



SCHOOL DISTRICT OF THE CHATHAMS CURRICULUM PROFILE



CONTENT AREA(S): iSTEM

GRADE LEVEL(S): 7th Grade

COURSE: Digital Fab Lab (*formerly CAD*)

TIME FRAME: Quarterly
(39-40 days)

I. Course Overview

Students will develop fundamental skills for digital 2D & 3D design. Using computer aided design (CAD) software, students will develop prototypes and design solutions that can be fabricated in our prototyping lab utilizing rapid prototyping equipment, such as 3D printers, laser engravers, and vinyl cutters. An emphasis is placed on the proper application of CAD software and rapid prototyping principles in order to develop a working toolkit of skills and knowledge that can be applied to a variety of problem solving situations.

II. Units of Study

- 1.) 3D Printers and Basic CAD Software (*~8 days*)
- 2.) Basic Measurements and Engineering Design Process (*~8 days*)
- 3.) Advanced CAD Applications (*~23 days*)

III. Essential Questions

Unit 1: 3D Printers and Basic CAD Software

- How can CAD software and 3D printers be used in the real world to help solve problems?
- How can simple shapes and design elements be used to develop a complex object?
- What kind of impact can 3D printed objects have on the environment?

Unit 2: Basic Measurements and Engineering Design Process

- Why is it important to design, visualize objects, transform ideas into sketches, and use the design process to solve problems?
- How can the Engineering Design Process be used to better help develop an idea?

Unit 3: Advanced CAD Applications

- How can the Engineering Design Process be used to help better develop an idea?
- How can the process of brainstorming “bad” ideas assist in the creation of good ideas?
- How can CAD software and 3D printers be used in the real world to help solve problems?
- How can we use our creativity to add more functionality to a project within the project constraints?

IV. Learning Objectives

NJSLS - Design Technology

- 8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
- 8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
- 8.2.8.B.1 Design and create a product that addresses a real-world problem using the design process and working with specific criteria and constraints.



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- 8.2.8.B.3 Solve a science-based design challenge and build a prototype using science and math principles throughout the design process.
- 8.2.8.B.5 Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries and societies.
- 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.
- 8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.
 - 8.2.8.C.5.a Create a technical sketch of a product with materials and measurements labeled.
- 8.2.8.D.1 Design and create a product that addresses a real-world problem using the design process and working with specific criteria and constraints.
- 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.
- 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.

Technology Integration | NJSLS 8.1

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- 8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

21st Century Integration | NJSLS 9

- 9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

Career Ready Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP11. Use technology to enhance productivity.

Interdisciplinary Connections

- NGSS | 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.
- NJSLS | Mathematics
 - 7.EE.B.b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p , q , and r are specific rational numbers. Graph the solution set of the



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inequality and interpret it in the context of the problem. For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.

- 7.G.A.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
- 7.G.A.2. Draw (with technology, with ruler and protractor, as well as freehand) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

V. Instructional Materials

Core Materials:

- [3D Printing Projects](#) by Dorling Kindersley
- [TinkerCAD](#)
- TinkerCAD for Education Lessons
- Epilog Laser Guide for Lasers in Education
- MakerBot Educators Guidebook For 3d Printing In The Classroom
- Roland Vinyl Cutter Project Based Learning Guide
- Basic Rapid Prototyping Equipment
 - 3D Printers
 - Vinyl Cutter
 - Laser Cutter/Engraver
 - Heat Press
 - Dye Sublimation Printer
- Teacher computer with Internet access and projector/Smart Board
- Document Camera
- Desktop Computing Devices

Supplemental/District Created Materials:

- First Day of Class Presentation
- Safety Permission Slip
- What is 3D printing and how does it work?? (video)
- What Is 3D Printing and How Does It Work? | Mashable Explains (video)
- 3D Printers | How It's Made (video)
- Boy gets prosthetic hand made by 3-D printer (video)
- How 3-D-Printed Prosthetic Hands Are Changing These Kids' Lives | Short Film Showcase (video)
- Make It Shape It Presentation
- Penguin Project Rubric
- Engineering Design Process Presentation
- Nesting Doll Rubric Handout
- Nesting Doll Getting Started Demonstration Video
- Nesting Doll Written Instruction Notes
- Creative Grass Planters Rubric Handout
- Creative Pencil Holder Rubric Handout



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- Co2 Rockets Handout
- Co2 Rockets Intro (video)
- String Test Handout
- Rocket Submission Instructions
- CAD 2D Rubric Handout
- CAD 2D Project Choice Folder and Instruction Documents
- Set up File Laser Engraver (Video)
- Cutting and Engraving Laser Engraver (Video)
- Adobe Illustrator Getting Started (Video)
- Adobe Illustrator Rasterize Text (Video)
- Adobe Illustrator Import Images (Video)
- Adobe Illustrator Mirror Objects (Video)
- Adobe Illustrator Cutting Shapes out of an Image (Video)
- Practical Design Rubric Handout
- Practical Design Process Guide

VI. Key Performance and Benchmark Tasks

Assessment Methods:

- Students will complete approximately five (5) projects between unit 1 and 3.
- When a student completes a project, s/he will complete a checklist, reflect on their work and answer thoughtful questions on their design process.
- A rubric is outlined on the checklist sheet, delineating the project parameters and expectations.

Summative:

Unit 1: 3D Printers and Basic CAD Software

- Utilize scaffolded tutorials to develop basic structures for 3D models as well as independently select and utilize geometric manipulations and additions to redesign and modify existing designs.
- Demonstrate a basic understanding of functions within 3-D modeling software.
- Identify basic shapes and tools that are available for use in the CAD software.
- Group simple shapes and negative space to create a complex object.
- Manipulate common shapes to create complex or uncommon shapes.
- Create and save files, demonstrate the use of hot keys and navigation shortcuts in operating basic tool sets.
- Students will be able to identify, manipulate, and transform 2-dimensional sketches into 3-dimensional objects.
- Identify, manipulate, and transform 2-dimensional faces into 3-dimensional objects.

Unit 2: Basic Measurements and Engineering Design Process

- Develop an understanding of how objects can be scaled while holding shape constraints to achieve a desired outcome.
- Develop an understanding of the engineering design process and how it applies to CAD or prototyping technologies.
- Demonstrate the ability to create an assembly of objects that can fit together if printed.



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Unit 3: Advanced CAD Applications

- Students will be able to apply the design process to an open ended project.
- Students will be able to create functional prototypes that can be 3D printed, cut in the laser engraver, or vinyl cutter.
- Demonstrate the ability to create an assembly of objects that can fit together if printed.

Formative:

- Peer Feedback: TAG (Tell, Ask, Give) Sticky Notes
- Peer Feedback Form
- Self-Reflection: 2 Stars & 1 Wish
- Critique Guide
- Reflective Exit Tickets/Slips
- Penguin Project
 - Penguin Project Checklist
- Nesting Dolls
 - Nesting Dolls Checklist
- Creative Grass Planters
 - Creative Grass Planter Checklist
- Creative Pencil Holder
 - Creative Pencil Holder Checklist
- CAD in 2D
 - CAD in 2D Graded Checklist
- Practical Design
 - Practical Design Graded Checklist

Alternative:

- Student choice is built into each project, which makes each project unique for each and every student.
- Adjustments to assessment criteria and assessments themselves are described below in Section VII.

VII. Accommodations & Modifications for Special Education, Students at Risk for School Failure, English Language Learners, Gifted & Talented, and 504s

Special Education

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify 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.



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- Provision of Written Notes and Directions:
 - First Day of Class Notes
 - Make It Shape It Notes
 - Penguin Project
 - Penguin Project Written Instructions
 - Engineering Design Process Notes
 - Nesting Dolls
 - Nesting Doll Written instructions
 - Nesting Doll Getting Started Demonstration Video
 - Nesting Doll Written Instruction Notes
 - Creative Grass Planter
 - Creative Grass Planters Written Instructions
 - Creative Pencil Holder
 - Creative Pencil Holder Written Instructions
 - Co2 Rockets
 - Co2 Rockets Written Instructions
 - String Test Written Instructions
 - Rocket Submission Written Instructions
 - CAD 2D
 - CAD 2D Written Instructions
 - CAD 2D Project Choice and Written Instructions
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 - Adobe Illustrator Getting Started (Video)
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 - Adobe Illustrator Mirror Objects (Video)
 - Adobe Illustrator Cutting Shapes out of an Image (Video)
 - Practical Design
 - Practical Design Written Instructions
 - Practical Design Process Guide

English Language Learners

- 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.



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Gifted & Talented

- Access to additional materials to develop ideas and project details.
 - A Habitat for Darwin and Speedi
 - Adobe Illustrator
 - Chatham Cougar
 - Cheeseburger
 - Creative Eyewear
 - Darwin and Speedi
 - Landmarks and Monuments
 - My Lego Person
 - Origami Hand Modeling
 - Phone Case
 - Popular Science
 - Sculptris
 - Skyscraper

Students at Risk of School Failure

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify 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.

504s

- Completely dependent on the student's 504 plan.
 - 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.

GENERAL NOTES:

- The order in which the units are taught can be adjusted at the teacher's discretion.
- Days are fluid and some activities may extend longer.
- Lessons and units will be adjusted as per students' prior knowledge.