GEORGIA MIDDLE SCHOOL Instructional Resources

CAREER, TECHNICAL, & AGRICULTURAL EDUCATION

ENGINEERING & TECHNOLOGY

COURSE: Exploring Engineering and Technology

UNIT 1: The Assembly Line Challenge

INTRODUCTION

Annotation:

This unit will provide students with an introduction to manufacturing including processes associated with assembly line production. Students will also use mathematics to help with setting up different processes in an assembly line.

Grade(s):

X	6th
	7th
	8th

Time:

7.5 Class Hours Total

Author:

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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 appropriately. 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. Many students (both with and without disabilities) who struggle with reading may benefit from the use of text reading software or other technological aids to provide access to printed materials. Many of these are available at little or no cost on the internet.

FOCUS STANDARDS

GPS Focus Standards:

ENGR-EET-5- Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.

c) Examine Manufacturing

GPS Academic Standards:

M6A2- Students will consider relationships between varying quantities.

M6D1- Students will pose questions, collect data, represent and analyze the data, and interpret results.

UNDERSTANDING & GOALS

Enduring Understandings:

Students will understand the basic processes used to manufacture products, the power and efficiency of assembly lines, and will realize the importance of the manufacturing industry on our economy and future careers.

Essential Questions:

- What is manufacturing?
- What are the basic processes used in manufacturing products?
- How are assembly lines used in the manufacturing of products?
- How is mathematics used to monitor manufacturing?

Knowledge from this Unit:

- Students will be able to define manufacturing.
- Students will explain the basic processes of separating, forming, combining, and conditioning in manufacturing.
- Students will explain how assembly lines are organized utilizing the push and pull methods.
- Students will use mathematical skills to calculate assembly line quality and speed.
- List the basic processes used in manufacturing.
- List the steps in the manufacturing process.

Skills from this Unit:

Students will…

- Analyze the impact of manufacturing on our economy and careers.
- Organize and operate an efficient assembly line.
- Evaluate assembly line effectiveness using basic mathematical skills.

ASSESSMENTS

Assessment Method Type:

____ Pre-test
X Objective assessment - multiple-choice, true- false, etc.
X Quizzes/Tests
__ Unit test
X 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
X Subjective assessment/Informal observations
__ Essay tests
X Observe students working with partners
X Observe students role playing
____ Peer-assessment
__ Peer editing and commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
X Dialogue and Discussion
__ Student/teacher conferences
X Partner and small group discussions
X 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
X Post-test

Assessment(s) Title:

The Assembly Line Challenge

Assessment(s) Description/Directions:

Use the attached PowerPoints to lead class discussions. Unit is broken down into three areas; Introduction to Manufacturing, Manufacturing Processes, and Assembly Line Procedures.

Attachments for Assessment(s):

LESSON PLANS

• LESSON 1: INTRODUCTION TO MANUFACTURING

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

ENGR-EET-5 - Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.

C) Examine Manufacturing

2. Review Essential Question. Essential Questions should be posted in the classroom for each lesson.

- What is manufacturing?

3. Identify and review unit vocabulary. *Word Wall should be posted in the classroom for unit.*

Manufacturing	Durable Goods
Separating	Non-Durable Goods
Forming	Manufacturing Process
Combining	Push Production
Conditioning	Pull Production

Word introduced in lesson: **Manufacturing**

4. Ask students to list 5 items in the classroom that they believe were made in a factory.
Ask students to list 5 items in the classroom that were not produced in a factory.

Examples of manufactured items might be: pencils, desk, chairs, lights, or books
Students will probably come up with examples, but correct examples of non-manufactured items will be very hard, students might list: the students themselves, the school, or the air we breathe.

5. (Optional) If available, students will watch the video "What's Up in Manufacturing". The video may be purchased from Destination Education using the following website link:
http://shopdei.com/ecommerce/catalog.php?product=1403

6. Students will watch a very short videos explaining what manufacturing is at the following link:
http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=13

7. Have students copy the following definition on their note taking guide:

Manufacturing -- is the constructing of many of the same item at one time, usually using assembly lines and interchangeable parts.

8. Ask students to discuss the importance of manufacturing. During discussion be sure to emphasize: Manufacturing is important in all aspects of our society. This includes the manufacturing of food, fuel, shoes, cars, modular homes, integrated circuit chips, and millions of others products.

9. Review Essential Question and summarize.
   - What is manufacturing?

Optional discussion questions:
   - Why is manufacturing so important?
   - What are some manufacturing plants in our community?

• LESSON 2: MANUFACTURING PROCESSES

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**
   ENGR-EET-5 - Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.
   C) Examine Manufacturing

2. **Review Essential Question. Essential Questions should be posted in the classroom for each lesson.**

   - What are the basic processes used in manufacturing products?

3. **Identify and review the unit vocabulary.** *Word Wall should be posted in the classroom for unit.*

Manufacturing	**Durable Goods**
Separating	**Non-Durable Goods**
Forming	**Manufacturing Process**
Combining	**Push Production**
Conditioning	**Pull Production**

   Words introduced in lesson: **Separating, Forming, Combining, Conditioning, Durable Goods, Non-Durable Goods, Manufacturing Process** (Definitions in text below and in PowerPoint)

4. Students will watch a very short video explaining what manufacturing processes at the following link: http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=14

5. Explain and have students copy the definition of **Separating** on their note taking guide: **Separating** is the process by which part of a material is removed, usually through cutting.
   Explain the various methods of separating:

Cutting	Shaping
Shearing	Turning
Sawing	Chemically
Drilling	Magnetically
Grinding	Filtering

6. Explain and have students copy the definition of **Forming** on their note taking guide: **Forming** is the process of changing the shape of a material without cutting it.
Explain the various methods of forming:

Casting	Extruding
Pressing	Blow Molding
Forging	Vacuum Forming

7. Explain and have students copy the definition of **Combining** on their note taking guide: **Combining** means putting one material together with others.
Explain the various methods of combining:

- Riveting
- Nailing
- Screwing
- Soldering
- Welding
- Gluing
- Electroplating

8. Explain and have students copy the definition of **Conditioning** on their note taking guide: **Conditioning** changes the internal properties of materials.
Explain the various methods of conditioning:

- Magnetizing
- Heat-treating (Hardening, Tempering, and Annealing)
- Mechanical conditioning
- Chemical conditioning.

9. Explain and have students copy the definition of **Durable and Non-Durable Goods** on their note taking guide: **Durable Goods** last a long time. **Non-Durable Goods** are designed to be consumed in a short period of time.

10. Familiarize students with the basic steps in manufacturing a product:

1.) Designing a product
2.) Obtaining and preparing raw materials
3.) Processing the materials mechanically or chemically
4.) Assembling
5.) Testing
6.) Inspecting
7.) Packaging.

11. Review Essential Question and summarize.

Ask students what are the basic processes used in manufacturing products?

Ask each class member to name and explain a manufacturing process.

• LESSON 3: ASSEMBLY LINE PROCEDURES

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**
   ENGR-EET-5 - Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.
   C) Examine Manufacturing

2. **Review Essential Question. Essential Questions should be posted in the classroom for each lesson.**

   - How are assembly lines used in the manufacturing of products?

3. **Identify and review the unit vocabulary.** *Word Wall should be posted in the classroom for unit.*

Manufacturing
Durable Goods

Separating	Non-Durable Goods
Forming	Manufacturing Process
Combining	Push Production
Conditioning	Pull Production

Words introduced in lesson: Push Production, Pull Production (Definitions in text below and in PowerPoint)

4. Students will watch a very short video explaining the History of Manufacturing at the following link: http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=15

5. Explain the assembly line problem.

"You and your team are assembly-line workers in Company XYZ. Your line manager has given you a new product to assemble. You will assemble the product according to the manager's instructions. Then you will brainstorm ways to improve the overall production.

The product is a bolt with three washers and a nut that holds the washers firmly in place. The diagram shows how the product should be assembled and what the finished product looks like."

6. Divide the class into two groups.

Briefly show the students the slide showing the bolt project.

Do not:

* explain that the nut on the bolt should be tight or the order of the washers
* go into detail; just show the picture of the bolt object
* give the teams time to assign duties
* assign a leader

Have the class go to the lab and begin assembling the bolt project as quick as possible. The idea is to allow chaos during the assembly of the bolt project to help explain the necessities of organizing assembly line duties.

(Note: If you have a student that has been in your class before, let him or her be a timer and do not allow them to talk with other students. They may try to quickly organize their team prior to starting the assembly line.)

7. Just prior to starting assembly line, assign the number of bolt items you want produced (between 15 to 20). Time the assembly lines.

Do not explain the rules for assembly until after the first chaotic assembly line:

1.) Any part that falls on the floor is defective and may not be used
2.) The nut must be tight to prevent any noise when shaking the bolt object
3.) The order of the parts on the bolt is small washer, large washer, lock washer, and nut
4.) Each team will provide a list of names and their duties to the instructor
5.) Students may not change jobs or do other people's job after the assembly line begins

8. Review the times and how the process went with the class.

9. This time, assign duties. If you have more than 8 students, make extra students suppliers, and time keepers.

10. Discuss how the assembly line process went.

11. Students will watch a very short video explaining New Trend in Manufacturing at the following link: http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=16

12. Explain and have students copy the definition of Push Production and Pull Production on their note taking guide: Push Production: Each person is to do their individual task, and when it is complete, they are to give the product to the next person. (It is pushed to the next person.)
Pull Production: Each person is only to do their task when there is one product waiting to be assembled. (It is pulled from them.) Also, discuss how "kanban: ordering parts just-in-time" is used in manufacturing (in the video).

13. Reassign duties to students on each team (students are "cross training" ("Cross training: learning other people's jobs to allow reassignment if someone is out". Term used in optional video). If you have more than 8 students, make extra students suppliers, and time keepers. Assign one half of the class to use push production and the other half to use pull production. (Note: Students may bring up the fact that the pull production may be slower, but the goal to show the decrease in wasted materials.)

14. Complete assembly line and then review the assembly line process. Discuss the pros and cons of push and pull production. Discuss how it the assembly line could be used and use the term "kaizen" ("Kaizen: Constant improvement". Term used in video).

15. Now you will begin your Assembly Line Challenge. Review rules on slide.

    Ensure you have the same number of students on each team. Have each team elect a leader. Rules are the same as before. Winning team will be determined by time. A 5 second penalty will be given for each defective part (dropped or laying out not used) and a 25 second penalty for any defective bolt object (rattles or assembled in wrong order). The teams will now have 10 – 15 minutes to form their quality circles ("Quality circles: A group of workers that meet to discuss ways to improve production". Term used in the optional video) and to discuss ways to make their assembly line more efficient. They do not have to assign duties the same as use in the previous assembly lines. Have the team leader assign duties to each student. More than one student may now do the same job, or simpler jobs may be combined as one job. Students will not be allowed to help others with their job or to switch jobs after the competition begins. Have the team leader give the instructor a list of names and duties.

16. Assign a random number of items to be produce (between 10 and 20) and time process.

17. If you have time, you may wish to give teams a second chance to improve their assembly line process.

18. Discuss assembly line process and determine a winning group.

19. Assess student performance/participation using Manufacturing Challenge Rubric.

20. Review Essential Question and summarize.

Ask students "How are assembly lines used in the manufacture of products?"

• LESSON 4: USING MATHEMATICS IN MANUFACTURING (Optional Lesson – could be included as worksheet in lesson 3)

1. Identify the Standards. Standards should be posted in the classroom for each lesson.
   ENGR-EET-5 - Students will analyze the designed world of engineering, electronics, manufacturing, and energy systems.
   C) Examine Manufacturing

M6A2 Students will consider relationships between varying quantities.
M6D1 Students will pose questions, collect data, represent and analyze the data, and interpret results.

2. Review Essential Question. Essential Questions should be posted in the classroom for each lesson.

   - How are assembly lines used in the manufacturing of products?

3. Identify and review the unit vocabulary. You may wish to add these two words to your Word Wall. Word Wall should be posted in the classroom for unit.

   Quality Control Production Rate

   Words introduced in lesson: Quality Control, Production Rate (Definitions in text below and in PowerPoint)

4. Give students a copy of the Push/Pull Production and Efficiency Worksheet.

5. Explain that students will now use their mathematical skills to determine the efficiency of assembly lines by completing the Push/Pull Production and Efficiency Worksheet on quality and production rate. Explain the formulas for quality and production rate (also shown on worksheet) and work an example on the board.

   Quality control can be expressed as a rate that tells what portion of the "bolt objects" that were made passed inspection. Rates can be expressed either in the form of a ratio, fraction, percent or all three (total made ÷ total that passed inspection x 100).
   Production rate is the number of quality "bolt objects" produced per minute.

6. Allow student sufficient time to complete worksheet and review answers.

7. Review Essential Question and summarize.

Review & Vocabulary Test

1. Use attached Jeopardy file. To utilize the file, first go to http://stujeopardy.com for free download of Stu's Double Jeopardy Game engine. If you wish to change questions or convert information in this file to a PowerPoint, use notepad to open file and edit.

2. After review, ensure students have completed their note taking guides.

3. Give vocabulary test.

• ATTACHMENTS FOR LESSON PLANS

Power point:

Manufacturing Lesson 1
Manufacturing Lesson 2
Manufacturing Lesson 3
Manufacturing Lesson 4

Word Documents:

ENGR_6-1_UNIT PLAN The Assembly Line Challenge (This document)
GPS Standard Manufacturing
EQ Manufacturing Lesson 1
EQ Manufacturing Lesson 2
EQ Manufacturing Lesson 3
EQ Manufacturing Lesson 4
Push Pull Production and Efficiency Worksheet
Manufacturing Note Taking Guide
Manufacturing Vocabulary Test
Manufacturing Challenge Rubric

Games:

Stu's Double Jeopardy Manufacturing Review
Download Stus Jeopardy Link

- **NOTES & REFLECTION:**

To utilize the Jeopardy file, first go to http://stujeopardy.com for free download of Stu's Double Jeopardy Game engine. To convert file information in file to a PowerPoint, use notepad to open file.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Attachments for Culminating Performance Task: Please list.

UNIT RESOURCES

Web Resources:

http://shopdei.com/ecommerce/catalog.php?product=1403

http://www.aptv.org/Pressroom/WordReleases/WUIF.pdf

http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=13

http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=14

http://www.aptv.org/APTPLUS/Digitalibrary/digitalmediadetail.asp?ConVidID=16

http://stujeopardy.com/

http://www.iteaconnect.org/EbD/CATTSresources/StateSiteAgreements/GeorgiaSiteAgreement.htm

Attachment(s):

Materials & Equipment:

- Handouts
- PowerPoint projector/screen
- Internet
- 100 bolts
- 100 small washers
- 100 large washers
- 100 lock washers
- 100 nuts.

What 21st Century Technology was used in this unit?

X	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)
	Web Design Software		Blog	X	Video
	Animation Software		Wiki	X	Electronic Game or Puzzle Maker
	Email	X	Website		