Think, Design, Make! (Grade 7)

Content Area: **STEM**
Course(s): **Williamstown Middle School Course**
Time Period: **6 weeks**
Length: **1 Cycle (30 Days)**
Status: **Published**

Unit Overview

Think, Design, Make! introduces students to design thinking and through a series of hands-on design challenges that integrate a variety of academic disciplines such as Science, Technology, Engineering, Art and Math. Studio activities are designed to stimulate creativity and strengthen student's ability in problem analysis, creative problem solving, and visual literacy skills. Some skills that will be developed in this course are, but not limited to, techniques in brainstorming, design development, presentation and problem solving. Students will explore 3D CAD as a design tool and various desktop manufacturing options such as 3D printing and CNC Machining of soft materials.

Transfer

Students will be able to independently use their learning to...

- Analyze a problem, brainstorm solutions, and develop a product using the design process, a 3D CAD program, and various desktop manufacturing tools/methods.

- Successfully use learned skills to problem solve creatively.

- Develop, on their own, working prototypes or visual concepts and refine the design through the iteration process.

- Explore multiple solutions to solve the same problem and making educated decisions to which would be the best solution to persue.

- Properly and effectively use Compuer Aided Design software to develop 3D models.

- Manage mechanical tools such as a 3D printer or table top CNC to make digital works a reality that can be held and used.

- Determine difrferent ways to access 3D models for printing and utilization in projects.

Meaning

Understandings

Students will understand that...

- Successful products don't just happen. It is through proper planning, brainstorming and iteration that a successful product can be created.

- Every measurement and dimension in a digital model will effect how the physical product works.

- Knowledge of how a tool works is just as important as knowing how to use it.

- There is a correct and incorrect way to design for the tool being used.

- There are multiple possible answers to the same problem.

- There are multiple ways to manufacture the same product and determining the best tool for the project at hand is important.

- Self-evaluation and reiteration of work is key to successful creation.

- It is important to have empathy to properly define the problem that needs a solution

- Failure is part of the design and creation process. We learn from our mistakes and reiterate. We "Learn by Doing"

Essential Questions

Students will keep considering...

- What steps do industrial designers take to analyze, brainstorm, design and build a product?

- What is desktop manufacturing?

- What is a 3D printing?

- What is CNC Machining?

- What are the different types of 3D printer?

- What are the parts of a 3D printer and how do they work?

- What materials can I print with a 3D printer?

- How do you print a 3D model?

- How has desktop manufacturing changed the way products are created and manufactured?

- How has the ease and accessibility of desktop manufacturing effected how big companies create and produce?

- How has the ease and accessibility of desktop manufacturing effected how home hobbyist and small startups create and produce?

- What is 3D Computer Aided Design?

- What other ways can 3D models be obtained?

Application of Knowledge and Skill

Students will know...

Students will know...

The next industrial revolution is all about personal fabrication, and it's happening now. 3D printing and Digital 3D Modeling is poised to unlock the potential in every person to create, innovate and fabricate. It's already transforming manufacturing; soon it will change the world. Recognizing the profound implications of 3D printing for the future of design and manufacturing, this course is designed to prepare students for current and emerging careers in those fields. Students will begin their careers equipped with practical 3D printing experience and a critical eye for the technology's advantages and limitations. From there, the possibilities are theirs to explore.

Students will be skilled at...

Students will be skilled at...

- Brainstorming and Ideating creatively to solve a problem

- Explaining current and emerging 3D printing applications in the manufacturing field

- Understand the advantages and limitations of each 3D printing technology

- Evaluating scenarios and recommending the appropriate use of 3D printing/CNC Milling Technologies.

- Identifying opportunities to apply 3D printing technology for time and cost savings.

- Take a rough sketch of an idea and design it digitally in a 3D modeling program.

- Successfully exporting 3D model in .STL format and creating GCode or similar for printing using a 3D model slicing program.

Academic Vocabulary

Vocab - Tools

3D Printer, FDM Printing, SLS Printing, DMLS Printing, SLA (Stereolithography) Printing, CNC Machine, Filament, Extruder, Hot End, Extrusion, Print Bed/Print Platform, Stepper Motor, Timing Belt, Pully, Linear Bearing, Smooth Rod, Lead Screw, X, Y, & Z axis, Caliper.

Vocab - 3D CAD

CAD, Sketch, Primitive, Merge, Subtract, Intersect, Loft, Sweep, Revolve, Extrude, Push/Pull, Transform (Move/Rotate, Scale), Tweak, Fillet, Chamfer, Snap, Orbit, Pan, Materials, Outlines, Workpane, Solids, Meshes. Units

Vocab - Design Process

Empathize, Define, Ideate/Brainstorm, Model/Prototype, Test/Evaluate, Publish/Produce, Aesthetics, Annotate, Constraints, Consumer, Criteria, Decision Matrix, Design, Design Brief, Design Elements, Design Process, Designer, Dimension, Engineer, Ergonomics, Evaluate, Experimentation, Investigate, Model, Modify, Optimize, Problem Solving, Process, Prototype, Requirements, Testing, Texture, Trade-Off, Visualization, Sketch

Learning Goal 1

Students will be able to label the parts of a Desktop Manufacturing Machine such as a 3D printer or CNC and explain how it works to create objects.

Target 1

Students will be able to label the parts of a 3D printer and explain its purpose.

TECH.8.2.8.A.2	Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
TECH.8.2.8.A.3	Investigate a malfunction in any part of a system and identify its impacts.
TECH.8.2.8.D.CS2	Use and maintain technological products and systems.
TECH.8.2.8.E.2	Demonstrate an understanding of the relationship between hardware and software.
TECH.8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.

Target 2

Students will be able to explain the printing/milling process used by popular desktop manufacturing machines and how a digital model produced on these tools.

LA.8.CCSS.ELA-Literacy.CCRA.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.
TECH.8.1.8.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.2.8.A.CS1	The characteristics and scope of technology.
TECH.8.2.8.A.CS2	The core concepts of technology.
TECH.8.2.8.B.2	Identify the desired and undesired consequences from the use of a product or system.
TECH.8.2.8.C.3	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
TECH.8.2.8.C.6	Collaborate to examine a malfunctioning system and identify the step-by-step process used to troubleshoot, evaluate and test options to repair the product, presenting the better solution.
TECH.8.2.8.D.CS2	Use and maintain technological products and systems.
TECH.8.2.8.E.2	Demonstrate an understanding of the relationship between hardware and software.

Learning Goal 2

Students will be able to utilize the Design Process to successfully design a prototype or concept with 3D modeling, 3D printing, and CNC manufacturing in mind.

Target 1

Students will be able to successfully utilize the Design Process to create a prototype or concept of a product.

TECH.8.2.8.C.1	Explain how different teams/groups can contribute to the overall design of a product.
TECH.8.2.8.C.2	Explain the need for optimization in a design process.
TECH.8.2.8.C.3	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
TECH.8.2.8.C.4	Identify the steps in the design process that would be used to solve a designated problem.
TECH.8.2.8.C.7	Collaborate with peers and experts in the field to research and develop a product using the design process, data analysis and trends, and maintain a design log with annotated sketches to record the developmental cycle.
TECH.8.2.8.C.8	Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.
TECH.8.2.8.C.5a	Explain the interdependence of a subsystem that operates as part of a system.
TECH.8.2.8.C.CS2	The application of engineering design.
TECH.8.2.8.D.1	Design and create a product that addresses a real world problem using a design process under specific constraints.
TECH.8.2.8.D.2	Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook.
TECH.8.2.8.D.3	Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
TECH.8.2.8.D.CS1	Apply the design process.
TECH.8.2.8.D.CS2	Use and maintain technological products and systems.
TECH.8.2.8.E.1	Identify ways computers are used that have had an impact across the range of human activity and within different careers where they are used.
TECH.8.2.8.E.CS1	Computational thinking and computer programming as tools used in design and engineering.

Target 2

Students will be able to creatively design parts of a product with the appropriate manufacturing method in mind.

TECH.8.2.8.D.2	Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook.
TECH.8.2.8.D.3	Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
TECH.8.2.8.D.4	Research and publish the steps for using and maintaining a product or system and incorporate diagrams or images throughout to enhance user comprehension.
TECH.8.2.8.D.CS2	Use and maintain technological products and systems.
TECH.8.2.8.D.CS3	Assess the impact of products and systems.
TECH.8.2.8.E.2	Demonstrate an understanding of the relationship between hardware and software.
TECH.8.2.8.E.4	Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

Summative Assessment

Students' will be evaluated for overal learning through the use of a high stakes common assessment "final exam". The exam will utilize a combination of multiple choice, matching, word bank and fill-in-the-blank questions.

21st Century Life and Careers

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.

Formative Assessment and Performance Opportunities

Assessment throughout the 30 day cycle will be a combination of the following...

- Daily quick warm up exercises regarding previously learned information.

- Quizzes

- Assigned activities and group/individual project based assignments assessed using performance based rubric

- Self Assessment and group assessment

- Class participation

- Oral Presentation

- Exit Tickets

- Student Interviews

Differentiation/Enrichment

- Individualized project topics
- Lesson extension
- Manipulative items

- Review and Practice exercises
- Self-Reflections
- Small group instruction
- Video and other visual presentations

Unit Resources

- 3D Printers
- Autodesk Fusion 360
- Learn.printrbot.com
- plusus.org/our-thoughts/page2
- Thingiverse.com (3D Model Sharing Repository)
- TinkerCad.com (Browser Based 3D Modeling Program)
- Windows Workstations