adventures.

As a Matter of Fake (Humanities: History)
Learn how to differentiate fake news or deliberate online falsehoods by analyzing texts using natural language processing.

Diversity of Flowers (STEM: Biology)
Investigate how diversity enables flowers to adapt to their environment and create a machine learning model to classify irises.

Envisioning Safer Cities (Humanities: Geography)
Discover how planners and policymakers can make cities safer through the use of computer vision.

Figuratively Speaking (Language Arts: Language)
Identify and analyze figurative language in prose and apply story writing skills using AI Dungeon.

Microcontroller Robot (STEM: Physics)
Learn the basics of robotics and create a functional self-initiated floor cleaner robot.

Plastic, Plastic, Everywhere (Humanities, Geography)
Delve deeper into the problem of microplastics and how computer vision can help in creating solutions.

Pathos, Logos, and Ethos (Language Arts: Language)
Analyze persuasion techniques used in advertising and create a chatbot that is able to identify instances of pathos, logos, and ethos.

Sensing Motion (STEM: Mathematics)
Learn how computer vision can be used to emulate how a human being perceives motion of an everyday object.

Uncovering Cyberbullying (Language Arts: Language)
Analyze words using natural language processing to gain insights into cyberbullying.

References and Works Reviewed:

AI4K12. (2020). Grade band progression charts. https://ai4k12.org/gradeband-progression-charts/

DAILy Curriculum. https://raise.mit.edu/daily/index.html The DAILy Curriculum for Middle School Students was created by the MIT Media Lab Personal Robots Group and the MIT STEP Lab

Digital Promise (2020). Computational thinking for next generation science. Retrieved from: https://digitalpromise.org/initiative/computational-thinking/computational-thinking-for-next-generation-science/

Erickson, T., Wilkerson, M., Finzer, W., & Reichsman, F. (2019). Data moves. Technology Innovations in Statistics Education, 12(1). https://escholarship.org/uc/item/0mg8m7g6

Lee, I., & Malyn-Smith, J. (2020). Computational thinking integration patterns along the framework defining computational thinking from a disciplinary perspective. Journal of Science Education and Technology, 29, 9–18. https://doi.org/https://doi.org/10.1007/s10956-019-09802-x

Rich, K. M., Binkowski, T. A., Strickland, C., & Franklin, D. (2018). Decomposition: A K-8 computational thinking learning trajectory. ICER 2018 - Proceedings of the 2018 ACM Conference on International Computing Education Research, 124–132. https://doi.org/10.1145/3230977.3230979

Rich, K., Binkowski, T. A., Strickland, C., & Franklin, D. (2019). A K-8 debugging learning trajectory derived from research literature. SIGCSE '19 - Proceedings of the 50th ACM Technical Symposium on Computer Science Education, 745–751.

Rich, K. M., Strickland, C., Binkowski, T. A., Moran, C., & Franklin, D. (2017). K-8 learning trajectories derived from research literature: Sequence, repetition, conditionals. 182–190. https://doi.org/10.1145/3105726.3106166

Talladega County Schools (2021). Computational thinking look for documents. Retrieved from: https://sites.google.com/tcboe.org/tcboe-ct/computational-thinking-look-for-documents