

DESIGN & MODELING IN A FAB LAB

CURRICULUM/CONTENT AREA	COURSE LENGTH
<i>Applied Technology and Engineering</i>	<i>45 days</i>
GRADE LEVEL	DATE LAST REVIEWED
<i>7 & 8 grades</i>	<i>2022</i>
PREREQUISITE(s) if applicable	BOARD APPROVAL DATE
<i>None</i>	<i>11/15/2022</i>

PRIMARY RESOURCE if applicable

DESIRED RESULTS

COURSE DESCRIPTION AND PURPOSE

Have you ever dreamed of becoming an engineer or some type of designer? Then this course is for you! Design and Modeling in a Fab Lab students discover the engineering design process and develop an understanding of the influence of creativity and innovation in their lives. They are then challenged and empowered to use and apply the design process throughout the unit to design solutions to various problems. Students will use a Fab Lab to bring their designs to life using 3D printers, laser engravers, CNC technology, and vinyl cutters.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<i>Students will understand that...</i>	<i>Students will keep considering...</i>
Creativity, innovation, and critical thinking are essential for success in a technologically advanced world.	Why is creativity and innovation important? How is creativity and innovation used in graphic design and manufacturing?
	What strategies and processes can I use to become a more effective creator, thinker and problem solver?
The ability to communicate and collaborate with people with diverse backgrounds and perspectives is key to participation in a global economic society.	Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?
	What is effective teamwork? What strategies can I use/teams use to work better together? How can perspectives and experiences of a diverse group develop innovative solutions to a given problem?

<p>Career and technical education provides pathways to high-demand, high-wage career opportunities, and personal fulfillment.</p>	<p>How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?</p> <p>What are employability skills? How do I prepare myself for a career that is in demand now and in 5, 10, or 20 years from now?</p>
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PRIORITY CAREER & TECHNICAL STANDARDS
Students will be skilled at...

Creativity, Critical Thinking, Communication and Collaboration
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.
 a: I develop effective resolutions for a given problem, decision or opportunity using available information.
 b: I develop and implement a resolution for a new situation using personal knowledge and experience.

Career Development
CD4: Students will identify and apply employability skills.
 a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.
 c: I identify and exhibit traits for retaining employment.
 d: I develop positive relationships with others.

Information, Media, Technology
IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.-
 c: I select relevant information necessary for making decisions and solving problems
 d: I apply data and information to communicate ideas and create new opportunities.

PRIORITY CONTENT STANDARDS
Students will know...

- Standard: BB1:** Students will analyze the core concepts of technology.
- Standard: ENG1:** Students will demonstrate the attributes of design.
- Standard: ENG3:** Students will demonstrate research and development, invention and innovation and experimentation in problem solving.
- Standard: MNF1:** Students will be able to select and use manufacturing technologies.

UNIT 2: GRAPHIC Design

STAGE 1: Desired Unit Results What will students understand as a result of the unit?		STAGE 2: Assessment Evidence By what criteria will performances of understanding be assessed? Through what authentic performance tasks will students demonstrate the desired unit results?
ESSENTIAL QUESTION (s) What thought-provoking questions will foster inquiry, understanding, and transfer of learning?		Success Criteria with Standards The criteria for evaluating performance on standards is constant.
Why is creativity and innovation important? How is creativity and innovation used in graphic design and manufacturing?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback. In their portfolio/evidence journal, students will reflect on the essential questions through a quick write, constructed response.
What strategies and processes can I use to become a more effective creator, thinker, and problem solver?		
Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?		
How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?		
PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets		Performance Tasks Options/ Assessment Strategies by Standard Students may be given options to show their learning in varied ways.
Creativity, Critical Thinking, Communication and Collaboration		
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.		
a: I develop effective resolutions for a given problem, decision or opportunity using available information.	4C2.a.6.m: I can develop multiple resolutions for a given problem, decision or opportunity. 4C2.a.7.m: I can identify problems that became worse due to poorly thought out or poorly informed solutions	Students will create two dimensional designs using a variety of technologies. These designs could include hand sketching and/or drawing as well as various software programs.
Career Development		
CD4: Students will identify and apply employability skills.		
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.4.m: I can demonstrate flexibility and willingness to learn new knowledge and skills. CD4.a.5.m: I can identify positive workqualities typically desired in each of the career cluster's pathways. CD4.c.2.m: I can demonstrate the behavior and etiquette appropriate to interactions with adults.	Students will actively participate and engage in creating virtual and physical two dimensional designs. Students will apply previous knowledge of sketching and drawing from art classes as well as other previous 2 dimensional work they may have done. Discussions of attitude, work ethic and respecting coworkers is all part of being an effective member of the work force. Timeliness and deadlines are also part of real life and everyone's work environment, whether it is in manufacturing, in an office setting or even if you are self-employed.
c: I identify and exhibit traits for retaining employment.	CD4.d.3.m: I can interact with others in a respectful and non-judgmental manner.	
d: I develop positive relationships with others.	CD4.d.4.m: I can use cooperative behavior in helping peers accomplish goals and tasks.	
Information, Media, Technology		
IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.		
a: I choose appropriate sources of data and information for a given purpose.	IMT1.b.5.m: I can demonstrate ability to gather information from electronic and non-electronic sources.	Students will utilize online resources available through Canvas to access information on how to create 2 dimensional designs. Students will also

	<p>IMT1.b.6.m: I can analyze various sources of data and information for relevance, validity and timeliness.</p> <p>IMT1.c.3.m: I can evaluate the relevance and reliability of various sources of information.</p>	<p>learn sketching techniques and use manipulatives to demonstrate knowledge and ability of 2 dimensional work.</p>
<p>c: I select relevant information necessary for making decisions and solving problems</p>	<p>IMT1.d.4.m: I can incorporate information from multiple sources to communicate a new idea or support an argument.</p>	
<p>d: I apply data and information to communicate ideas and create new opportunities.</p>	<p>IMT1.d.5.m: I can apply a system for tracking and accessing data and information from multiple sources.</p>	
PRIORITY CONTENT STANDARDS & Learning Targets		Performance Tasks Options/ Assessment Strategies by Standard
<p>Standard: BB1: Students will analyze the core concepts of technology.</p>	<p>I can use appropriate tools to measure and layout a piece of material (e.g., length, width, thickness, angles, circles, arcs and volume) within tolerances.</p>	<p>Students will create designs and select the best design to manufacture a logo or sticker design within specifications.</p>
<p>Standard: ENG1: Students will analyze and demonstrate the attributes of design.</p>	<p>I understand requirements for a design are made up of criteria and constraints.</p>	
<p>Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.</p>	<p>I can demonstrate how invention and experimentation can solve problems.</p>	<p>Students will use parts of the design thinking process to develop the best idea to prototype. Students will work within given criteria and constraints to keep their designs within tolerances.</p>
<p>Standard: ICT1: Students will analyze, select and use information and communication technologies.</p>	<p>I can demonstrate how the use of symbols, measurements and drawings promotes clear communication by providing a common language to express ideas.</p>	<p>Students will use programs like Graphtec Studio and Adobe Illustrator to create designs that communicate ideas.</p>
<p>Standard: MNF1: Students will be able to select and use manufacturing technologies.</p>	<p>I can use tools, materials and machines safely.</p>	<p>Students will assist in using the vinyl cutter, laser and other cnc equipment to prototype their designs.</p>
	<p>I can comprehend and engage in communication methods to convey ideas, concepts and requirements to other individuals and teams.</p>	<p>Students will be able to discuss what their designs represent and how they created their prototypes.</p>
Stage 3: Learning Activities		
<p>A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unfold in a natural flow?</p>		
GUIDING UNIT QUESTIONS	STRATEGIES/ACTIVITIES	RESOURCES/MATERIALS
<p>Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning</p>	<p>What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.</p>	<p>This includes an applicable textbooks, software, industry recognized certification software/tools, subscriptions (such asPLTW), etc.</p>
<p>1.How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?</p>	<p>explicit instruction in L.A.U.N.C.H. cycle (design thinking)</p>	<p>Autodesk inventor, Graphtec Studio, Retina Engrave</p>

2. Why is accurate measurement, precise dimensioning, and thorough documentation necessary for both mechanical dissection and creative problem solving?		L.A.U.N.C.H. Design Thinking by John Spencer resources
3. Why is it important for an engineer to be aware of the criteria and the constraints when designing a project?		Defined Learning/Defined STEM
4. Why are teams of people more successful than an individual when solving problems?		PLTW Design & Modeling curriculum resources
5. Why is brainstorming, research, and testing important when creating, modifying, or improving a design solution?		
6. How are sketches used to document and communicate design ideas with accuracy?		

PROTOTYPING & MANUFACTURING

STAGE 1: Desired Unit Results		STAGE 2: Assessment Evidence
What will students understand as a result of the unit?		By what criteria will performances of understanding be assessed? Through what authentic performance tasks will students demonstrate the desired unit results?
ESSENTIAL QUESTION (s)		Success Criteria with Standards
What thought-provoking questions will foster inquiry, understanding, and transfer of learning?		The criteria for evaluating performance on standards is constant.
Why is creativity and innovation important? How is creativity and innovation used in graphic design and manufacturing?		CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.
Why is communication and collaboration important? How do positive work behaviors and personal qualities impact communication and collaboration?		In their portfolio/evidence journal, students will reflect on the essential questions through a quick write, constructed response.
How might technical knowledge and skills influence one's employability and advancement opportunities within various work settings?		
PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets		Performance Tasks Options/ Assessment Strategies by Standard
Creativity, Critical Thinking, Communication and Collaboration		
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.		
a: I develop effective resolutions for a given problem, decision or opportunity using available information.	4C2.a.6.m: I can develop multiple resolutions for a given problem, decision or opportunity. 4C2.a.10.m: I can explain the process for choosing an action or making a decision.	In their portfolio/evidence journal, students will reflect on design problems and the process to develop solutions through a quick write, constructed response.
b: I develop and implement a resolution for a new situation using personal knowledge and experience.	4C2.b.3.m: I can analyze problems to determine what past experiences might be related and relevant. 4C2.b.4.m: I can analyze a problem to determine how it relates to existing knowledge.	Students will demonstrate proper safety and assist in using the vinyl cutter, laser and other cnc equipment to create prototypes their designs.
Career Development		
CD4: Students will identify and apply employability skills.		
a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.	CD4.a.4.m: I can demonstrate flexibility and willingness to learn new knowledge and skills. CD4.a.5.m: I can identify positive workqualities typically desired in each of the career cluster's pathways.	In their portfolio/evidence journal, students will reflect on positive work behaviors as it relates to employability skills through a quick write, constructed response.
c: I identify and exhibit traits for retaining employment.	CD4.c.2.m: I can demonstrate the behavior and etiquette appropriate to interactions with adults. CD4.c.3.m: I can distinguish between appropriate behaviors in a social vs. professional setting.	
d: I develop positive relationships with others.	CD4.d.3.m: I can interact with others in a respectful and non-judgmental manner. CD4.d.4.m: I can use cooperative behavior in helping peers accomplish goals and tasks.	

PRIORITY CONTENT STANDARDS & Learning Targets		Performance Tasks Options/ Assessment Strategies by Standard
Standard: BB1: Students will analyze the core concepts of technology.	I can describe how resources are the things needed to complete a task (e.g., tools, machines, materials, information, energy, people, capital and time).	Students may be given options to show their learning in varied ways. Through the use of various manufacturing technology (e.g.- the vinyl cutter, laser and other cnc equipment) students will create prototypes for their designs. In their portfolio/evidence journal, students will analyze their implementation of the creative planning process (LAUNCH process).
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	I can demonstrate that design that is a creative planning process that leads to useful products and systems. I understand there is no perfect design.	
Standard: MNF1: Students will be able to select and use manufacturing technologies.	I can use tools, materials and machines safely.	
	I can discuss how robotics and automation play a role in manufacturing cutting operations. I can comprehend and engage in communication methods to convey ideas, concepts and requirements to other individuals and teams.	

Stage 3: Learning Activities

A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unfold in a natural flow?

GUIDING UNIT QUESTIONS	STRATEGIES/ACTIVITIES	RESOURCES/MATERIALS
Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning	What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.	This includes an applicable textbooks, software, industry recognized certification software/tools, subscriptions (such asPLTW), etc.
1.How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?	explicit instruction in L.A.U.N.C.H. cycle (design thinking)	Graphtec Studio, Autodesk Inventor, Retina Engrave, Makerbot Print, Laptop or desktop computers, Coreldraw or Inkscape, Easel
2.Why is accurate measurement, precise dimensioning, and thorough documentation necessary for both mechanical dissection and creative problem solving?		L.A.U.N.C.H. Design Thinking by John Spencer resources
3.Why is it important for an engineer to be aware of the criteria and the constraints when designing a project?		Defined Learning/Defined STEM
4.Why are teams of people more successful than an individual when solving problems?		PLTW Design & Modeling curriculum resources
5.Why is brainstorming, research, and testing important when creating, modifying, or improving a design solution?		
6.How are sketches used to document and communicate design ideas with accuracy?		

3D DESIGN & 3D MODELING

STAGE 1: Desired Unit Results
What will students understand as a result of the unit?

STAGE 2: Assessment Evidence
By what criteria will performances of understanding be assessed?
Through what authentic performance tasks will students demonstrate the desired unit results?

ESSENTIAL QUESTION (s)
What thought-provoking questions will foster inquiry, understanding, and transfer of learning?

Success Criteria with Standards
The criteria for evaluating performance on standards is constant.

How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?

CTE standards-based Rubric: Throughout the course, students and teachers use the rubric for communication of success criteria, reflection, goal setting, and feedback.

Why is it important for an engineer to be aware of the criteria and the constraints when designing a project?

In their portfolio/evidence journal, students will reflect on the essential questions through a quick write, constructed response.

Why is brainstorming, research, and testing important when creating, modifying, or improving a design solution?

PRIORITY CAREER & TECHNICAL STANDARDS & Learning Targets

Performance Tasks Options/ Assessment Strategies by Standard
Students may be given options to show their learning in varied ways.

Creativity, Critical Thinking, Communication and Collaboration

4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.

a: I develop effective resolutions for a given problem, decision or opportunity using available information.

4C2.a.5.m: I can analyze symptoms to identify the root cause of a problem.

4C2.a.6.m: I can develop multiple resolutions for a given problem, decision or opportunity.

4C2.a.7.m: I can identify problems that became worse due to poorly thought out or poorly informed solutions

C2.a.8.m: I can explain how implementation of a solution or action may affect one or more corresponding systems.

C2.a.9.m: I can explain how different resolutions may be appropriate under different circumstances.

4C2.a.10.m: I can explain the process for choosing an action or making a decision.

Students will utilize the design process to identify a problem and develop potential solution(s). They will learn how to use 3D modeling software such as Tinkercad, Autodesk Inventor and/or Easel. Students will use the 3D modeling software to design a prototype or prototypes that will then be manufactured on 3D printers or other cnc equipment.

b: I develop and implement a resolution for a new situation using personal knowledge and experience.

4C2.b.3.m: I can analyze problems to determine what past experiences might be related and relevant.

4C2.b.4.m: I can analyze a problem to determine how it relates to existing knowledge.

Career Development

CD4: Students will identify and apply employability skills.

a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable.

CD4.a.3.m: I can demonstrate selfdiscipline, self-worth, positive attitude and integrity.

CD4.a.4.m: I can demonstrate flexibility and willingness to learn new knowledge and skills.

	CD4.a.5.m: I can identify positive workqualities typically desired in each of the career cluster’s pathways.	
c: I identify and exhibit traits for retaining employment.	CD4.c.2.m: I can demonstrate the behavior and etiquette appropriate to interactions with adults. CD4.c.3.m: I can distinguish between appropriate behaviors in a social vs. professional setting.	Students will either work individually or cooperatively in teams to discuss, design and produce viable solutions to a variety of problems. Students will share their struggles and celebrate their successes when presenting their solutions.
d: I develop positive relationships with others.	CD4.d.3.m: I can interact with others in a respectful and non-judgmental manner.	
	CD4.d.4.m: I can use cooperative behavior in helping peers accomplish goals and tasks.	

Information, Media, Technology
IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.

a: I choose appropriate sources of data and information for a given purpose.	IMT1.a.5.m: I can use information sources to support an argument, idea or initiative.	As part of the design process, students will research existing solutions and identify potential modifications that could improve designs. Students will use this information to help guide them to their final solutions.
d: I apply data and information to communicate ideas and create new opportunities.	IMT1.d.4.m: I can incorporate information from multiple sources to communicate a new idea or support an argument.	

PRIORITY CONTENT STANDARDS & Learning Targets **Performance Tasks Options/ Assessment Strategies by Standard**
 Students may be given options to show their learning in varied ways.

Standard: BB1: Students will analyze the core concepts of technology.	I can describe how resources are the things needed to complete a task (e.g., tools, machines, materials, information, energy, people, capital and time).	Students will utilize the design process to identify a problem and develop potential solution(s). They will learn how to use 3D modeling software such as Tinkercad, Autodesk Inventor and Easel. Students will use the 3D modeling software to design a prototype or prototypes that will then be manufactured on 3D printers or other cnc equipment.
Standard: ENG1: Students will analyze and demonstrate the attributes of design.	I understand requirements for a design are made up of criteria and constraints.	
Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	I can demonstrate how invention and experimentation can solve problems.	
Standard: ICT1: Students will analyze, select and use information and communication technologies.	I can demonstrate how the use of symbols, measurements and drawings promotes clear communication by providing a common language to express ideas.	
Standard: MNF1: Students will be able to select and use manufacturing technologies.	I can use tools, materials and machines safely. I can comprehend and engage in communication methods to convey ideas, concepts and requirements to other individuals and teams.	

Students will be able to discuss what their designs represent and how they created their prototypes.

Stage 3: Learning Activities
 A brief summary of the key learning activities- How will students build knowledge & develop skills? How will learning be relevant, accessible, and engaging? How will the learning unfold in a natural flow?

GUIDING UNIT QUESTIONS Using Costas Level of Thinking, what questions will hook and hold students so that they develop a deep understanding of the desired results? The guiding questions are more topic-specific to the particular unit. They guide the exploration of the essential questions and rigor of the standards. This may include questions that guide project based/ problem based learning	STRATEGIES/ACTIVITIES What learning strategies and experiences will authentically engage students so that they gain understanding the desired results? This includes strategies and activities that help learners acquire targeted knowledge and skills, make meaning of important ideas, and transfer their learning to new situations. Consider how the learning will be tailored and flexible to address the interests and learning styles of all students.	RESOURCES/MATERIALS This includes an applicable textbooks, software, industry recognized certification software/tools, subscriptions (such asPLTW), etc.
1.How is a design process used to effectively develop a design solution that solves a problem or addresses a design opportunity?	explicit instruction in L.A.U.N.C.H. cycle (design thinking)	Graphtec Studio, Autodesk Inventor, Retina Engrave, Makerbot Print, Laptop or desktop computers, Coreldraw or Inkscape, Easel
2.Why is accurate measurement, precise dimensioning, and thorough documentation necessary for both mechanical dissection and creative problem solving?		L.A.U.N.C.H. Design Thinking by John Spencer resources
3.Why is it important for an engineer to be aware of the criteria and the constraints when designing a project?		Defined Learning/Defined STEM
4.Why are teams of people more successful than an individual when solving problems?		PLTW Design & Modeling curriculum resources
5.Why is brainstorming, research, and testing important when creating, modifying, or improving a design solution?		
6.How are sketches used to document and communicate design ideas with accuracy?		

Priority Standards	Unit 1	Unit 2	Unit 3
<p>Creativity, Critical Thinking, Communication and Collaboration 4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills. a: I develop effective resolutions for a given problem, decision or opportunity using available information. b: I develop and implement a resolution for a new situation using personal knowledge and experience.</p>	X	X	X
<p>Career Development CD4: Students will identify and apply employability skills. a: I identify and demonstrate positive work behaviors and personal qualities needed to be employable. b: I demonstrate skills related to seeking and applying for employment to find and obtain a desired job. c: I identify and exhibit traits for retaining employment. d: I develop positive relationships with others.</p>	X	X	X
<p>Information, Media, Technology IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives. a: I choose appropriate sources of data and information for a given purpose. b: I determine the relevance, validity and timeliness of data and information. c: I select relevant information necessary for making decisions and solving problems d: I apply data and information to communicate ideas and create new opportunities.</p>	X	X	X
<p>Standard: BB1: Students will analyze the core concepts of technology.</p>	X	X	X
<p>Standard: ENG1: Students will analyze and demonstrate the attributes of design.</p>	X	X	X
<p>Standard: ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.</p>	X		X

Standard: ICT1: Students will analyze, select and use information and communication technologies.	X		X
Standard: MNF1: Students will be able to select and use manufacturing technologies.	X	X	X