PHJH STEM Curriculum Map

Unit 1: What is STEM?

ProjectSTEM Activities

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Review Class Rules & Procedures	**Lesson 0.1:** Why Does Computer Science Matter? **Lesson 0.2:** What is a Computer Program? **Lesson 0.3:** Growth Mindset **Lesson 0.4:** Pair Programming **Lesson 0.5:** Welcome to Scratch	**Lesson 1.1:** Events and Responses **Lesson 1.2:** Animate a Name **Lesson 1.3:** Exploring the XY Grid **Lesson 1.4:** Magic Room Cleaner **Lesson 1.5:** Mid-Unit Recap and Debugging	**Lesson 2.1:** Introduction to Loops (Unplugged) **Lesson 2.2:** Exploring Animation **Lesson 2.3:** Effects in Animation **Lesson 2.4:** Vector Animation **Lesson 2.5:** Mid-Unit Recap and Debugging	**Lesson 3.1:** Conditionals **Lesson 3.2:** Race to the Finish, Part 1 **Lesson 3.3:** Race to the Finish, Part 2 **Lesson 3.4:** Dance Battle **Lesson 3.5** Mid-Unit Recap and Debugging	**Lesson 4.1:** Operators (Unplugged) **Lesson 4.2:** Rocket Launch **Lesson 4.3:** Let's Chat! **Lesson 4.4:** Translator **Lesson 4.5:** Mid-Unit Recap and Debugging	**Lesson 5.1:** Data and Variables (Unplugged) **Lesson 5.2:** Mad Libs **Lesson 5.3:** Improve the Games **Lesson 5.4:** Multiplication Game **Lesson 5.5:** Mid-Unit Recap and Debugging	**Intermediate** **Block B Project: Where is Carmen Scratch-iego?** **Advanced** **Block C Project: Avatar Builder**
Intro to STEM Presentation **STEM Vocabulary Crossword Puzzle**							
Marshmallow Challenge **Small Group Mini-Project**							

Unit 3: Engineering & Design

Unit 4: Robotics

Unit 5: Design & CAD Programming

Week 9	Week 10 & 11	Week 12	Week 13 & 14	Week 15	Week 16 - 18
Introduction to Engineering & Design • Lesson Plan - Solving Everyday Problems Using the Engineering Design Cycle • Introduction to the Engineering Design Cycle Presentation	Bridge Collapse Video & Discussion	Sphero RVR Intro Video Sphero RVR Lessons • RVR Lesson 1 • RVR Lesson 2 • RVR Lesson 3	RVR Obstacle Course • RVR Obstacle Course Challenge Packet • RVR Obstacle Course Poster	CAD Modeling • CAD Modeling Lesson • CAD Modeling Worksheet • 3D Printing Introduction TinkerCAD Skills Review • TinkerCAD Tutorials	3D Name Plate Keychain Project • Keychain Project Student Directions Cellphone Keychain Stand Project • Cellphone Keychain Stand Student Directions
Marisol Case Study Activity • Scenario Wksht. • Group Leader Discussion Wksht. • Group Discussion Response Sheet • Schematic Drawing	Bridge Build Activity • Challenge Packet • Prototype Build & Test • Refine/Finalize Design & Build				

STEM Challenges

Skyscraper STEM Challenge Student Group Packet Teacher Directions Packet	**Paper Airplane Challenge**
Walking Paper Horse Challenge	**Airplane Launcher Challenge**
Tallest Cup Tower Challenge Student Group Packet Teacher Directions Packet	**Inertia Challenge**
Cup Stacking Challenge	**Hand Crank Wench**
Card Towers Challenge	**Twist & Turn Roller Coaster Track**
Paper Chain Challenge	**Book Stacking Challenge**

Unit 1 What is STEM?

Activity	Concepts & Skills	Vocabulary	Resources/Materials	Standards
Intro to STEM Presentation **STEM Vocabulary Crossword**	- Define STEM - Identify the skills used in STEM - Understand why STEM is important - Begin learning about engineering & the design process	- Engineering - Design Process - Problem Solving - Critical Thinking - Perseverance - Digital Literacy - Model - Prototype - Invention - Innovation - Criteria - Constraints - Computer Science - Efficiency - Brainstorm	- Intro to STEM PPT - STEM Vocabulary Crossword - Crossword Answer Key	**ISTE** ***1.1d:** Students understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively, and are adept at thoughfully exploring emerging technologies., .
Marshmallow Challenge Team Building Activity	- Structural Design - Weight - Material Selection - Trial & Error - Reflecting on & refining design	- Freestanding Structure - Team Building - Reflection	- Marshmallow Challenge Packet - Measuring Tape - Build a Tower, Buid a Team TED Talk Video - Consumable Materials Per Group - 20 Sticks of Spaghetti - 1 Meter of String - 1 Meter of Tape - 1 Paper Bag or Envelope - 1 Large Marshmallow	**NGSS** • **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **ISTE** • **1.4a:** Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. • **1.4c:** Develop, test, and refine prototypes as part of a cyclical design process. • **1.4d:** Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **ITEEA** • **STEL-1J:** Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants. • **STEL-1M:** Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches. • **STEL-2Q:** Predict outcomes of a future product or system at the beginning of the design process. • **STEL-2S:** Defend decisions related to a design problem. • **STEL-5B:** Explore how technologies are developed to meet individual and societal needs and wants. • **STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design. • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL -7S:** Create solutions to problems by identifying and applying human factors in design. • **STEL-7T:** Assess design quality based upon established principles and elements of design. • **STEL-7U:** Evaluate the strengths and weaknesses of different design solutions. • **STEL-7V:** Improve essential skills necessary to successfully design. • **STEL-8J:** Use devices to control technological systems.

Unit 2: Computer Science - ProjectSTEM CSE1					
Weeks	**Block/Unit**	**Lesson(s)**	**Objectives**	**Vocabulary**	**Standards**
2	**Block A Unit 0**	**Lesson 0.1: Why Does Computer Science Matter? Lesson 0.2: What is a Computer Program? Lesson 0.3: Growth Mindset Lesson 0.4: Pair Programming Lesson 0.5: Welcome to Scratch**	• Identify traditional and non-traditional systems as computers. • Solve basic coding problems through problem-solving techniques. • Explain the real-world social, creative, and practical functions of computer science.	• Computer Science • Growth Mindset • Program • Coding • Scratch • Algorithm • Pair Programming • Driver • Navigator • Sprite • Blocks • Block Palette • Scripts • Code Area • Backdrop • Stage • Green Flag	**IL CS Standards/CSTA Standards** • **2-IC-20:** Compare tradeoffs associated with computing technologies that affect people's everyday activities and career options. • **2-DA-07:** Represent data using multiple encoding schemes. • **2-AP-13:** Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • **2-AP-15:** Seek and incorporate feedback from team members and users to refine a solution that meets user needs.
3	**Block A Unit 1**	**Lesson 1.1: Events and Responses Lesson 1.2: Animate a Name Lesson 1.3: Exploring the XY Grid Lesson 1.4: Magic Room Cleaner Lesson 1.5: Mid-Unit Recap and Debugging**	• Demonstrate how events are used to trigger actions to happen in Scratch. • Explain the relationship between events and responses. • Build chains of events and responses in both sequential flow and parallel flow. • Demonstrate how sequences are processed from top to bottom in a specific order. • Build an animation in Scratch using the letters of their name. • Identify animation as a series of still images shown in rapid succession. • Utilize XY coordinates to move multiple sprites around the Scratch Stage in sequences. • Explain the difference between the Motion blocks set x/y to () and change x/y to () in Scratch. • Develop a Scratch animation of a sprite kicking a ball across the Stage. • Execute events when a key is pressed in Scratch. • Make a scene initialize when their Scratch program starts. • Explain the difference between the move steps and glide blocks in Scratch. • Debug a series of programs using concepts learned in Unit 1. • Explain what example Scratch code blocks from this unit do in a program. • Demonstrate understanding of Unit 1 concepts.	• Event • Sequence • Parallelism • Initializing • Animation • XY Coordinates • Debugging	**IL CS Standards/CSTA Standards** • **2-AP-10:** Use flowcharts and/or pseudocode to address complex problems as algorithms • **2-AP-13:** Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • **2-AP-17:** Systematically test and refine programs using a range of test cases.
4	**Block B Unit 2**	**Lesson 2.1: Introduction to Loops (Unplugged) Lesson 2.2: Exploring Animation Lesson 2.3: Effects in Animation Lesson 2.4: Vector Animation Lesson 2.5: Mid-Unit Recap and Debugging**	• Identify repeat and forever blocks in Scratch as loops. • Explain why loops are useful in programming. • Create an algorithm that uses loops • Interpret animation as a series of frames that are shown in rapid succession. • Compare the effects of different repeat and wait block values on a Scratch animation. • Apply the concept of initialization to animation by specifying a starting costume for a sprite. • Explain the difference between infinite (forever) and count-controlled (repeat) loops. • Demonstrate how effects can be created in Scratch animations by using loops. • Model the illusion of 3-D (aka multiplanar) movement on a 2-D surface using Scratch. • Determine when to use bitmap graphics versus vector graphics. • Modify sprites using the vector art tool in Scratch. • Debug a series of programs using concepts learned in Unit 2. • Explain what example Scratch code blocks from this unit do in a program. • Demonstrate understanding of Unit 2 concepts.	• Loop • Algorithm • Frame • Frame Rate • Computer Graphics • Bitmap • Vector • Animation	**IL CS Standards/CSTA Standards** • 2-AP-12: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • 2-AP-17: Systematically test and refine programs using a range of test cases. • 2-DA-07: Represent data using multiple encoding schemes.
5	**Block B Unit 3**	**Lesson 3.1: Conditionals Lesson 3.2: Race to the Finish, Part 1 Lesson 3.3: Race to the Finish, Part 2 Lesson 3.4: Dance Battle Lesson 3.5 Mid-Unit Recap and Debugging**	• Interpret if-then and if-then-else blocks in Scratch as conditional statements. • Identify conditional statements in everyday decision-making. • Build a conditional statement from a starter template using if-then-else in Scratch. • Develop and utilize pseudocode and flowcharts for their Scratch programs. • Create flowcharts for their Scratch programs. • Build a single player racing game in Scratch using conditionals. • Test for both true and false conditions in their racing game programs. • Test for both true and false conditions in conditional statements structured as if-then-else. • Develop a script that runs code in response to continuously checking for a condition. • Debug a series of programs using concepts learned in Unit 3. • Explain what example Scratch code blocks from this unit do in a program. • Demonstrate understanding of Unit 3 concepts.	• Condition • Conditional Statement • Pseudocode • Flowchart • Boolean • Loops • If-Then-Else Statements • Forever Block	**IL CS Standards/CSTA Standards** • 2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms • 2-AP-12: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • 2-AP-15: Seek and incorporate feedback from team members and users to refine a solution that meets user needs. • 2-AP-17: Systematically test and refine programs using a range of test cases. • 2-AP-19: Document programs in order to make them easier to follow, test, and debug.
6	**Block C Unit 4**	**Lesson 4.1: Operators (Unplugged) Lesson 4.2: Rocket Launch Lesson 4.3: Let's Chat! Lesson 4.4: Translator Lesson 4.5: Mid-Unit Recap and Debugging**	• Classify operators as arithmetic, comparison, or boolean types. • Evaluate expressions that use Operators blocks. • Make use of the three boolean operators (and, not, or). • Create conditions using boolean operators. • Build a program that collects user input that is used elsewhere in the program. • Compose a set of questions and responses for a chatbot that mimic human conversation. • Demonstrate how to add extensions to their Scratch programs. • Build a translator program in Scratch that speaks and displays translations of user input. • Debug a series of programs using concepts learned in Unit 4. • Explain what example Scratch code blocks from this unit do in a program. • Demonstrate understanding of Unit 4 concepts	• Operator • Expression • Evaluate • Arithmetic Operator • Comparison Operator • Boolean Operator • Evaluate • Input • User Input • Debugging	**IL CS Standards/CSTA Standards** • 2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms. • 2-AP-12: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • 2-AP-13: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • 2-AP-15: Seek and incorporate feedback from team members and users to refine a solution that meets user needs. • 2-AP-17: Systematically test and refine programs using a range of test cases.
7	**Block C Unit 5**	**Lesson 5.1: Data and Variables (Unplugged) Lesson 5.2: Mad Libs Lesson 5.3: Improve the Games Lesson 5.4: Multiplication Game Lesson 5.5: Mid-Unit Recap and Debugging**	• Relate variables in computer science to the word categories in the game Mad Libs. • Recall at least one way that variables are used to help people in the real world. • Build a Mad-Libs-style program in Scratch. • Distinguish between a variable and its value. • Improve upon an existing game program in Scratch by using variables to add incentives. • Explain the concept of abstraction as it relates to computer science. • Develop code in Scratch to generate a random value that is stored to a variable. • Debug a series of programs using concepts learned in Unit 5. • Explain what example Scratch code blocks from this unit do in a program. • Demonstrate understanding of Unit 5 concepts.	• Variable • Value • Random Values • Abstraction • Debugging	**IL CS Standards/CSTA Standards** • 2-AP-11: Create clearly named variables that represent different data types and perform operations on their values. • 2-AP-12: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • 2-AP-13: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • 2-AP-17: Systematically test and refine programs using a range of test cases.

8	**Culminating Project**	**<u>Intermediate Block B Project:</u>** **Where is Carmen Scratch-ego?** **---------- OR ----------** **<u>Advanced Block C Project:</u>** **Avatar Builder**	• Build a program in Scratch using conditionals and animation loops where users will choose an option to answer geographical clues. • Recommend improvements to peers through constructive feedback. • Improve on their program using peer feedback. ----------OR---------- • Build a Scratch program that uses user input to create an avatar out of different sprites. • Use user input to change what a program does, and perform input validation on user input. • Make use of variables to store the results of user choices. • Make use of lists to display multiple values and for input validation. • Recommend improvements to peers through constructive feedback. • Improve on their program using peer feedback.	• Loop • Condition • Conditional • Pseudocode • Flowchart • Debugging ----------OR---------- • Input Validation • Variable • List	**<u>IL CS Standards/CSTA Standards</u>** • 2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms. • 2-AP-12: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • 2-AP-17: Systematically test and refine programs using a range of test cases. ----------OR---------- **<u>IL CS Standards/CSTA Standards</u>** •2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms. • 2-AP-11: Create clearly named variables that represent different data types and perform operations on their values. • 2-AP-13: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • 2-AP-15: Seek and incorporate feedback from team members and users to refine a solution that meets user needs. • 3A-AP-14: Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables.

Unit 4: Engineering & Design					
Weeks	**Activity**	**Concepts & Skills**	**Vocabulary**	**Resources/Materials**	**Standards**
9	**Introduction to Engineering & Design** • Lesson Plan - Solving Everyday Problems Using the Engineering Design Cycle • Introduction to the Engineering Design Cycle Presentation **Marisol Case Study Activity** • Scenario Wksht. • Group Leader Discussion Wksht. • Group Discussion Response Sheet **• Schematic Drawing**	• Have a thorough understanding of the engineering design process • Identify the engineering design process steps in a case study • Determine whether a design solution meets the project criteria and constraints. • Think of daily life situations/problems that could be improved. • Apply the engineering design process steps to develop their own innovations to real-life problems. • Apply the engineering design cycle steps to future engineering assignments. • Collaborate with group members	• Engineering Design Process • Identify, Define, Develop, Evaluate, Test, Optimize, Communicate • Innovations • Prototype • Criteria • Constraints • Optimize	• Case study activity packet with group discussion sheet & response sheet • Laptop for research	**NGSS** **• MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **ISTE** **• 1.4a:** Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. **• 1.4b:** Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. **• 1.4d:** Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **ITEEA** **• STEL-1I:** Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants. **• STEL-1M:** Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches. **• STEL-2Q:** Predict outcomes of a future product or system at the beginning of the design process. **• STEL-2S:** Defend decisions related to a design problem. **• STEL-5B:** Explore how technologies are developed to meet individual and societal needs and wants. **• STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design. **• STEL-7Q:** Apply the technology and engineering design process. **• STEL-7R:** Refine design solutions to address criteria and constraints. **• STEL-7S:** Create solutions to problems by identifying and applying human factors in design. **• STEL-7T:** Assess design quality based upon established principles and elements of design. **• STEL-7U:** Evaluate the strengths and weaknesses of different design solutions. **• STEL-7V:** Improve essential skills necessary to successfully design.

10 & 11	Bridge Collapse Video & Discussion
	
	"Bridge Build Activity
	• Challenge Packet
	• Prototype Build & Test
	• Refine/Finalize Design & Build
		• Utilize the engineering design process
		• Identify types of bridges
		• Develop a list of design specifications
		• Create a list of all materials purchased for the bridge build
		• Create a scale drawing
		• Use various materials to create a bridge
		• Program the RVR with basic commands
		• Collaborate with group members
			• Engineering Design Process
			• Bill of materials
			• Dimensional scaled drawing
			• Types of Bridges
			  • Arch
			  • Beam
			  • Cable- Stayed
			  • Suspension
			  • Truss
				• Copies of bridge building packet
				• Sphero RVR
				• iPad with Sphero app installed
				• Pencils, Markers, Crayons
				• Popsicle sticks (smooth)
				• Plastic Cups
				• Straws
				• Tape
				• Glue stick
				• String/Pipe cleaners
				• Paper/Cardboard
				• Note cards
				• Rubber bands
					NGSS
					• MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
					• MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
					
					ISTE
					• 1.4a: Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems.
					• 1.4c: Develop, test, and refine prototypes as part of a cyclical design process.
					• 1.4d: Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.
					
					ITEEA
					• STEL-1I: Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.
					• STEL-1M: Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.
					• STEL-2Q: Predict outcomes of a future product or system at the beginning of the design process.
					• STEL-2S: Defend decisions related to a design problem.
					• STEL-5B: Explore how technologies are developed to meet individual and societal needs and wants.
					• STEL-7P: Illustrate the benefits and opportunities associated with different approaches to design.
					• STEL-7Q: Apply the technology and engineering design process.
					• STEL-7R: Refine design solutions to address criteria and constraints.
					• STEL-7S: Create solutions to problems by identifying and applying human factors in design.
					• STEL-7T: Assess design quality based upon established principles and elements of design.
					• STEL-7U: Evaluate the strengths and weaknesses of different design solutions.
					• STEL-7V: Improve essential skills necessary to successfully design.
					• STEL-8J: Use devices to control technological systems.

Weeks	Activity	Concepts & Skills	Vocabulary	Resources/Materials	Standards
12	Sphero RVR Intro Video **Sphero RVR Lessons** • RVR Lesson 1 • RVR Lesson 2 • RVR Lesson 3	• Identify the various parts of the Sphero RVR • Utilize the Sphero app to connect and drive the RVR • Create block coding within the app and explain why each type of movement block is used. • Move the RVR forward/ backwards/ turns • Program heading, speed, and delay • Program the color sensor • Use events to trigger actions with the color sensor • Program using loop forever •Program the light sensor to react to changes in light • Use if conditional blocks	•Speed •Heading •Duration •Roll Block •Drive Block •Inputs •Delay Block •Stop Block •Color Recognition Sensor •Ambient Light Sensor •Luminocity/ Lux Sensor •Speak Block •Events •If Block •Exit Program Block •Build String Operator •Loop forever •Asynchronous/ Synchronous Programming	• iPad for each group of students • Sephero RVR for each group • Google Slides lessons assigned in Google Classroom • Flashlight • Color Tiles • Ruler/yard stick	**IL CS Standards/CSTA Standards** • **2-DA-07:** Represent data using multiple encoding schemes. • **2-AP-12:** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • **2-AP-13**: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • **2-AP-15:** Seek and incorporate feedback from team members and users to refine a solution that meets user needs. • **2-AP-17:** Systematically test and refine programs using a range of test cases.
13 & 14	**RVR Obstacle Course** • RVR Obstacle Course Challenge Packet • RVR Obstacle Course Poster	• Utilize the engineering design process • Analyze the provided scaled drawing of the obstacle course to determine the size of the obstacles that will need to be created. • Follow a list of design specifications to create obstacles • Develop scaled drawings of each obstacle. • Create the obstacles to be placed on the course. • Program the RVR to navigate the course	• Engineering Design Process • Obstacles Structures • Scaled Drawings • RVR Coding Terminology	• Obstacle Course Challenge packet • Obstacle course printed out on poster paper • Sphero RVR • iPads • Building supplies (cardboard, paper, markers, etc.)	**IL CS Standards/CSTA Standards** • **2-DA-07:** Represent data using multiple encoding schemes. • **2-AP-12:** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. • **2-AP-13:** Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. • **2-AP-15:** Seek and incorporate feedback from team members and users to refine a solution that meets user needs. • **2-AP-17:** Systematically test and refine programs using a range of test cases. **ISTE** • **1.4a:** Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. • **1.4b:** Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. • **1.4c:** Develop, test, and refine prototypes as part of a cyclical design process. • **1.4d:** Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **NGSS** • **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **ITEEA**

Unit 5: Design & CAD Programming

Activity	Concepts & Skills	Vocabulary	Resources/Materials	Standards

CAD Modeling
• CAD Modeling Lesson
• CAD Modeling Worksheet
• 3D Printing Introduction
	• Identify the characteristics of 2D vs. 3D shapes
	• Identify the difference between CAD (Computer Aided Design) and CAD (Computer Aided Manufacturing
	• Identify the advantages of using computers in the design process.
	• Have a thorough understanding of 3D printers and how they function.
	• Identify the components of a 3D printer.
		• CAD - Computer Aided Design
		• CAM - Computer Aided Manufacturing
		• 2D & 3D Shapes
		• 3D Printing
		  • Display Unit
		  • Extruder
		  • Filament
		  • Hot End/Nozzle
		  • Print Bed/Plate
		  • Build Volume
		  • Cooling Fan
			• CAD Modeling Worksheet
			• 3D Printer
			• Filament
				ISTE
				• **Standard 3: Knowledge Constructor -** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
				
				ITEEA
				• **STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design.
				• **STEL-7U:** Evaluate the strengths and weaknesses of different design solutions.
				• **STEL-7V:** Improve essential skills necessary to successfully design.

TinkerCAD Skills Review • TinkerCAD Tutorials	• Select and place shapes on TinkerCAD workplane. • Change view of workplane to facilitate object placement. • Move, rotate, and resize object on the workplane. • Group objects on the workplane. • Use transparent objects and grouping to create holes in objects on the workplane. • Copy, duplicate, hide, and align objects on the workplane.	• 3D Design • Workplane • Placement • Perspective • Rotate • Resizing • Grouping • Align • Orthographic View • Hole • Copying • Duplicating	• Computer/Tablet with Internet • TinkerCAD Programming • TinkerCAD Learning Center Tutorials	**ISTE** • **Standard 3: Knowledge Constructor -** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. **ITEEA** • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL-7V:** Improve essential skills necessary to successfully design.
3D Name Plate Keychain Project • Keychain Project Student Directions	• Create a 3D object using TinkerCAD. • Select and place shapes on TinkerCAD workplane. • Change view of workplane to facilitate object placement. • Move, rotate, and resize object on the workplane. • Group objects on the workplane. • Use transparent objects and grouping to create holes in objects on the workplane. • Copy, duplicate, hide, and align objects on the workplane."Select and place shapes on TinkerCAD workplane. • Change view of workplane to facilitate object placement. • Move, rotate, and resize object on the workplane. • Group objects on the workplane. • Use transparent objects and grouping to create holes in objects on the workplane. • Copy, duplicate, hide, and align objects on the workplane.	• 3D Design • Workplane • Placement • Perspective • Rotate • Resizing • Grouping • Align • Orthographic View • Hole • Copying • Duplicating	• Computer/Tablet with Internet • TinkerCAD Programming • Copies of 3D Keychain lesson packet • 3D Printer • Filament • FlashDrive	**ISTE** • **Standard 3: Knowledge Constructor -** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. • **Standard 4: Innovative Designer -** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful, or imaginative solutions. • **Standard 6: Creative Communicator -** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats, and digital media appropriate to their goals. **NGSS** •**MS-ETS 1-2: Engineering Design -** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. •**MS-ETS 1-4: Engineering Design -** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **ITEEA** • **STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design. • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL-7T:** Assess design quality based upon established principles and elements of design. • **STEL-7U:** Evaluate the strengths and weaknesses of different design solutions. • **STEL-7V:** Improve essential skills necessary to successfully design.
Cellphone Keychain Stand Project • Cellphone Keychain Stand Student Directions	• Create a 3D object using TinkerCAD. • Select and place shapes on TinkerCAD workplane. • Change view of workplane to facilitate object placement. • Move, rotate, and resize object on the workplane. • Group objects on the workplane. • Use transparent objects and grouping to create holes in objects on the workplane. • Copy, duplicate, hide, and align objects on the workplane."Select and place shapes on TinkerCAD workplane. • Change view of workplane to facilitate object placement. • Move, rotate, and resize object on the workplane. • Group objects on the workplane. • Use transparent objects and grouping to create holes in objects on the workplane. • Copy, duplicate, hide, and align objects on the workplane.	• 3D Design • Workplane • Placement • Perspective • Rotate • Resizing • Grouping • Align • Orthographic View • Hole • Copying • Duplicating	• Computer/Tablet with Internet • TinkerCAD Programming • Copies of 3D Keychain Cellphone Stand lesson packet • 3D Printer • Filament • FlashDrive	**ISTE** • **Standard 3: Knowledge Constructor -** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. • **Standard 4: Innovative Designer -** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful, or imaginative solutions. • **Standard 6: Creative Communicator -** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats, and digital media appropriate to their goals. **NGSS** •**MS-ETS 1-2: Engineering Design -** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. •**MS-ETS 1-4: Engineering Design -** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **ITEEA** • **STEL-7J:** Evaluate designs based on criteria, constraints, and standards. • **STEL-7L:** Apply universal principles and elements of design. • **STEL-7N:** Practice successful design skills. • **STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design. • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL-7T:** Assess design quality based upon established principles and elements of design. • **STEL-7U:** Evaluate the strengths and weaknesses of different design solutions. • **STEL-7V:** Improve essential skills necessary to successfully design.

Unit 5: Design & CAD Programming

Activity	Concepts & Skills	Vocabulary	Resources/Materials	Standards
Skyscraper STEM Challenge Student Group Packet Teacher Directions Packet	• Utilize the engineering design process • Identify the uses for and various designs of scaffolding. • Develop a list of design specifications • Use various materials to create a scaffolding. • Collaborate with group members	• Skyscrapper • Scaffolding • Engineering Design Process	• Index Cards • Cardboard • Masking Tape • Toy Figurine • Scissors • Box Cutter • Painter's Tape • Meter Stick • Sorting Bins • Skyscrapper Challenge Student Packet • Skyscrapper Challenge Teacher Packet	**NGSS** • **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **ISTE** • **1.4a:** Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. • **1.4c:** Develop, test, and refine prototypes as part of a cyclical design process. • **1.4d:** Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **ITEEA** • **STEL-1M:** Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches. • **STEL-2Q:** Predict outcomes of a future product or system at the beginning of the design process. • **STEL-2S:** Defend decisions related to a design problem. • **STEL-7P:** Illustrate the benefits and opportunities associated with different approaches to design. • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL-7T:** Assess design quality based upon established principles and elements of design. • **STEL-7U:** Evaluate the strengths and weaknesses of different design solutions. • **STEL-7V:** Improve essential skills necessary to successfully design.
Tallest Cup Tower Challenge Student Group Packet Teacher Directions Packet	• Utilize the engineering design process • Design a stable structure despite material and time constraints. • Collaborate with group members	• Engineering Design Process • Tower • Structure • Criteria • Constraints	• Plastic Cups • Timer • Meter Stick	**NGSS** • **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • **MS-ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **ISTE** • **1.4a:** Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems. • **1.4c:** Develop, test, and refine prototypes as part of a cyclical design process. • **1.4d:** Exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems. **ITEEA** • **STEL-1M:** Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches. • **STEL-2Q:** Predict outcomes of a future product or system at the beginning of the design process. • **STEL-2S:** Defend decisions related to a design problem. • **STEL-7Q:** Apply the technology and engineering design process. • **STEL-7R:** Refine design solutions to address criteria and constraints. • **STEL-7T:** Assess design quality based upon established principles and elements of design. • **STEL-7V:** Improve essential skills necessary to successfully design.