



YOUR FUTURE is made in
MANUFACTURING

AN INTRODUCTION TO MANUFACTURING

Teacher Guide
Recommended for grades 6-12



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ACKNOWLEDGMENTS

This guide was made possible by Dream It. Do It. Minnesota, led by 360 Manufacturing Center of Excellence, a consortium of 15 colleges headed by Bemidji State University. 360 enhances the pipeline through Dream It. Do It. and develops industry-driven curriculum for advanced manufacturing. 360 is a member of the Minnesota State Colleges and Universities system and received a National Science Foundation grant in 2012 to become an Advanced Technological Education Regional Center. Learn more at 360mn.org and dreamitdoitmn.com.



LEADING THE
MANUFACTURING
TALENT REVOLUTION



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Dream It. Do It. Minnesota thanks the following for their input for the creation of Minnesota's Teacher Guide and disc:

- Luann Bartley, Minnesota Precision Manufacturing Association
- Debby Belfry, Blooming Public Schools
- David Haugan, Out Source Projects, Inc.
- Kathy Haugan, Out Source Projects, Inc.
- Sandy Kashmark, Midwest Manufacturers' Association
- Dan Meyer, International Precision Machining
- Michelle Marsh
- Rebecca Thomas, MRG Tool & Die
- Inger Wegener, North East Metro Intermediate District 916, White Bear Lake, Minnesota
- BTD, Detroit Lakes, Minnesota
- Central Boiler, Greenbush, Minnesota
- Clow Stamping, Coon Rapids, Minnesota
- Douglas Machine, Alexandria, Minnesota
- Douglas Scientific, Alexandria, Minnesota
- Dynamic Group, Merrifield, Minnesota
- Graphic Packaging, Crosby, Minnesota
- Jones Metal, Mankato, Minnesota
- Avantech (formerly Lakeland Mold), Brainerd, Minnesota
- Marvin Windows and Doors, Warroad, Minnesota
- MaxBat, Brooten, Minnesota
- MRG Tool & Die, Faribault, Minnesota
- Pequot Tool & Manufacturing, Jenkins, Minnesota
- WSI Industries, Monticello, Minnesota

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A photograph of several male students sitting at desks in a classroom or lecture hall. They are looking towards the left, presumably at a teacher. One student in the foreground is holding a book titled "COMPETING TO...".

DEAR TEACHER,

I am constantly in awe of what you do every day. You inform, you influence, you interact, and most importantly, you inspire young people preparing for the exciting world of learning and work.

Over the next decade, 2 million manufacturing jobs will go unfilled due to the skills gap. With your help, we can mitigate this gap and show students the reality of modern manufacturing. Many people of all ages are amazed to learn how much we manufacture in the United States and how diverse the careers are in our dynamic industry. Today's manufacturing is about new innovation, making an impact, and a chance to design and build the future.

Whether they are interested in design, engineering, or even the business side of the industry, there is a place for everyone in manufacturing. Not only does our industry offer a wide variety of demanding and fulfilling roles, it also offers high pay and opportunity for career advancement.

This toolkit will provide you with a number of activities to expand students' knowledge and awareness of the manufacturing industry. With your help, we can demystify manufacturing and open students to new horizons in their career explorations. Thank you for your commitment to this industry.

Sincerely,

A handwritten signature in dark ink, reading "Jennifer McNelly".

Jennifer McNelly
Executive Director
The Manufacturing Institute

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ALL VIDEOS REFERRED TO IN THIS GUIDE
CAN BE FOUND ONLINE AT:

<https://www.themanufacturinginstitute.org/Teacher.aspx>



WHAT IS MANUFACTURING?



WHAT IS MANUFACTURING?

It depends who you ask. Merriam-Webster defines manufacturing as “the process of making products, especially with machines in factories.” While that is technically true, those machines today likely include robots and conveyors. The factories may be as small as a one-room house or as large as a city block, and may very well be full of computers and sensors. The products can be everything from wind turbines to potato chips to silicon wafers.

SIMPLY PUT, MANUFACTURING IS MAKING STUFF.

For consumers, manufacturing is behind all the products we buy and use. For economists, manufacturing represents value-added production and a source of wealth in a community.

For millions of workers and their families, manufacturing means jobs—designing machinery, developing products, fixing robots, working in software, working in green technology, to name just a few. Later in this guide, you’ll see career information about the many fields in manufacturing.

“Manufacturing, the tangible expression of ideas that change the world like mechanical hearts or airbags, saves lives. Manufacturing is how we interact with the universe.”

JoAnn Mitchell, Senior Project Leader, Sandvik Coromant

MANUFACTURING REQUIRES SKILL AND ABILITY: DO YOU LIKE...



FIXING CARS, SNOWMOBILES, OR BIKES?

ROBOTICS?



ASSEMBLING MODELS?



BUILDING WITH LEGOS?

SOLVING PUZZLES?



These skills, and more, all relate to manufacturing.

Developing a product requires being able to visual, design, program, and more. Just think, instead of fixing a car, you could design the parts for a car.

The manufacturing industry requires other areas of expertise too, offering careers from customer service to marketing to finance.

WHAT IS MANUFACTURING?



APPLICABLE EDUCATION STANDARDS:

SCIENCE: (GRADE 6-12)

Strand 1: Nature of Science and Engineering

Sub strand 1: The practice of science (grade 7-12)

Sub strand 2: The practice of engineering (grade 6, 9-12)

Sub strand 3: Interaction among science, technology, engineering, mathematics, and society

TECHNOLOGY: (GRADE 9-12)

Strand 1: Inquiry, Research, and Problem Solving: The student will learn a continuous cycle of questioning, gathering, synthesizing, evaluating, and using information individually and collaboratively to create new knowledge and apply it to real world situations.

Strand 2: Expanding Literacies: Read, view, listen, and communicate in any format for a variety of purposes.

Sub strand 2: Collaboration

LANGUAGE ARTS: (GRADE 6-12)

Anchor Standards for speaking, viewing, listening, & media literacy:

Strand 1: Comprehension and Collaboration

Strand 2: Presentation of Knowledge and Ideas

Strand 3: Media Literacy

Anchor Language Standards:

Strand 4: Conventions of standard English

Anchor Standards for Writing:

Strand 5: Text types and purposes

Strand 6: Research to build and present knowledge

HELPFUL TIP

Introduce your students to manufacturing by showing them one of the following videos:



[DOUGLAS SCIENTIFIC](#)
[Alexandria, MN](#)



[PEQUOT TOOL & MANUFACTURING](#)
[Pequot Lakes, MN](#)



[JONES METAL](#)
[Mankato, MN](#)



[GRAPHIC PACKAGING](#)
[Crosby, MN](#)



[WSI INDUSTRIES](#)
[Monticello, MN](#)

Please be advised that the Applicable Education Standards are set to [Minnesota state standards](#).

OBJECTIVES:

STUDENTS WILL BE ABLE TO:

- Place parts of a story in the appropriate order to represent the manufacturing cycle.
- Understand and identify 12 manufacturing terms with their definitions.
- Contrast the phenomenon of reality vs. perception.
- Appreciate machining and welding.
- Apply the manufacturing cycle to a product they create.
- Differentiate steps of the manufacturing cycle.
- Apply research from different manufacturing companies into a creative jingle or slogan.

WHAT IS MANUFACTURING?



EXERCISE:

- 1. INSTRUCTOR:**
Review terms using the PowerPoint for Activity 1.
- 2. STUDENTS:**
Complete Chapter 1, Activity 1: *What is Manufacturing? Manufacturing Terms & Definitions.*
- 3. INSTRUCTOR:**
Explain The Manufacturing Cycle Diagram using the PowerPoint for Chapter 1, Activity 2. Provide students with Chapter 1, Handout 1.
- 4. STUDENTS:**
Complete Chapter 1, Activity 2, *What is Manufacturing? The Manufacturing Cycle.*

REALITY VS. PERCEPTION:

Often, when we think of manufacturing, we think of how it was in the Industrial Revolution, but that's not what manufacturing is today. Now, manufacturing uses technology and robotics—it's clean, safe, and innovative.

Additionally, while there is a lot of talk about manufacturing jobs moving overseas, there are many manufacturing companies who have stayed and will continue to stay in the United States. The reasons are many, including being able to better manage intellectual property and quality control—things that affect the overall cost. Today's manufacturing jobs are all about being innovative and creative to meet consumer needs—like you hear about in the videos.

QUOTABLE

"I'm a big believer in the Dream It. Do It. program because what it's doing is bringing education to the area of U.S. manufacturing to describe what manufacturing is all about."

Congressman Tom Reed, 23rd
Congressional District of New York



ACTIVITY 1:

MANUFACTURING TERMS & DEFINITIONS

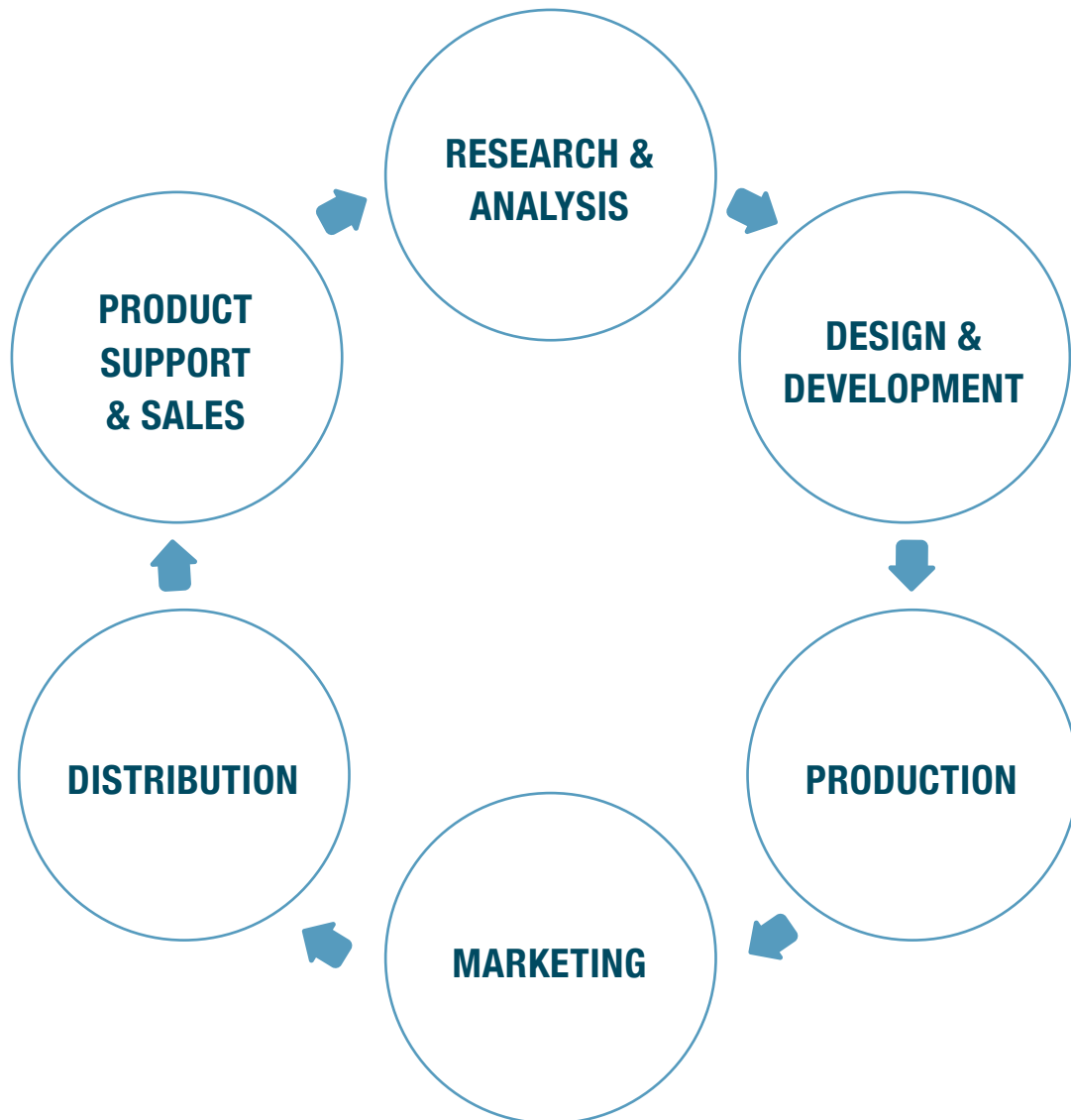
Student Name: _____

DIRECTIONS: Match each term with its definition on the other column by letter.

- | | |
|-------------------------------|--|
| 1. _____ Market Research | a. Taking a concept through the process of making a configuration, drawing, model, or plan that serves as the basis for the actual product and making sure the product meets specific needs or wants. |
| 2. _____ Prototype | b. An original model on which something is patterned and used to develop a product. |
| 3. _____ Raw Material | c. Being creative. |
| 4. _____ Hang Tag | d. A company that provides another company with goods or services, also called a vendor. |
| 5. _____ Warehouse | e. Amount of energy, work, products, or services produced in a given period by a company, individual or machine. |
| 6. _____ Production | f. Process of assessing a new product or service through research (like surveys, focus groups, or product testing) to test reactions to a product or service before making it available to the general public. |
| 7. _____ Design & Development | g. Make the actual product: usually includes technology, advanced machines, robotics and assembly lines. |
| 8. _____ Innovation | h. Something attached to a product (like a piece of clothing) that shares information about the manufacturer & the product. |
| 9. _____ Supplier | i. A material or substance used to make something. |
| 10. _____ Outputs | j. Taking an item after it has been manufactured and getting into the hands of a consumer. |
| 11. _____ Distribution | k. The expense of materials, labor, and other components of the manufacturing process to create an end product. |
| 12. _____ Manufacturing Costs | l. Where products can be stored before distribution. |

HANDOUT 1:

THE MANUFACTURING CYCLE



RESEARCH & ANALYSIS: Research and analyze your product as well as other products that are out there

DESIGN & DEVELOPMENT: Prototype

PRODUCTION: Includes testing, production costs

MARKETING: Includes marketing analysis and product marketing

DISTRIBUTION: Includes delivery methods

PRODUCT SUPPORT & SALES: Return policies, equipment failure

ACTIVITY 2:

APPLYING THE MANUFACTURING CYCLE

Student Name: _____

DIRECTIONS: *Create and present a PowerPoint, brochure, or poster, or write a paper on one of the machines listed below.*

1. Choose one of the following tools or machines:

CNC Lathe	MIG Welder	Band Saw
Water Jet	SMAW Welder (Stick Welding)	Vertical Mill
CNC Milling Machine	3D Printing	Hydraulic Power Press
Robotics	Grinder	Faro Arm
Wire Feed EDM Machine	Laser Texturing	Ironworker Machine
Compression Mold	Steel Stamping Press	Swiss Turning Machine
Sinker EDM Machine	Multiple Pallet CNC	Roll Bending & Forming Machine
Horizontal Mill	Hydraulic Shear	Pyramid Rolling Machine
Laser Cutters (Sheet Metal Fabrication)	Plastic Injection Mold	Screw Machine
Tube Laser	Press Brake (Brake Press)	Other: Teacher approval
TIG Welder	Belt Sander	
Die Manufacturing	Manual Lathe	

2. Include the following in your presentation:

- Image (photo) of the machine.
- Explain an industry where the machine is used.
- Describe a product made by this machine in your state.
- Where is the product made in your state?
- Explain which portion of the manufacturing cycle this machine is used for (could be more than one focus).

ACTIVITY 3:

APPLYING THE MANUFACTURING CYCLE

Student Name: _____

SUPPLIES NEEDED:

- 1 square piece (5½ inches) of corrugated (tubes inside) cardboard
- 2 CDs
- 1 wooden skewer (kabob skewer)
- 1 or 2 rubber band(s)
- Duct tape – 2 feet
- Scissors
- Ruler

DIRECTIONS: *Divide students into groups of 2 – 4 people.*

DESIGN & DEVELOPMENT/PRODUCTION:

1. **Design & develop** a vehicle (use the materials to build a vehicle that can travel 3 ft).
2. Draw a sketch of the vehicle before you develop the **prototype**.
3. **Test** the vehicle (students can videotape this portion).
4. Modify the **prototype**.

ANSWER THE FOLLOWING QUESTIONS:

1. **Research & Market Analysis:** Who would you market this vehicle to? (age group, gender, etc.)
2. **Marketing:** Would you sell this product as a kit or fully assembled? Why? How will you promote the product?
3. **Distribution & Packaging:** How would you distribute your product? How would you package your product?
4. **Distribution:** In what stores or venue would you sell this product?

ACTIVITY 3:

OPTIONAL ACTIVITY

Student Name: _____

SUPPLIES NEEDED:

- 1 balloon (9 inch or smaller)
- 1 flexible straw
- 1 wooden tongue depressor or craft stick
- 1 straight straw
- 2 candy mints (with a hole in the middle)
- 2 feet of duct tape
- 1 rubber band

DIRECTIONS: *Divide students into groups of 2 – 4 people.*

DESIGN & DEVELOPMENT/PRODUCTION:

1. **Design & Develop** a vehicle (use the materials to build a vehicle that can travel 3 ft).
2. Draw a sketch of the vehicle before you develop the **prototype**.
3. **Test** the vehicle (students can videotape this portion).
4. Modify the **prototype**.

ANSWER THE FOLLOWING QUESTIONS:

1. **Research & Market Analysis:** Who would you market this vehicle to? (age group, gender, etc.)
2. **Marketing:** Would you sell this product as a kit or fully assembled? Why? How will you promote the product?
3. **Distribution & Packaging:** How would you distribute your product? How would you package your product?
4. **Distribution:** What stores or venue would you sell this product?

MANUFACTURING IN AMERICA



APPLICABLE EDUCATION STANDARDS:

SCIENCE: (GRADE 6-12)

Strand 1: Nature of Science and Engineering

Sub strand 2: The practice of Engineering (grade 6, 9-12)

Sub strand 3: Interaction among science, technology, engineering, mathematics, and society

TECHNOLOGY: (GRADE 9-12)

Strand 2: Expanding Literacies: Read, view, listen, and communicate in any format for a variety of purposes.

Sub strand 2: Collaboration

Strand 4: Ethical Participation in a Global Society: The student will participate productively in the global learning community and demonstrate safe, ethical, legal, and responsible behavior in the use of information and technology.

Sub strand 4: Reflection/Evaluation

LANGUAGE ARTS: (GRADE 6-12)

Anchor Standards for speaking, viewing, listening, & media literacy:

Strand 1: Comprehension and Collaboration

Strand 2: Presentation of Knowledge and Ideas

Strand 3: Media Literacy

Anchor Language Standards:

Strand 4: Conventions of standard English

Anchor Standards for Writing:

Strand 5: Text types and purposes

Strand 6: Research to build and present knowledge

QUOTABLE

“I ask kids, what do you like to do? You like to play with Legos more than flying a kite? Have you ever thought about building stuff?”

Micah Raider, Wichita Area Technical College
Student



MANUFACTURING IN AMERICA



OBJECTIVES:

STUDENTS WILL BE ABLE TO:

- Recall information from chapter one and relate it to the companies they learn about in chapter two.
- Appreciate what America manufacturing jobs have to offer.
- Recognize manufacturing opportunities throughout America.
- Explain their manufacturing tool of choice in a class presentation, brochure, or poster.
- Realize what America manufactures.
- Visualize manufacturing in America.
- Recognize the manufacturing professional organizations.

EXERCISE: *Introduce students to America's manufacturing industries, and to reinforce the first chapter's content.*

1. STUDENTS:

Complete Chapter 2, Activity 4, *Manufacturing in America, True/False worksheet.*

2. INSTRUCTOR: Watch the Douglas Scientific and BTB profile videos.

ASK THE STUDENTS:

- How does this fit with what you learned about manufacturing in the previous chapter?
- How does this affect what you think of manufacturing?
- Did you know America had manufacturing like this?

3. STUDENTS:

Complete Chapter 2, Activity 5, *Manufacturing in America, Discover American Manufacturing.*

4. STUDENTS:

Complete Chapter 2, Activity 6, *Manufacturing in America, Digging Deeper into American Manufacturing.*

ACTIVITY 4:

TRUE / FALSE

Student Name: _____

1. _____ Manufacturing careers can offer opportunities to do work that saves lives, puts men on mars, and creates our quality of life.
2. _____ For every \$1.00 spent in manufacturing, another \$1.37 is added to the economy.
3. _____ All manufacturing companies have thousands of employees working in large factories.
4. _____ There are less than 1 million manufacturing workers in the United States.
5. _____ Manufacturing careers require a four-year college degree to be qualified.
6. _____ Over the next decade, nearly 3.5 million manufacturing jobs will likely be needed to be filled.
7. _____ Manufacturing helps to support partnership with other countries across the world.
8. _____ It is impossible to earn more than \$60,000 a year in a manufacturing job.
9. _____ Manufacturing jobs require teamwork, problem solving, and technical skills.
10. _____ Manufacturing jobs don't exist in large cities.

ACTIVITY 5:

DISCOVER AMERICAN MANUFACTURING

DIRECTIONS:

1. Go to the company website.
2. Find the location for each company.
3. List at least one product the company makes/produces or list what the company does.
4. Find and mark the city of the company in your classroom.

Use National Manufacturing Day's event directory as a way to find companies to explore in your state.

Student Name: _____

1. Ace Clearwater Enterprises

www.aceclearwater.com

Location:

Product:

2. AGCO Corporation

www.agcocorp.com

Location:

Product:

3. Alcoa, Inc.

www.alcoa.com

U.S. Corporate Headquarters:

Product:

4. APSCO

www.apscopower.com

Location:

Product:

5. Behlen Mfg. Co.

www.behlenmfg.com

Location:

Product:

6. Bison Gear and Engineering Corporation

www.bisongear.com

Location:

Product:

7. Caterpillar

www.caterpillar.com

U.S. Headquarters:

Product:

8. GenMet Corp

www.genmet.com

Location:

Product:

9. Jabil

www.jabil.com

U.S. Headquarters:

Product:

10. Lockheed Martin

www.lockheedmartin.com

Headquarters:

Product:

11. Nike

www.nike.com

World Headquarters:

Product:

12. Procter & Gamble

www.us.pg.com

U.S. Headquarters:

Product:

13. Rockwell Automation

www.rockwellautomation.com

Headquarters:

Product:

14. Tenneco

www.tenneco.com

Location:

Product:

15. Toyota Motor North America, Inc.

www.toyota.com

U.S. Headquarters:

Product:

16. Whirlpool Corporation

www.whirlpoolcorp.com

Headquarters:

Product:

ACTIVITY 6:

DIGGING DEEPER — DEVELOP A JINGLE OR SLOGAN

Student Name: _____

DIRECTIONS: *Divide students into groups of 2 – 4 people.*

1. Choose a manufacturing company in your state.
2. Research the company and take notes on the following questions.
 - What is the name of the company?
 - What does the company make?
 - Is there something unique about it?
 - Who do you think is its target audience?
 - What stands out to you about the company?
 - How does the company show it is innovative, creative, and/or uses modern manufacturing?
3. Use your notes to develop a slogan, jingle, or poster that highlights the company.
4. Present your jingle, slogan, or poster to the class.
5. Explain why your group chose to highlight certain aspects of the company.

CAREERS IN MANUFACTURING



APPLICABLE EDUCATION STANDARDS:

SCIENCE: (GRADE 6-12)

Strand 1: Nature of Science and Engineering

Sub strand 1: Interaction among science, technology, engineering, mathematics, and society

TECHNOLOGY: (GRADE 9-12)

Strand 1: Inquiry, Research, and Problem Solving: The student will learn a continuous cycle of questioning, gathering, synthesizing, evaluating, and using information individually and collaboratively to create new knowledge and apply it to real world situations.

Strand 2: Technology Use and Concepts: Students will explore multiple technologies, evaluate their suitability for the desired educational or personal task, and apply the tools needed.

Sub strand 2: Use of Technology

Strand 3: Ethical Participation in a Global Society: The student will participate productively in the global learning community and demonstrate safe, ethical, legal, and responsible behavior in the use of information and technology.

Sub strand 3: Reflection/Evaluation

LANGUAGE ARTS: (GRADE 6-12)

Anchor Standards for speaking, viewing, listening, & media literacy:

Strand 1: Presentation of Knowledge and Ideas

Strand 2: Media Literacy Anchor Language Standards

Strand 3: Conventions of standard English

Anchor Language Standards:

Strand 4: Conventions of standard English

Anchor Standards for Writing:

Strand 5: Text types and purposes

Strand 6: Writing process: Production & distribution of writing

Strand 7: Research to build and present knowledge

HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 1 OF 8)

BUILD YOUR CAREER:

With the right education, you can build your pathway to success--receiving a good paycheck for your work and advancing your career.

You can start by taking technical courses at a two-year college, earning a certificate or diploma. You'll have the skills to start your career, or you can keep going in your education.

You can take more courses to earn an Associate in Applied Science (A.A.S.). This will make you more qualified to move up the career ladder.

Your coursework will likely transfer to a four-year college or university, where you can earn a Bachelor's degree. You may even find some online opportunities that are convenient for your schedule.

CAREER OUTLOOK

Manufacturing Pays Higher Average Compensation

MANUFACTURING JOBS

\$62,079

NONMANUFACTURING JOBS

\$50,140

**U.S. Bureau of Economic Analysis*

Manufacturers also receive [more generous benefits](#) than other working Americans.

3.5 million jobs will be available in manufacturing between 2015 and 2025.



QUOTABLE

“One to two years in a technical program and you can come into a job making a very, very good wage.”
Andrew Freyholtz, Mechanical Designer



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 2 OF 8)

PRODUCTION TECHNOLOGY:

WHAT IS IT:

Working in modern manufacturing, using your knowledge of technical math, print interpretation, quality and safety, and manufacturing processes and production.

WHAT THAT MEANS:

You will be making products that people use to make their lives better. Reading and interpreting drawings and prints, operating machines, and refining parts are all things you might do. You have to understand how a product is manufactured, how to read general prints used in manufacturing, and how to create and measure quality products.

EDUCATION:

You'll start with at least a certificate and can move up with a diploma, gaining the skills you need to start in advanced manufacturing. You can move up the career pathway if you continue your education and specialize with a two- or four-year degree. Industry certifications, such as those offered by the Manufacturing Skill Standards Council (MSSC) are available to help you demonstrate your knowledge and skills.

POSSIBLE CAREER TITLES:

Inspector, Fabricator, Team Assembler, and Operator

WHAT YOU'LL LEARN IN COLLEGE:

You'll learn a broad range of topics along with the basics of manufacturing so you have a solid foundation to pursue your career. Some companies will also require or prefer specific industry certifications.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

63,200

AVERAGE NATIONAL EARNINGS:

\$13.28/hour

QUOTABLE

"I didn't even know that manufacturing like this existed. Something that was clean, something that I would want to do. But now I love my job! I get here at six in the morning smiling!"

Alicia Thomsen, Electrical Assembler



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 3 OF 8)

ELECTRONICS/ROBOTICS/MAINTENANCE/AUTOMATION/MECHATRONICS:

WHAT IS IT:

People run, inspect, install and maintain autonomous and semi-autonomous machines.

WHAT THAT MEANS:

Ever drive or build a robot? Fixed a lawn mower? That's the type of stuff you get to do, but on a larger scale.

You use your skills in math and engineering to design, build, or improve how things are made—from small parts to large pieces of machinery. You might work with robots to put parts together or make sure that things are always running. You could be inspecting machines or implementing changes to make sure everything and everyone is manufacturing quality parts. You'll apply your knowledge of mechanics, design, production, computers, and electronics as you work with power tools, precision measuring instruments, motors, sensors, programming, and electrical and electronic testing devices.

POSSIBLE CAREER TITLES:

Maintenance Machinist, Maintenance Technician, Applications Programmer, Electrical Controls Engineer, Production System Technician, Automation Technician, Development Mechanic, Experimental and Electrical Mechanic

EDUCATION:

You can get started with a certificate or a diploma, but a two-year degree and experience will help you succeed.

WHAT YOU'LL LEARN IN COLLEGE:

In college, you'll get to have hands-on experience in mechanics, pneumatics, and hydraulics and work with machine tools and electrical circuits. This knowledge will help you test and troubleshoot equipment and prevent problems from happening. You also can study robotic programming, CAD (computer-aided design), CAM (computer-aided manufacturing), other computer software programs, and robotic welding. These types of courses prepare you to understand how they work with robots, circuit boards, and other machines used in manufacturing and understand how they work within the manufacturing process.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

22,100

AVERAGE NATIONAL EARNINGS:

\$20.80/hour

QUOTABLE

"I'm proud to work here. I'm proud of the work I produce. It is always changing; it is always new. I have a good opportunity to keep learning, and I'm excited about that."

William Johnson, Robotic Welder



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 4 OF 8)

MACHINE TOOL TECHNOLOGY:

WHAT IS IT:

Programming and operating computer numerically controlled (CNC) machines to make parts to sell or assemble.

WHAT THAT MEANS:

You make sure parts turn out how they should, often cutting away material that isn't needed, starting from a block or sheet or an existing part. You have to understand procedures, print reading, reports, and how to analyze data. You could be making parts that are used for a diverse group of products from computers to medical devices.

You'll work with today's machines using computer software and technology, like writing the program on the computer to tell the machine how to custom cut and assemble parts. Many of the machines are automated, but you still have to understand science, technology, engineering, and math (STEM) to manage the machines and have them do what you want. You may operate the machines or develop programs, but you also have to be able to understand the product design as you apply your knowledge of mechanics and programming to help create a final product. You work with tools like lathes, gauges, and calipers as well as computer software.

POSSIBLE CAREER TITLES:

Machine Operator, CNC Programmer, CNC Tool Maker, CNC Operations Technician, Tool & Die Maker, Moldmaker

EDUCATION:

You can earn a certificate or diploma to enter this area as well as earn a two-year degree. Industry certifications, such as those offered by the National Institute for Metalworking Skills (NIMS) are available to help you demonstrate your knowledge and skills.

WHAT YOU'LL LEARN IN COLLEGE:

You'll be trained how to work with hand tools, power tools, and computer software like computer numerically controlled (CNC) programs that are used in manufacturing. Hands-on experience will give you knowledge that you'll use throughout your career. Some companies will also require or prefer specific industry certifications.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

154,700

AVERAGE NATIONAL EARNINGS:

\$19.49/hour

QUOTABLE

"You take an aluminum block and make it into something that can fly. That's pretty cool."

Todd Baumhardt, Senior Machinist and Setup

"I like the R&D (research & development) aspect. Somebody brings you something that's never been done before, Band [asks] 'Hey, can you build this part?'"

Seth Anderson, CNC Programmer



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 5 OF 8)

WELDING & FABRICATION:

WHAT IS IT:

Making parts come together using heat.

WHAT THAT MEANS:

You melt pieces of material together to form new parts or products. This can be done in a manufacturing plant, outside, under water, or even outer space! You will study the science of materials and metals to know how they work together (metallurgy). Materials you'll work with can include titanium, aluminum, and plastics. There are lots of different areas and processes for welding, like gas metal arc welding (GMAW or MIG), gas tungsten arc welding (GTAW or TIG), or shielded metal arc welding (SMAW). You'll work with blow torches, brazing equipment, and welding guns along with raw materials to get the job done.

POSSIBLE CAREER TITLES:

Manufacturing Welding Technician, Welding Technician, Advanced Welding Technician, Fitter.

EDUCATION:

Certificates and diplomas are available, but you can also earn a two-year degree. Industry certifications, such as those offered by the American Welding Society (AWS) are available to help you demonstrate your knowledge and skills.

WHAT YOU'LL LEARN IN COLLEGE:

You'll learn about different types of welding processes, what type of welding to use in different situations, power sources, how to work with torches, how metals work together, how to read fabrication drawings, and how to design fabrication assemblies. With all of this, plus hands-on experience, you'll learn how to work with the different technology in welding. Along with applying the science of materials to welding, you'll know how to apply math to be effective at your job. Some companies will also require or prefer specific industry certification.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

17,100

AVERAGE NATIONAL EARNINGS:

\$17.38/hour

QUOTABLE

"I love my job in manufacturing because it's not a dead end job, and it's not just a job that you are at. It's a career that you can keep for a lifetime."

Erica Morrison, Fabricator/Quality Support



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 6 OF 8)

MECHANICAL DESIGN & DRAFTING:

WHAT IS IT:

Using computer-aided design (CAD) to create models, design parts, write manufacturing instructions for the creation and assembly of parts.

WHAT THAT MEANS:

You use your knowledge of math, science, technology, and computer software to create 2D and 3D drawings and models so people know what they are making, such as its size, shape, and dimensions. You can develop how to put parts together and provide instructions for making and assembling everything from simple one-piece parts to complex machines. As you gain experience, you can work your way up to designing custom parts customers buy directly. Nearly everything that is made needs someone who identifies the details needed to make it right.

POSSIBLE CAREER TITLES:

CAD Drafter, CAD Designer, Engineering Technician, Mechanical Technician.

EDUCATION:

To get started in this field, you'll want to look at a two-year degree.

WHAT YOU'LL LEARN IN COLLEGE:

You'll learn software like SolidWorks, Autodesk Inventor, or Creo (PRO/Engineer) so you know how to make models. You'll also learn how things work in manufacturing and the science of how materials work, like how much pressure it can take.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

7,800

AVERAGE NATIONAL EARNINGS:

\$25.73/hour

QUOTABLE

"It's really satisfying at the end of the day to say, "Hey, I made this part of that fixture over there," or "I made this part of that car emblem mold."

Rebecca Thomas, Industrial Engineer



HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 7 OF 8)

ENGINEERING AND ENGINEERING TECHNOLOGY:

WHAT IS IT:

A commonly known field, you might not know that engineers in manufacturing can design new products or manage process and people who make the products.

WHAT THAT MEANS:

You may work in product design, generate computer-based models, improve current processes, and manage projects. Hands-on experience working with products and today's machines and technology helps you know how to design and work through the manufacturing process.

EDUCATION:

There are some two-year programs available to get you started, but a four-year degree will really help you succeed in engineering.

POSSIBLE CAREER TITLES:

Product Development Technician, Industrial Designer, Quality Engineer, Industrial Engineer, Manufacturing Engineer, Product Engineer

WHAT YOU'LL LEARN IN COLLEGE:

You'll use what you learn about science, engineering, and math and apply it to research, product development, and manufacturing processes. You'll take lots of classes in science and math, like calculus, physics, and engineering courses.

THERE ARE DIFFERENT AREAS OF ENGINEERING THAT YOU CAN STUDY:

INDUSTRIAL ENGINEERING:

You'll learn how to manage the "big picture"—different projects, equipment, manufacturing operations, product design, quality, people—to know the best way to manufacture products.

MECHANICAL ENGINEERING:

You will work with the mechanics of manufacturing, from designing machines to testing tools. You will study

things like thermal and mechanical systems, machine design, materials, and fabrication.

CHEMICAL ENGINEERING:

Focused on chemical processes and production, you will study how to make products from cosmetics to food to medicine. You learn about chemical reaction and how materials work together so you can plan, test, and manage the chemical design.

ELECTRICAL ENGINEERING:

Working with electrical and electronic systems, you learn about computers, controls, automation, and circuits. You will need to know how electrical power works and how to harness it to create electrical equipment, like iPods and GPS systems.

APPLIED ENGINEERING & ENGINEERING TECHNOLOGY:

Applied engineering combines technical skills with management. You will learn things like CAD, CNC, machining, 3D modeling, and how to manage manufacturing operations, like supply chain management, technical sales, and packaging.

MANUFACTURING ENGINEERING:

You'll focus on manufacturing production—how to set-up and implement manufacturing processes. You will use modern equipment and techniques to create cost-effective designs and processes.

NUMBER OF PROJECTED OPENINGS FOR 2014-2024:

33,000

AVERAGE NATIONAL EARNINGS:

\$46.11/hour

HANDOUT 1:

MANUFACTURING CAREERS

(PAGE 8 OF 8)

OTHER CAREER OPPORTUNITIES:

These are areas specific to manufacturing, but there is more you can do. Think about the manufacturing cycle—the industry also needs people in logistics, marketing, finance, human resources, and more.

AREAS OF STUDY:

Program names, certificates, diplomas and degrees for manufacturing can vary according to the college, but here's a sampling of what to look for: Engineering Technology, Applied Engineering, Manufacturing Engineering, Manufacturing Maintenance, Welding & Fabrication, Mechanical Design, Energy & Mechatronics, Machine Tool Technology, Manufacturing Technology, Electronics Technology, 3D Model Making, CNC Programming, and Robotics/Automotive Technology.

LEARN MORE AT:

<http://www.themanufacturinginstitute.org/Skills-Certification/Educator-Resources/M-List/M-List.aspx>

ACTIVITY 7:

CAREER INVESTIGATION

Student Name: _____

DIRECTIONS: Watch the *Douglas Machine* profile video and answer the following questions.

1. What does the company do/make?

2. The following are careers of some of the employees at Douglas Machine. In one or two sentences, describe the following careers.

- CNC Programmer
- President & COO (What does COO stand for?)
- Sales Support
- Field Support
- Mechanical Engineer
- Administrative Assistant
- CEO
- Engineering Technician

OPTIONAL:

Write a “Help Wanted” ad for each job, listing responsibilities, pay, and qualifications.

ACTIVITY 8:

CAREER INVESTIGATION

Student Name: _____

DIRECTIONS: *Watch the Dynamic Group video and answer the following questions.*

1. What does the company do/make?

2. The following are careers of some of the Dynamic Group employees.
In one or two sentences, describe the following careers.
 - Tooling Manager

 - Co-Owner

 - Molding Manager

 - IT Manager

ACTIVITY 9:

CAREERS & EDUCATION

(PAGE 1 OF 2)

Student Name: _____

DIRECTIONS: *Review Handout 1.*

Match the college awards to the # of years in college

- | | |
|------------------------|--|
| 1. _____ Certificate | a. 2 years of college education (Associate of Science) |
| 2. _____ Diploma | b. Typically from 18 weeks or less up to 1 year. |
| 3. _____ A.S. Degree | c. 4 years of college (Bachelor of Science) |
| 4. _____ A.A.S. Degree | d. 2 years of college education (Associate of Applied Science) |
| 5. _____ B.S. Degree | e. Typically 1 year of college education |

Match the careers to education required

- | | |
|--|------------------|
| 6. _____ Production Technology: Inspector | a. 2 year degree |
| 7. _____ Automation Technician (2 correct answers) | b. Certificate |
| 8. _____ Electrical Mechanic (2) | c. 4 year degree |
| 9. _____ Electrical Engineer | d. Diploma |
| 10. _____ Engineering Technician | |
| 11. _____ Welding Technician (2) | |
| 12. _____ Advanced Welding Technician | |
| 13. _____ CAD Drafter | |
| 14. _____ CAD Designer | |
| 15. _____ CNC Programmer | |

ACTIVITY 9:

CAREERS & EDUCATION

(PAGE 2 OF 2)

Student Name: _____

Match the potential earnings to the manufacturing area.

- | | |
|---|-----------------|
| 1. _____ Production Technology | a. \$20.80/hour |
| 2. _____ Electronics/Maintenance/Robotics/Automation/Mechatronics | b. \$19.49/hour |
| 3. _____ Machine Tool Technology | c. \$17.38/hour |
| 4. _____ Welding & Fabrication | d. \$25.73/hour |
| 5. _____ Mechanical Design & Drafting | e. \$13.28/hour |

List the six areas of engineering listed in Handout 1.

- | | |
|----|----|
| 1. | 4. |
| 2. | 5. |
| 3. | 6. |

THE M-LIST

The M-List recognizes high schools, community colleges, technical schools, and universities that are teaching manufacturing students to industry standards. Specifically, these schools offer students the opportunity to earn [NAM-Endorsed Manufacturing Skills Certifications](#) as a standard part of their manufacturing education programs.

ACTIVITY 10:

CAREER & EDUCATION

Student Name: _____

DIRECTIONS: Visit <http://www.toyota.com/usa/careers/>, and explore the “Career Opportunities” section and the “Browse Jobs” section.

1. Choose two career areas you are interested in and list them.
3. Find one career in each of the career areas you listed above. List the careers. Describe the position description.
4. Write a paragraph on what intrigues you about this position.
5. What kind of education or certifications would you need after high school graduation for these positions? *(list your source)*
6. Could you see a future in manufacturing? Why or why not?

ACTIVITY 11:

PROFESSIONS

Student Name: _____

DIRECTIONS: *Watch the Central Boiler & Altoz Precision Mowers videos.*

1. Andy Hedlund is a Safety & Environmental Director. What do you think he does in that position?

2. Marita Becker works in Materials Management. What is materials management?

3. Jason Lee is the Welding Manager. Match the following terms.

_____ GMAW (most widely used)

_____ SMAW

_____ TIG

_____ Oxy Acetylene

a. Tungsten Inert Gas. Expert operators are used.

b. Also called MIG welding. Gas Metal Arc Welding.

c. Used for maintenance work and gas metal cutting.

d. Called stick or arc welding. Shielded Metal Arc Welding.

4. Can you grow professionally and financially in manufacturing? Why or why not?

ACTIVITY 12:

MANUFACTURING WRAP UP

Student Name: _____

1. Now that you know so much about manufacturing, if you were stopped in the street by a reporter and asked, “What do you think is cool about manufacturing?,” what would you say?

ACTIVITY 1:

MANUFACTURING TERMS & DEFINITIONS

Notes for Chapter 1, Activity 1

There is a PowerPoint for review of definitions with additional information in the notes section.

- | | |
|------|-------|
| 1. f | 7. a |
| 2. b | 8. c |
| 3. i | 9. d |
| 4. h | 10. e |
| 5. l | 11. j |
| 6. g | 12. k |

HANDOUT 1:

THE MANUFACTURING CYCLE

Provide students with a copy of the Manufacturing Cycle. There is a PowerPoint to assist with the explanation of the Manufacturing Cycle.

ACTIVITY 2:

MACHINING & WELDING — APPLYING THE MANUFACTURING CYCLE

Notes for Chapter 1, Activity 2

The purpose of the activity is to demonstrate to students the types of equipment that are used in manufacturing. Students can also play a welding game at: Trades Gamer @ <http://tradesgamer.com>. This website provides students a way to learn about welding through the TIG welder game.

ACTIVITY 3:

APPLYING THE MANUFACTURING CYCLE

Notes for Chapter 1, Activity 3

Students should work in groups.

Students should be given the supplies for the project but not the instructions on how to make the project.

Student focus is on Design & Development.

Project instructions can be found at: <http://pbskids.org/designsquad/build/rubber-band-car/>.

DIRECTIONS:

1. Make the body.
 - Hold the cardboard so the corrugations (tubes) run side to side, not up and down.
 - Cutting across the corrugations, cut out a 2 inch wide and 1 ½ inch deep rectangle, making a notch in the center of one side.
 - Throw away the piece you cut out.
2. Make the axle.
 - Slide the skewer straight through one of the corrugations so it crosses the middle of the notch.
 - Make sure the axle sticks out the same amount on each side of the body.
3. Make the wheels.
 - Plug up the holes in the CD's with the pieces of Styrofoam. Make sure they stick out on each side of each CD by about half an inch. These are your wheels.
 - Slide each wheel onto the axle, poking the end of the skewer into each piece of Styrofoam. Push the skewer straight through the hole of the CD and out the other side.
 - Slide the wheel so that the Styrofoam doesn't rub on the cardboard.
4. Create a "catch."
 - Find where the skewer goes across the notch.
 - In the middle of this section, wrap a small piece of tape to make a "catch" for the rubber band.
5. Attach the power source.
 - Tape your rubber band to the end of the cardboard opposite the catch.
6. Power your car.
 - Wrap the unattached end of the rubber band over the catch.
 - Spin the axle a few times to wind up your car.
 - Set your car on the floor.
7. Release it.

ACTIVITY 3:

OPTIONAL ACTIVITY

Notes for Chapter 1, Activity 3 (OPTIONAL)

Students should work in groups.

Students should be given the supplies for the project but not the instructions on how to make the project.

Student focus is on Design & Development.

Project instructions can be found at: <http://pbskids.org/designsquad/build/2-wheel-balloon-car/>.

DIRECTIONS:

1. Make the jet.
 - Put the long end of a flexible straw into a balloon.
 - Attach the straw and balloon so that no air can escape, using either a rubber band or tape.
2. Attach the jet.
 - Tape the jet to the top of the tongue depressor or craft stick (i.e., the body).
 - Make sure the jet is parallel to the floor or tabletop as much as possible. If it points up, down, or to the side, your car won't move as fast or far as if the jet points straight back.
3. Make the axle and wheels.
 - Slip two candy mints onto the straw.
 - Bend back the tips of the straw so the candy can't fall off. Tape the tips in place.
4. Attach the body.
 - Tape the axle to the bottom of the body, at the front. The end with the wheels is the front.
 - Make sure the wheels spin freely.
 - Make sure the wheels line up with the direction you want the car to move.
5. Power the jet.
 - Blow up the balloon. Put your finger over the end of the straw to stop air from escaping.
 - Make sure the balloon doesn't flop over onto the floor or tabletop. If it does, it will act like an anchor and will stop the car from moving.
 - Put the car on a smooth surface and let it go!

ACTIVITY 4:

TRUE/FALSE

1. **TRUE**
 2. **TRUE**
 3. **FALSE**
 4. **FALSE**
There are 12.33 million manufacturing workers in the United States, accounting for 9 percent of the workforce.
 5. **FALSE**
 6. **TRUE**
 7. **TRUE**
 8. **FALSE**
In 2014, the average manufacturing worker in the United States earned \$79,553 annually, including pay and benefits.
 9. **TRUE**
 10. **FALSE**
Manufacturing supports an estimated 17.2 million jobs in the U.S.
-

ACTIVITY 5:

DISCOVER AMERICAN MANUFACTURING

Notes for Chapter 2, Activity 6

- Large map will be needed in the classroom for visualization of manufacturing.
- Students can work in groups or individually.
- Companies can be divided amongst the students.
- Students could also check to see if there are any job openings at the company and list that information.

ACTIVITY 5:

DISCOVER AMERICAN MANUFACTURING

1. Ace Clearwater Enterprises

www.aceclearwater.com

Location: Torrance, CA

Product: Builds complex formed and welded assemblies for the aerospace and power generation industries.

2. AGCO Corporation

www.agcocorp.com

Location: Duluth, GA

Product: Agricultural equipment

3. Alcoa, Inc.

www.alcoa.com

U.S. Corporate Headquarters: Pittsburgh, PA

Product: Lightweight metals

4. APSCO

www.apscopower.com

Location: Tulsa, OK

Product: Pneumatic cylinders, controls and valves for the mobile, truck equipment and automotive markets

5. Behlen Mfg. Co.

www.behlenmfg.com

Location: Columbus, NE

Product: Steel fabrication

6. Bison Gear and Engineering Corporation

www.bisongear.com

Location: Charles, IL

Product: HP AC motors, DC Motors and PMDC motors, gearboxes, gear reducers, as well as a full selection of AC and DC parallel shaft gearmotors, right-angle gearmotors, and brushless DC gearmotors.

7. Caterpillar

www.caterpillar.com

U.S. Headquarters: Peoria, IL

Product: Construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel electric locomotives.

8. GenMet Corp

www.genmet.com

Location: Mequon, WI

Product: Metal fabrication

9. Jabil

www.jabil.com

U.S. Headquarters: St. Petersburg, FL

Product: Independent supplier of turnkey manufacturing services for circuit board assemblies, subsystems and systems.

10. Lockheed Martin

www.lockheedmartin.com

Headquarters: Bethesda, MD

Product: American global aerospace, defense, security and advanced technologies

11. Nike

www.nike.com

World Headquarters: Beaverton, OR

Product: Footwear and apparel

12. Procter & Gamble

www.us.pg.com

U.S. Headquarters: Cincinnati, OH

Product: Product ranges including family, personal and household care products.

13. Rockwell Automation

www.rockwellautomation.com

Headquarters: Milwaukee, WI

Product: Industrial automation and information products

14. Tenneco

www.tenneco.com

Location: Lake Forest, IL

Product: Clean air and ride performance products and systems for the automotive, commercial truck and off-highway markets and the aftermarket.

15. Toyota Motor North America, Inc.

www.toyota.com

U.S. Headquarters: Torrance, California

Product: Motor vehicles

16. Whirlpool Corporation

www.whirlpoolcorp.com

Headquarters: Benton Harbor, MI

Product: Home appliances

ACTIVITY 6:

DIGGING DEEPER — DEVELOP A JINGLE OR SLOGAN

Notes for Chapter 2, Activity 6

The purpose of this activity is to demonstrate to students that there are professional organizations in manufacturing and that marketing plays a role in many aspects of manufacturing.

ACTIVITY 7:

CAREER INVESTIGATION

CHAPTER THREE: CAREERS IN MANUFACTURING

1. Douglas Machine builds machines that put prepackaged goods into another case to be sold. They design machines and fabricate their own parts.
2. Careers discussed in the video:
 - CNC Programmer: develop and run programs which direct the CNC machines to cut and shape metal or plastic for such things as airplanes, automobiles and other industrial machines.
 - President and COO: President oversees all aspects of the company including day to day operations. COO stands for 'Chief Operations Officer.'
 - Sales Support: These team members cultivate new sales leads for the sales team, monitor customer accounts, help keep the sales team in the field so they can sell the products.
 - Field Support: These team members respond to customer issues and ensure quality follow up to customers.
 - Paperboard Mechanical Engineer: Mechanical Engineers that specialize in paperboard products.
 - Administrative Assistant: Usually one of the first people that you see when you enter a company. Daily tasks include correspondence, scheduling, word processing, creating presentations for others, etc.
 - CEO: Chief Executive Officer, inspires employees to do a good job, works with COO, investor relations.
 - Engineering Technician: This person is trained with skills to assist the engineer. Engineering technicians solve technical problems. They work on research and development projects.

ACTIVITY 8:

CAREER INVESTIGATION

1. The Dynamic Group designs injection molds and metal injection molds for the medical industry.
2. Careers discussed in the video:
 - Tooling Manager: They are in charge of the tool room, ordering tools, provides tools in good working order.
 - Co-owner: Is someone that owns a company with another person.
 - Molding Manager: This person has worked in injection molding and now manages/leads the molding portion of the company.
 - IT Manager: Manages staff, data networks, computer hardware/software.

ACTIVITY 9: CAREERS & EDUCATION

- | | | |
|---------|----------|-----------------------------|
| 1. b | 11. b, d | 21 – 27. (in any order) |
| 2. e | 12. a | • Industrial Engineering |
| 3. a | 13. a | • Mechanical Engineering |
| 4. d | 14. a | • Chemical Engineering |
| 5. c | 15. a | • Electrical Engineering |
| 6. a | 16. e | • Applied Engineering |
| 7. b, d | 17. a | • Manufacturing Engineering |
| 8. a, d | 18. b | Additional: Biomedical |
| 9. c | 19. c | |
| 10. a | 20. d | |

ACTIVITY 10: CAREER & EDUCATION

CHAPTER THREE: CAREERS IN MANUFACTURING

1-6. Student answer.

ACTIVITY 11: PROFESSIONS

CHAPTER THREE: CAREERS IN MANUFACTURING

- Lead safety teams within the company. Teach safety initiatives/training. Reviews worker injury cases. Keeps a database of injuries.
- A person who keeps track of logistics, materials, ordering, shipments, planning.
- GMAW = Also called MIG welding. Gas Metal Arc Welding.
SMAW = Called stick or arc welding. Shielded Metal Arc Welding.
TIG = Tungsten Inert Gas. Expert operators are used.
Oxy Acetylene = Used for maintenance work and gas metal cutting.
- Student answer.

ACTIVITY 12:

MANUFACTURING WRAP UP

Notes for Chapter 3, Activity 12

Students can answer the question on paper, interview, and/or video each other.

Things to think about:

Was there a manufacturing company that intrigued you?

Was the company a manufacturer of:

- Aerospace equipment
- Agricultural equipment
- Medical/Dental equipment and supplies
- Petroleum/Natural gas machinery
- Renewable energy equipment/parts
- Sports equipment
- Other

Why is the product(s) they make so cool?

“Do you consider manufacturing important to the US economy? Why?”

IF STUDENTS ARE STUCK

YouTube Video: Manufacturing: Your Future? <https://www.youtube.com/watch?v=wk4SjFWD6tg>

- 17 million jobs in manufacturing
- In 2012, manufacturers contributed \$2.03 trillion to the U.S. economy



ADDITIONAL RESOURCES

360

360mn.org

Information about manufacturing careers, including information for students and educators.

APICS Supply Chain STEM Educational Outreach

www.apics.org/supplychainstem

Dream It. Do It. Minnesota

dreamitdoitmnmn.com

Career resources, videos, and additional information about manufacturing in Minnesota.

Dream It. Do It.

<https://www.youtube.com/user/DreamItDoItMN/featured>

Videos on YouTube (Click on playlists.)

MN Curriculum Frameworks

<http://education.state.mn.us/MDE/EdExc/StanCurri/K-12AcademicStandardsSTEMScienceTechnologyEngineeringandMathematics/index.htm>

PBS Kids

<http://pbskids.org/designsquad/build/rubber-band-car>

Minnesota STEM Teacher Center

<http://www.scimathmn.org/stemtc>

eGFI (Engineering, Go For It!)

egfi-k12.org

An interactive website that offers information about engineering.

FIRST Robotics

usfirst.org

Exciting mentorship programs in science and technology.

How Everyday Things Are Made

manufacturing.stanford.edu/hetm.html

A website that provides information and videos about how different things are made.

How Stuff Works

science.howstuffworks.com/how-its-made-videos-playlist.htm

A video playlist that shows how things are made, from guitars to pinball machines.

ISEEK

iseek.org/industry/manufacturing/

Provides information about various careers, including an area about manufacturing.

I WAS wondering...

iwaswondering.org

A website designed to help you learn more about science and engineering.

Try Engineering

<http://tryengineering.org/play-games>

A website designed to engage students to learn about what engineering is by the use of games.

Trades Gamer

<http://tradesgamer.com>

This website provides students a way to learn about welding through the TIG welder game.

Making Science Make Sense - Bayer

<http://www.bayer.com/en/making-science-make-sense>

Getting a million children interested in science by 2020 – that's the clear goal of the Bayer program "Making Science Make Sense".

Manufacture Your Future

<http://www.manufactureyourfuture.com>

Alcoa Foundation and Discovery Education have partnered to provide 3rd-12th grade educators, administrators, school counselors and families with materials to cultivate the next generation of manufacturing leaders and innovators.

Manufacturing Day

<http://www.mfgday.com>

Manufacturing Day is a celebration of modern manufacturing meant to inspire the next generation of manufacturers.

Manufacturing is cool!

manufacturingiscool.com

Learn how manufacturing makes our lives better, including videos about how things are made, how electronics work, and information about careers.

The Manufacturing Institute

themanufacturinginstitute.org

Affiliated with the National Association of Manufacturers, the Manufacturing Institute provides information about manufacturing in United States and the national Dream It. Do It. program.

O*NET

onetonline.org

Provides information about careers, including manufacturing.

Project Lead the Way

pltw.org and www.mnpltw.org

This national program offers pre-engineering middle school and high school curriculum.

Rock MFG DAY Kit

<http://edufactor.org/FeaturePage.aspx?id=rock-mfg-day-kit&zid=217>

The Rock MFG Day Kit is a time-saving and turnkey package of cinematic media and interactive resources to promote and host an event that will change perceptions of manufacturing, inspire students, spark conversations, connect to parents and provide meaningful feedback on the success of the event.

Siemens Science Day

<http://siemensscienceday.com>

VEX Robotics

vexrobotics.com

Designed for students ages 12 and up, the VEX Robotics Competition (VRC) is a small team robotics program that requires teams to build a robot using a VEX Robotics Design System kit.

[illegible]



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