



GEORGIA

PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

COURSE: Foundations of Engineering and Technology

UNIT: 9: Manufacturing Systems



INTRODUCTION

Annotation:

In this unit students will learn about the different types of manufacturing systems, the production process, tools and resources used in manufacturing, and proper production safety precautions. Students will also learn what branding and packaging considerations go into the manufacturing process.

Grade(s):

X	9 th
X	10 th
X	11 th
X	12 th

Time:

15 days

Author:

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Additional Author(s):

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.



FOCUS STANDARDS

GPS Focus Standards: Please list the standard and elements covered.

ENGR-FET-1d – Participate in hands-on activities related to multiple engineering and technology pathways.

ENGR-FET-2 – Students will describe the history of technological advancement.

ENGR-FET-3a – Describe the processes of input, processing, output, and feedback that comprise the universal systems model.

ENGR-FET-3b – Demonstrate applications of the universal systems model across the spectrum of technologies.

ENGR-FET-4 – Students will apply mathematics and science to the solution of a technological problem.

ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

ENGR-STEM-5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

ENGR-STEM-6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

ENGR-STEM-7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

CTAE-FS-1 – Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-6 – Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-8 – Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 – Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-11 – Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

GPS Academic Standards:

SSUSH11 The student will describe the growth of big business and technological innovations after Reconstruction.

SSUSH21 The student will explain economic growth and its impact on the United States 1945-1970.

SSUSH24 The student will analyze the impact of social change movements and organizations of the 1960's.

SSWH21 The student will analyze globalization in the contemporary world.

SCSh8. Students will understand important features of the process of scientific inquiry.

MM3P1. Students will solve problems (using appropriate technology).

SCSh3. Students will identify and investigate problems scientifically.

SCSh6. Students will communicate scientific investigations and information clearly.

MM3P3. Students will communicate mathematically.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

SCSh7. Students analyze how scientific knowledge is developed.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

MM3P1. Students will solve problems (using appropriate technology).

MM3P2. Students will reason and evaluate mathematical arguments.

MM3P4. Students will make connections among mathematical ideas and to other disciplines.

ELAALRC2 The student participates in discussions related to curricular learning in all subject areas.

ELAALRC3 The student acquires new vocabulary in each content area and uses it correctly.

ELAALRC4 The student establishes a context for information acquired by reading across subject areas.

MM3P3. Students will communicate mathematically.

MM3P5. Students will represent mathematics in multiple ways.

SCSh6. Students will communicate scientific investigations and information clearly.

National / Local Standards / Industry / ISTE:



UNDERSTANDINGS & GOALS

Enduring Understandings: Enduring understandings are statements summarizing important ideas and have lasting value beyond the classroom. They synthesize what students should understand – not just know.

Students will understand the steps involved in transforming an idea, plan, or drawing into a tangible product that is available to consumers.

Essential Questions: Essential questions probe for deeper meaning and understanding while fostering the development of critical thinking and problem-solving skills. Example: Why is life-long learning important in the modern workplace?

1. What are some important developments in the history of manufacturing?
2. What are the different types of production?
3. What materials, tools, and equipment are used in manufacturing?
4. What safety precautions should be taken during manufacturing?
5. How are branding and packaging used in the manufacturing process?

Knowledge from this Unit: Factual information.

1. Students will know the history of manufacturing.
2. Students will know the steps involved in producing a product.
3. Students will recall safety measures.

Skills from this Unit: Performance.

1. Students will identify the appropriate steps in development of a product.
2. Students will apply safety measures in the laboratory.
3. Students will discuss Logo and branding in production.



ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

- ☐ Pre-test
- ☒ Objective assessment - multiple-choice, true- false, etc.
 - ☒ Quizzes/Tests
 - ☐ Unit test
- ☒ Group project
- ☒ Individual project
- ☐ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
 - ☐ Self-check rubrics
 - ☐ Self-check during writing/planning process
 - ☐ Journal reflections on concepts, personal experiences and impact on one's life
 - ☐ Reflect on evaluations of work from teachers, business partners, and competition judges
 - ☐ Academic prompts
 - ☐ Practice quizzes/tests
- ☐ Subjective assessment/Informal observations
 - ☐ Essay tests
 - ☐ Observe students working with partners
 - ☐ Observe students role playing
- ☐ Peer-assessment
 - ☐ Peer editing & commentary of products/projects/presentations using rubrics
 - ☐ Peer editing and/or critiquing
- ☒ Dialogue and Discussion
 - ☐ Student/teacher conferences
 - ☐ Partner and small group discussions
 - ☒ Whole group discussions
 - ☐ Interaction with/feedback from community members/speakers and business partners
- ☒ Constructed Responses
 - ☒ Chart good reading/writing/listening/speaking habits
 - ☒ Application of skills to real-life situations/scenarios
- ☒ Post-test

Assessment(s) Title:

Safety Test

Assessment(s) Description/Directions:

Students must pass a safety test in order to operate tools and equipment. The test and answer key are provided for use with this lesson.

Attachments for Assessment(s): Please list.

Safety Test
Safety Test Answer Key



LEARNING EXPERIENCES

Instructional planning: Include lessons, activities and other learning experiences in this section with a brief description of the activities to ensure student acquisition of the knowledge and skills addressed in the standards. Complete the sequence of instruction for each lesson/task in the unit.

Sequence of Instruction

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

ENGR-FET-1d – Participate in hands-on activities related to multiple engineering and technology pathways.

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CTAE-FS-11 – Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

2. Review Essential Questions.

1. What are some important developments in the history of manufacturing?
2. What are the different types of production?
3. What materials, tools, and equipment are used in manufacturing?
4. What safety precautions should be taken during manufacturing?
5. How are branding and packaging used in the manufacturing process?

3. Identify and review the unit vocabulary.

Trademark
Trade name
Brand name
Tag line
Copy
Layout
Packaging
Biodegradable
Recyclable
Manufacturing
Barter system
Mercantile system

4. Assessment Activity.

Day 1 – Introduction to Manufacturing

1. Distribute Zip-lock bag with complete car kit and pie plate to each student. (REMOVE INSTRUCTIONS)
2. Instruct students to make a vehicle from Lego kit individually – (2 time trials) Everyone starts on “GO” – Teacher calls out time to students who raise their hand when finished. Student records time on hand-out sheet (Time-Motion Study Sheet)
3. Teacher leads discussion on Custom Production, i.e.: compare the vehicles to each other (should have differences). Ask: “do we have identical cars?” and ask students to name a car that is manufactured using Custom Production (examples: Batmobile, Night Rider’s “KIT”, Nascars, Concept Cars)
4. Students return all parts and plate to Zip-Lock bag in preparation for next activity.
5. Instruct students to make the Lego vehicle from the provided plans individually – (2 time trials) Everyone starts on “GO” – Teacher calls out time to students who raise their hand when finished. Student records time on Intermittent section of hand-out sheet (Time-Motion Study Sheet)
6. Teacher leads discussion on Intermittent (Flexible / Job Lot) Production using individual product assembly. These companies manufacture a limited amount of a product then either stop until more are needed or make an entirely different product. Compare the vehicles to each other (should be identical) Ask: “do we have identical cars?” This is the way they built the first Oldsmobile. It’s the method of assembling modern exotic cars like Lamborghini. Separate teams build one car from the ground up then start another in the same spot. Greeting card manufacturers work this way. Ask students to tell you the positive and negatives of this.
7. Have students replace all of the parts and plate to the Zip-lock bag and collect them. (A check-out/check-in sheet is recommended)

Day 2 – History of Production

1. Go over History of Manufacturing PowerPoint with questions using the SRS system for submitting answers. You will need to use the Video “Manufacturing Engineering WGA.” The presentation will tell you to play the video and at the beginning of each video you should see colored bars. Videos are only a couple of minutes each

Day 3 – Mass Production

1. Before students arrive place two straight rows (for two teams) of pie plates with the second set of bags that have the separate parts for the car on each.
2. Divide class in two teams and send them to the two “production lines”. Tell each team to place a member on each side of the plates in such a way that they can pass their piece(s) of the vehicle

to the next person and so-on through the assembly line. Completed cars must be “parked” for shipping in rows of four at the end of the assembly line.

3. Instruct students to make 28 identical vehicles from Lego kit as a line production company would – (1st time trial) Everyone starts on “GO” – Teacher calls out time to the last team member in each group’s assembly line who raise their hand when they have 28 cars finished and are properly “parked”. Students record time on hand-out sheet (Time-Motion Study Sheet)
4. Have the class take their total production times and divide by 28 for the time per car. Students record time on hand-out sheet (Time-Motion Study Sheet)
5. Have students replace all of the parts on the plate it came from in preparation for phase 2 of the activity (reverse the assembly line to disassemble the cars.) While students are disassembling the cars ask the students to think of ways to speed up production. Allow the repositioning of plates, parts and people to make production more efficient.
6. Return the two teams to the two “production lines”. Repeat assembly line process with the objective being to cut production time. Everyone starts on “GO” – Teacher calls out time to the last team member in each group’s assembly line who raise their hand when they have 28 cars finished and are properly “parked”. Students record time on hand-out sheet (Time-Motion Study Sheet)
7. Teacher leads discussion on Line Production, i.e.: compare the vehicles to each other (should be identical) “Do we have 28 identical cars?” Ask students to tell you the positive and negatives of this type of production. What thought processes went into improving the production time? Make sure that these points are brought out: How important are social skills?
Some potential positives: More identical products manufactured in virtually the same time frame as a single custom produced individual product; consistent quality; predictable output; skill specialization means lower labor costs.
Some potential negatives: Boring repetitive tasks; loss of concentration lead to accidents or mistakes/defects; difficult to change to another product.
8. Go over Types of Production PowerPoint and lead a discussion that compares and contrasts the types of production, as well as the pros and cons of each
9. SRS quiz on the different types of production

Day 4 – Production Planning

1. The teacher will use the attached SRS lesson and PowerPoint on production planning to explain the basics. This has an SRS test.
2. Plans/Technical Drawings
3. Materials/Parts List
4. Flow Chart
 - a. Symbols
 - b. Layout of charts
5. Activity – After a quick tutorial, students move to workstations to create a flow chart using software Flowchart Maker for the 2nd assembly line that they engineered on day 3. Students should use the accompanying Production Flow Chart Worksheet to complete the assignment.

Day 5 – Resources of Production

1. Go over Resources of Production PowerPoint with students. This will cover people, time, materials, tools/equipment, etc.
2. Play video with system model found in PowerPoint
3. SRS quiz
4. Activity – Students are sent to workstations with the assigned task of locating sources to buy materials for the production of the Clipboard. Students must secure at least three sources for each necessary part or material used to manufacture the product. They must also give price quotes and shipping costs if applicable. Information is recorded on the attached Materials Resource Worksheet. Make note of better places to buy the actual components if they locate such places.

Day 6 – Safety

1. Go over Safety PowerPoint with embedded SRS quizzes with students
2. Provide Students with the Technology Education Safety Checklist
3. Handout the Safety Rules Contract for students to read and sign

Day 7 – Safety Test and Productions Tools

1. After a brief review, students will take the Safety Test. Those that do not make a passing score must re-take the test. (It is up to the teacher whether they re-take it then, the next day in the morning, the next class, or after school). Passing the test is a requirement for students to handle tools. If a student fails to make a 100 they must watch instead of operating tools and equipment.
2. Go over the Production Tools PowerPoint and SRS Questions\
3. Assign the 5 production equipment worksheets (Corner Rounder, Drill Press, Electric Miter Saw, Jointer, Table Saw) for practice or a graded assignment
4. Poll students on what pieces of equipment they are comfortable using Production Tool Polls 1 and 2

Day 8 – Logo and Branding

1. Go over the Logo and Branding PowerPoint
2. Explain the 2 rotations that students will begin on Day 9 and the products that will be created at each station.
3. Divide students into 2 groups, 1 for each rotation, before the next class. If enough resources are available, students can be divided into a larger number of groups, with half of the groups doing the Branding rotation and half doing the Packaging rotation. After 3 days, groups rotate to their second activity.

Day 9-14 – Rotations (3 days per rotation)

1. Branding/Logo (marketing). Students must:
 - a. Create a distinctive logo
 - b. Develop a company Tag Line
 - c. Create a Billboard AdvertisementSee Branding Rotation Rubric for more in-depth directions and grading criteria
2. Packaging (include branding). Students must:
 - a. Package has been designed to protect the product from being damaged if dropped or crushed.
 - b. Package has an attractive exterior design including company name, logo, tagline and bar code.
 - c. Package is designed where the consumer can easily determine what is contained within the package
 - d. Package has a shape other than a common box
 - e. Package is designed to reduce waste or environmental hazards
 - f. At least four paper boxes each with a different material in it: Ziplock bags, construction paper, poster board, card stock, printed bar code (fake), grocery sacks, etc.See Packaging Rotation Rubric for more in-depth directions and grading criteria

Day 15 – Follow-up

1. Students should apply their decals to clipboards
2. (Optional) Teacher may hand out Rotation Survey Form for feedback

Attachments for Learning Experiences: Please list.

PowerPoints:

- History of Manufacturing
- Types of Production
- Production Planning
- Resources of Production
- Safety
- Production Tools
- Logo and Branding

Worksheets:

- Time-Motion Study Sheet
- Production Flow Chart Worksheet
- Materials Resources Worksheet
- Safety Rules Contract
- Technology Education Safety Checklist
- Production Equipment Worksheets (2 versions of each – one for teacher and one for student)
 - Corner Rounder
 - Drill Press
 - Electric Miter Saw
 - Jointer
 - Table Saw
- Production Tool Poll 1
- Production Tool Poll 2

Rotation Survey Form

Notes & Reflections: May include notes to the teacher, pre-requisite knowledge & skills, suggestions, etc.



CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Branding Challenge
Packaging Challenge

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Branding Rubric Highlights:

Logo Design	40 points
Product/Company Tag Line	30 points
Billboard Advertising Design	30 points

Packaging Rubric Highlights:

Protect product	20 points
Attractive exterior	20 points
Contained in package	20 points
Shape of package	20 points
Reduce waste/environmental hazards	20 points

Attachments for Culminating Performance Task: Please list.

Branding Rotation Rubric
Packaging Rotation Rubric



UNIT RESOURCES

Web Resources:

- How Things Work: <http://manufacturing.stanford.edu/>
- Manufacturing is Cool: <http://manufacturingiscool.com>
- Discover Engineering: <http://www.discoverengineering.org/>
- ASEE Engineering 12 Center: <http://www.engineeringk12.org/>
- Student Engineering Resources (scroll down for manufacturing): <http://www.engineerinyou.com/students.html>
- 'Adventures in Manufacturing' video (Order # PI-VT484E-4000): service@sme.org
- Power of Manufacturing Instructional Posters (Order #PI-2315E-4000): service@sme.org
1st set is free, additional sets are \$10.95

Attachment(s): Supplemental files not listed in assessment, learning experiences, and performance task.

Catt Manufacturing Materials

Materials & Equipment:

Powerpoint display, internet access, various drafting instruments, various materials for packaging exercise.

What 21st Century Technology was used in this unit:

<input checked="" type="checkbox"/>	Slide Show Software	<input checked="" type="checkbox"/>	Graphing Software	<input type="checkbox"/>	Audio File(s)
<input type="checkbox"/>	Interactive Whiteboard	<input type="checkbox"/>	Calculator	<input checked="" type="checkbox"/>	Graphic Organizer
<input type="checkbox"/>	Student Response System	<input type="checkbox"/>	Desktop Publishing	<input checked="" type="checkbox"/>	Image File(s)
<input type="checkbox"/>	Web Design Software	<input type="checkbox"/>	Blog	<input type="checkbox"/>	Video
<input type="checkbox"/>	Animation Software	<input type="checkbox"/>	Wiki	<input type="checkbox"/>	Electronic Game or Puzzle Maker
<input type="checkbox"/>	Email	<input checked="" type="checkbox"/>	Website		