

Unit 3: Technology in Manufacturing (3 weeks)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

UNIT RATIONALE

Teaching students about technology leads them to become more knowledgeable citizens and consumers. Learning about the evolution of manufacturing and product packaging design is vital for students to understand how these technologies have impacted everyday life.

ESSENTIAL QUESTIONS

What is manufacturing?

What roles do digital modeling and 3D printing play in modern manufacturing?

What are the purposes of packaging?

What are the types of packaging?

STANDARDS

NEW JERSEY STUDENT LEARNING STANDARDS: 21st CENTURY

CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new

technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

NEW JERSEY STUDENT LEARNING STANDARDS: CONTENT AREA

New Jersey (NJSL) - Grades 6-8 - Computer Science and Design Thinking (2020)

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.2:

Identify the steps in the design process that could be used to solve a problem.

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.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).

8.2.8.ITH.1:

Explain how the development and use of technology influences economic, political, social, and cultural issues.

8.2.8.ITH.2:

Compare how technologies have influenced society over time.

CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.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).
CS.6-8.8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
CS.6-8.8.2.8.ITH.2	Compare how technologies have influenced society over time.

NEW JERSEY STUDENT LEARNING STANDARDS: CAREER READINESS, LIFE LITERACIES AND KEY SKILLS

PFL.9.1.8.EG.5	Interpret how changing economic and societal needs influence employment trends and future education.
WRK.9.2.8.CAP.10	Evaluate how careers have evolved regionally, nationally, and globally.
TECH.9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.

NEW JERSEY STUDENT LEARNING STANDARDS: COMPUTER SCIENCE AND DESIGN THINKING

CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.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).
CS.6-8.8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
CS.6-8.8.2.8.ITH.2	Compare how technologies have influenced society over time.

PRE-ASSESSMENTS

What is Manufacturing? discussion

INSTRUCTIONAL PLAN

MODULE 1

Activity 1 - What is Manufacturing?

Student Learning Intentions (SLI) WALT: (We are learning to...)	I am learning about manufacturing so that I can describe how it has evolved through history.
Student Learning Strategies	Class discussion Review questions Writing prompts Peer learning Cooperative learning Visual models
Success Criteria	I can describe how manufacturing has evolved from small production, custom items to mass produced, interchangeable ones.

Formative Assessment (drives instructional decisions)

Feedback and participation during discussions

Questions related to video

Activities and Resources

1. Initiate the discussion: What is manufacturing? How were things made before manufacturing developed? How does manufacturing relate to our concepts of technology and engineering?

2. Define **manufacturing**: the process of converting a raw material into a finished product

3. Introduce students to the history of manufacturing with a [video](#). Students answer questions to highlight important factors:

- How were products created before mass production manufacturing?
- What invention(s) helped to create the industrial revolution? Mills, cotton gin, power loom, steam engines
- What concept made assembly lines possible? Breaking down manufacturing into steps, interchangeable parts
- Assembly lines allowed for new jobs doing what type of labor? Unskilled labor

4. Define important concepts from the video:

- **Assembly line - a manufacturing process for the mass production of a product that involves adding interchangeable parts in sequence**
- **Assembling - combining many components into one product**
- **Interchangeable parts - parts designed with precise tolerances (total permissible variances in size) to**

	<p>allow them to be easily exchanged</p> <p>5. Introduce types of materials processing (raw, recycled, standard industry materials), and have students classify different materials.</p> <p>6. Relate materials forming processes to the structural forces we covered in the previous unit - compressing/stretching/bending; pressing/punching; forging; extruding; drawing; casting.</p> <p>7. Pose the question: How are materials processed in the modern age? Engage students in discussion that points towards computer-integrated manufacturing (CIM), Just-in-time manufacturing (with discussion of storage and inventories), and CAD/CAM.</p>
Suggested Modifications	

MODULE 2

Activity 2 - 3D Printing and Manufacturing

Student Learning Intentions (SLI) WALT: (We are learning to...)	I am learning about 3D printing so that I can understand how it is used in manufacturing today.
Student Learning Strategies	<ul style="list-style-type: none"> Class discussion Review questions Writing prompts Self-reflection Peer learning Cooperative learning Think-pair-share Visual models
Success Criteria	I can describe how 3D printing can be used to increase manufacturing productivity.
Formative Assessment (drives instructional decisions)	<p>Feedback and participation during discussions</p> <p>Questions related to video</p>

<p>Activities and Resources</p>	<ol style="list-style-type: none"> 1. Review concepts from previous lesson - manufacturing assembly lines, CIM, just-in-time, materials processing. 2. Introduce 3D printing as a manufacturing process and have students classify its type and how it processes materials. 3. Show video on 3D printing - ask students to follow along and prompt to pick out concepts they didn't know or that are interesting to them. Initiate discussion around this info. 4. Overview the 3D printing processes, including alternate methods - SLA/DLP/SLS etc. 5. Students use their notes and understanding of 3D printing concepts to think-pair-share. Students should be instructed to brainstorm 3 ways 3D printing and traditional manufacturing are similar and 3 ways they are the different. After initial brainstorming, students share their answers with a neighbor and write down new ideas. After sharing with a neighbor, students discuss as a class. Highlight important concepts - additive vs subtractive; mass production vs small-scale; ability to customize vs retooling.
<p>Suggested Modifications</p>	

MODULE 3

Activity 3 - Introduction to 3D Modeling

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning to use TinkerCAD so that I can create digital 3D models.</p>
<p>Student Learning Strategies</p>	<p>Review questions Demonstration Software tutorials Visual and written instructions</p>
<p>Success Criteria</p>	<p>I can use all the basic tools of TinkerCAD appropriately to create a digital 3D model.</p>

Formative Assessment (drives instructional decisions)	<p>Feedback and participation during discussions</p> <p>Successful completion of TinkerCAD intro lessons</p>
Activities and Resources	<ol style="list-style-type: none"> 1. Prompt/discuss with students: What do we need in order to create a 3D print? (printer, material, 3D model) How do we get a 3D model? (find one, make one) 2. Introduce and have students get logged in to TinkerCAD to create 3D models. 3. Walk students through how to use TinkerCAD with the simple lessons available.
Suggested Modifications	

MODULE 4

Activity 4 - 3D Modeling Project

Student Learning Intentions (SLI) WALT: (We are learning to...)	<p>I am learning to use TinkerCAD so that I can create digital 3D models.</p> <p>I am learning to apply the engineering design process so that I can create like an engineer.</p>
Student Learning Strategies	<p>Writing prompts</p> <p>Self-reflection</p> <p>Demonstration</p> <p>Hands-on practice</p> <p>Iteration</p>
Success Criteria	<p>I can use all the basic tools of TinkerCAD appropriately to create a digital 3D model.</p> <p>I can use the engineering design process as a template to guide my progress through a design project.</p>
Formative Assessment (drives instructional decisions)	<p>Direct feedback during project work</p> <p>Completion of design project</p>
Activities and Resources	<ol style="list-style-type: none"> 1. Reinforce with students the core concepts of designing with TinkerCAD: solid and hole shapes;

	<p>grouping; precise measurements.</p> <p>2. Introduce students to original design project: use the Engineering Design Process to Create a Toy in TinkerCAD. Students will Ask, Imagine, Plan, Create, Improve, and Communicate to design a toy that will be 3D printed.</p> <p>3. A day or two after students get started, introduce how 3D printing works, from model to slicer to gcode to printer. Review with students the importance of viewing the <i>entire</i> model to check for disconnected pieces, overhangs, etc. that could cause later print problems. As students complete their designs, they will be 3D printing them.</p>
Suggested Modifications	

MODULE 5

Activity 5 - What are the Purposes of Packaging?

Student Learning Intentions (SLI) WALT: (We are learning to...)	I am learning about purposes and types of packaging that I can understand what information designers use to create it.
Student Learning Strategies	<ul style="list-style-type: none"> Class discussion Review questions Writing prompts Self-reflection Peer learning Cooperative learning Visual models Think-Pair-Share
Success Criteria	I can describe the four purposes (protection, convenience, image, and sustainability) and three types (primary, secondary, and tertiary) of packaging, and how each is used.
Formative Assessment (drives instructional)	Feedback and participation during discussions and

decisions)

classwork activities

Activities and Resources

1. Engage students in a discussion: In manufacturing, what can we do after we have developed a product? (possible answers - improve, market it, sell, **package**, ship)

2. Focus on packaging - Have students fold a piece of looseleaf paper into quarters and label it "The Purpose of Packaging." Explain to students, "packaging design is a career. Designers have to think about many purposes of packaging. What do you think the purposes might be?" This will be a Think-Pair-Share.

3. As students share examples, put them in the boxes based on unlabeled qualifications

(**protection**, **convenience**, **image**, and **sustainability** will be labeled later). Possible suggestions: (**protection**) holds pre-measured amounts, ship without breaking, keep food fresh/from spoiling, keep from leaking, keep drinks carbonated, health warnings, keep at a certain temperature from being stolen, keep all pieces in one place; (**convenience**) easier to store stuff, easier to stack, cook in, to re-seal and use later, easy to carry, not frustrating to open, keep smaller items together, barkeep keep product at a certain temp, see or touch item before you buy; (**image**) look good on a shelf, persuade you to buy it, informs you, list ingredients, advertise a brand, instructions on use, learn about company or product, health warnings, nutrition, pictures of product in use, characters/mascots; (**sustainability**) if you can recycle it's made of recycled "stuff", reusable, reduce trash/

4. Discuss with students the similarities in the column purposes, and use questions that lead them to identify the four purposes - **Protection, convenience, image, sustainability.**

Students should record the following summaries/definitions:

Protection: for the product - transportation without spillage or breaking; for the consumer - reduces worry and increases safety

Convenience: ease of use and decision making; saves time and improves quality of life

Image: shelf-appeal, brand awareness, and product/company/consumer values

Sustainability: reduction of environmental impact; consumers can make a difference

	<p>5. Show students a typical commercially-available wine bottle. Ask students to identify the packaging. After discussion, reveal the three types of packaging:</p> <p>Primary Packaging: packaging that touches the product</p> <p>Secondary Packaging: packaging on the product that does not touch the product itself</p> <p>Tertiary Packaging: packaging that holds together multiple items</p> <p>6. Have students consider one of their favorite products and write down and/or find pictures of the primary, secondary, and tertiary packaging for that product. Once they have these, they should then identify aspects of packaging that display each of the four purposes of packaging. When students have finished their research/brainstorming, they will share their answers with the class.</p> <p>(https://kenanfellows.org/kfp-cp-sites/cp17/cp17/packaging-lesson-2-what-purpose-packaging/index.html)</p> <p>7. For homework, ask that students bring in (clean) examples of packaging, so we can classify and explain them in the next lesson.</p>
<p>Suggested Modifications</p>	

Activity 5 - Simple Purposeful Packaging

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about purposes and types of packaging that I can understand what information designers use to create it.</p>
<p>Student Learning Strategies</p>	<p>Class discussion Review questions Writing prompts Self-reflection Peer learning Cooperative learning Demonstration Visual models</p>
<p>Success Criteria</p>	<p>I can describe the four purposes (protection, convey information, sustainability, and convenience) and three types (primary, secondary, and tertiary) of packaging, and how each is used.</p>

Formative Assessment (drives instructional decisions)	Feedback and participation during discussions and classwork activities
Activities and Resources	<p>1. Introduce the next exploration - identifying the type and purpose of packaging, using the previous lesson's information. Students will trade the item brought in from home with another student and then have a few minutes to identify the type and purpose(s) of it in their notes. When complete, students share their answers and get feedback if needed.</p> <p>2. Students trade back their items to then begin their exploration about how materials were used and how they might have been processed into the shapes they are currently using. If feasible, students should be encouraged to carefully disassemble their packaging to discover how it might have been manufactured. Students will complete this activity as a think-pair-share.</p> <p>3. The focus of our exploration of packaging will be paper/cardboard boxes. With several packages disassembled, demonstrate to students how a single sheet is marked, cut, creased, folded, and glued to form a complete container. Spread out and trace or draw the layout on the board to highlight this, and hand out pre-cut worksheets for students to add designs, cut out, and glue up into small tuckboxes.</p>
Suggested Modifications	

MODULE 6

Activity 6 - Packing for Manufacturing Final Project

Student Learning Intentions (SLI) WALT: (We are learning to...)	<p>I am learning about purposes and types of packaging so that I can understand what information designers use to create it.</p> <p>I am learning to apply the engineering design process so that I can create like an engineer.</p>
Student Learning Strategies	<p>Self-reflection Demonstration Hands-on practice</p>

	Iteration
Success Criteria	<p>I can describe the four purposes (protection, convenience, image, and sustainability) and three types (primary, secondary, and tertiary) of packaging, and how each is used.</p> <p>I can use the engineering design process as a template to guide my progress through a design project.</p>
Formative Assessment (drives instructional decisions)	<p>Direct feedback during project work</p> <p>Completion of design project</p>
Activities and Resources	<ol style="list-style-type: none"> 1. Reinforce with students the core concepts of packaging design: it protects; adds convenience; creates an attractive image; and can exemplify sustainability. 2. Introduce students to the final design project: using the Engineering Design Process to Create a Package for the toy they designed earlier in the unit. Students will Ask, Imagine, Plan, Create, Improve, and Communicate to plan and construct an attractive package for their own 3D-designed toy, that serves each of the purposes of packaging (Protection, convenience, image, and sustainability). 3. Remind students that their package design will have to hold their toy, so they will need to measure it to ensure the package will be large enough to adequately hold it. Show students how the measurements will be used to define the dimensions of the package they are creating, and hand out worksheets that can be used to assist in package creation. 4. As students complete their designs, they should cut, fold, and paste them together to test that they work as intended. 5. When projects are complete, have a gallery walk to show off!

SUGGESTED MODIFICATIONS

Suggested Modifications (ELL, Sp. Ed, Gifted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student

may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, and when the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

REFLECTIONS

INTERDISCIPLINARY CONNECTIONS: NEW JERSEY STUDENT LEARNING STANDARDS FOR ELA, SOCIAL STUDIES, SCIENCE AND/OR MATHEMATICS

LA.RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
LA.RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
LA.RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

LA.RST.6-8.10

By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

LA.WHST.6-8.2.D

Use precise language and domain-specific vocabulary to inform about or explain the topic.