Curriculum	
Content Area: Computer Science and Design Thinking	
Unit: Innovative Programmer/Computational Thinker	Duration: 15 - 20 Days
Grade Level: 6th Grade	

Essential Questions

- How can we program and animate program characters with outside hardware input?
- How do conditionals direct how our program will run?
- How can variables help create more complex programs using data?
- How can we use conditionals and variables to direct the flow of our programs?

Enduring Understandings

- Computer programmers use critical thinking skills and a variety of technologies to plan and manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
- Computer programmers design, test, and debug algorithms that are readable, concise, and reusable.
- Computer programmers create variables to store data values of different types and perform appropriate operations on their values.
- Computer programmers define parameters for procedures that generalize behavior and increase reusability.
- Computer programmers design and test solutions to identify problems taking into consideration the diverse needs of the users and the community.

Student Learning Targets (Objectives):

- Students will be able to apply general understanding of computer systems to make sense of human-made machines.
- Students will be able to use the engineering design process and apply technology to use the best digital tool to solve problems.
- Students will be able to develop efficient solutions to computational problems by breaking into subproblems and identifying parts that can be abstracted and modularized.
- Students will be able to find a bug and debug a program that is malfunctioning.
- Students will be able to use digital tools to collect and organize information.

Focus Standards (Major Standards)

- 8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
- 8.1.8.AP.4: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.
- 8.1.8.AP.5: Create procedures with parameters to organize code and make it easier to reuse.
- 8.1.8.AP.8: Systematically test and refine programs using a range of test cases and users.

- 8.1.8.AP.9: Document programs in order to make them easier to follow, test, and debug.

New Jersey Student Learning Standards: Interdisciplinary Connections

Math:

- 6.NS.C.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
- 6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.
- 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.
- 6.EE.A.4 Identify when two expressions are equivalent
- 6.EE.B.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.
- 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable.
- 6.G.A.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
- 6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- 6.SP.B.5 Summarize numerical data sets in relation to their context.

Science:

- 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-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- 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.

LA

- NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- W.6.6. Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of three pages in a single sitting.
- NJSLSA.SL1. 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.

- NJSLSA.SL5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- NJSLSA.SL6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

New Jersey Student Learning Standards: College and Career Readiness

- 9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.
- 9.4.8.DC.5: Manage digital identity and practice positive online behavior to avoid inappropriate forms of self-disclosure.
- 9.4.8.DC.7: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.4.8.IML.13: Identify the impact of the creator on the content, production, and delivery of information (e.g., 8.2.8.ED.1).
- 9.4.8.TL.5: Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.

New Jersey Student Learning Standards: Computer Science and Design Thinking

- 8.1.8.DA.5: Test, analyze, and refine computational model.
- 8.1.8.NI.1: Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.
- 8.1.8.CS.1: Recommend improvements to computing devices in order to improve the ways users interact with the devices.

Instructional Plan

Unit: Computer Programming
Lesson 1: How has computer science changed our society? Why is computer science important to our society?
Lesson 2: Sequencing Basic Coding Steps
Lesson 3: Running a Coding Sequence to Test for Errors
Lesson 4: Creating a Program with Events
Lesson 5: Creating a Program with Loops
Lesson 6: Creating a Program with Conditions
Lesson 7: Creating a Program with Variables
Lesson 8: Create your Own Program

Evidence of Student Learning

Formative Assessments

- Code Prediction - students are provided a set of code, a program or an algorithm and asked to predict what is going to happen. Students can respond by drawing or writing out their prediction using general terms.

- Debugging - students are provided a completed project that has an intentional error or bug. Students are then asked to identify the bug and provide a solution.

Summative Assessments

- Performance Task - computer science offers a unique opportunity for a hands-on approach to create computer science artifacts such as animation, digital stories, games, applications, and websites. A formative assessment can also be a collection of artifacts creating a student portfolio.
- Peer Feedback - in the computer science classroom students can provide meaningful feedback and assessment on their classmates work and projects.

Suggested Options for Differentiation

Modifications (ELLs, Special Education, 504, Students at risk of failure, Gifted and Talented)

Special Education

- Follow student IEP requirements.
- Preferential seating.
- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify and repeat expectations by providing digital copies, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed in group work to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc)
- Positive reinforcement and praise
- Use of word processors and digital image software to replace writing and drawing by hand.
- Pacing and guidance in long term projects.
- Work chunked out based on tasks, individual check-ins.
- Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.

504

- Follow student 504 requirements.
- Preferential seating.
- If the student cannot utilize computers or look at screens, research, planning, and computer-based learning experiences can be done on paper.
- If the students' level of mobility is limited, making it difficult for the students to navigate the classroom, the student will be assigned a buddy to help with acquiring the necessary materials and supplies.
- If the students' fine or gross motor skills are impacted, s/he will receive assistance from the teacher for the specific artistic skills that require them.

Students at Risk for Failure

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarification and repetition of expectations, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc.).
- Positive reinforcement.
- Pacing and guidance in long term projects.
- Work chunked out based on tasks, individual check-ins.
- Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.

Gifted and Talented:

- Provide access to additional materials to develop ideas and project details.
- Teach more advanced coding skills and give students new problems to solve or debug

ELL:

- Use of Google Translate to assist students with instructions and lessons so they can follow along.
- Adjust goals to allow for language acquisition.
- Visual prompts and demonstrations.
- Teacher modeling of skills.
- Simplified written and verbal instructions.
- Include written instructions to supplement verbal.
- Preferential seating.

Suggested Materials

- Computer
- Online Programming Tools

Suggested I Resources

- Online Programming Tools
- Launch Input/Output: Computer Systems
- Laptop, Chromebook, or Computer
- Tablet

Curriculum	
Content Area: Computer Science and Design Thinking	
Unit: Engineering Design Applications 3D Design and Printing	Duration: 15 - 20 Days
Grade Level: 6th Grade	

Essential Questions

- What are computer aided design (CAD) and 3D Printing and how are they used in the engineering design process and problem solving?
- How does an object go from an idea, to a CAD file to a 3D physical object to solve real world problems?
- How can I use the materials and time provided, as well as our prior knowledge and new knowledge to solve the problem at hand?
- How do I clearly communicate the attributes of my/our design to others to aid in the manufacturing/production process?

Enduring Understandings

- Engineers use the engineering design process to invent, innovate, or improve solutions to real world problems.
- Computer Aided Design (CAD) is used by Designers, Engineers, and Architects to create technical drawings used to communicate design solutions. CAD software is used to develop visual representation of design ideas in 2D and 3D drawings.
- 3D Printing technology) is used by Designers, Engineers, and Architects to create physical prototypes of their design solutions. CAD software is used to develop visual representation of design ideas in 3D drawings and the 3D printer creates the physical 3D object.
- Innovation in digital tools and products are utilized to aid and simplify work and maximize efficiency.

Student Learning Targets (Objectives):

- Students will apply the Engineering Design Process to solve a design challenge.
- Students will be able to analyze a real world problem to create, innovate, or improve a design solution.
- Students will be able to develop fundamental drafting and design skills using a computer aided 3 design software program.
- Students will be able to utilize computer aided design software for a design challenge.
- Students will be able to utilize 3D printing technology to create a physical prototype of their 3D design.
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Focus Standards (Major Standards)

- 8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

- 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
- 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

New Jersey Student Learning Standards: Interdisciplinary Connections

Math:

- 6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.
- 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.
- 6.EE.B.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.
- 6.G.A.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

Science:

- 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.
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- W.6.6. Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of three pages in a single sitting.
- NJSLSA.SL1. 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.
- NJSLSA.SL4. 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.
- NJSLSA.SL6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

New Jersey Student Learning Standards: College and Career Readiness

- 9.4.8.CI.2: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).
- 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.
- 9.4.8.IML.13: Identify the impact of the creator on the content, production, and delivery of information (e.g., 8.2.8.ED.1).

- 9.4.8.TL.5: Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.

New Jersey Student Learning Standards: Computer Science and Design Thinking

- 8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or system.
- 8.2.8.NT.1: Examine a malfunctioning tool, product, or system and propose solutions to the problem.
- 8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.
- 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
- 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.

Instructional Plan

Unit: Engineering Design Applications 3D DESIGN
Lesson 1: What is computer aided design (CAD) and how is it used in engineering design and problem solving? How does an object go from an idea, to a CAD file to a 3D physical object?
Lesson 2: What are some real world uses for CAD and 3D printing? 3D CAD design to 3D Printed Prototype
Lesson 3: CAD Software Intro Skills
Lesson 4: Basic Real-World Design Project
Lesson 5: 3D Printing Basics and Safety
Lesson 6: Individual Real - World Design Challenge

Evidence of Student Learning

Formative Assessments

- CAD Software Tutorial- students are provided a set of parameters to assess the basic skills of the CAD program.
- Improving Design - students are provided a project and they identify a design flaw and improve it.

Summative Assessments

- Performance Task - 3D designing offers a unique opportunity for a hands-on approach to create 3D designs for real world applications. A formative assessment can also be a collection of 3D designs creating a student portfolio.
- Peer Feedback - in the engineering design classroom students can provide meaningful feedback and assessment on their classmates work and projects.

Suggested Options for Differentiation

Modifications (ELLs, Special Education, 504, Students at risk of failure, Gifted and Talented)

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- Support of student focus: verbal prompts, visual cues (lights out, etc)
- Positive reinforcement and praise
- Use of word processors and digital image software to replace writing and drawing by hand.
- Pacing and guidance in long term projects.
- Work chunked out based on tasks, individual check-ins.
- Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.
- Use physical objects to familiarize the student with the 3D objects and how they relate to the screen design.

504

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Suggested Materials
• Computer • Online CAD Tools
Suggested I Resources
• Online CAD Tools • Launch Input/Output: Computer Systems • Laptop, Chromebook, or Computer • Tablet