ANALYZING THE MANUFACTURING LABOR MARKET

Unit 1

Summary

In this unit, students are introduced to the big picture of labor market realities—which industries are growing, which are shrinking, and technology's impact on the market. They learn about a range of careers in Manufacturing.

1 · LABOR VOCABULARY: WHAT ARE WE TALKING ABOUT WHEN WE TALK ABOUT LABOR?

Students learn the language of labor—careers, jobs, industries, sectors—what does it all mean?

LITERACY TIE-IN: Determine meaning through activating background knowledge

2 · WHAT IS THE MANUFACTURING SECTOR?

Students read a labor overview of the Manufacturing sector and work together to summarize its main points.

TASC TIE-IN: Determine central idea

3 · MYTHS AND FACTS ABOUT JOBS IN MANUFACTURING

Students complete an anticipation guide prior to reading an article that discusses myths and facts about careers in Manufacturing.

4 · INTERPRETING BAR GRAPHS: JOB LOSSES AND GAINS ACROSS SECTORS

Students predict then analyze a graph showing the job losses and gains by sector and consider which fields are ones to watch.

TASC TIE-IN: Interpret graphs

4.1 • Interpreting Graphs: Total Employment and Compensation in Manufacturing*

Students interpret graphs that include information on Manufacturing subsectors in New York State, average salaries and benefits, and the impact of educational attainment on wages.

NUMERACY TIE-IN: Calculations with Percents

TASC TIE-IN:
- Interpret graphs
- Cite evidence from the text to support your analysis

5 · DEVELOPING A MANUFACTURING VOCABULARY

Students review a list of Manufacturing terms and match them to their definitions.

* ADAPT TO YOUR REGION

*RAENs will provide regional adaptations.

6 · THE MANUFACTURING CYCLE

Students learn about the steps involved in taking a product from idea to production, and finally to distribution. They work in groups to identify tasks in each phase required to produce and distribute a product.

6.1 • Manufacturing Jobs and Skills
Students discuss careers in each phase of the manufacturing cycle and brainstorm the duties and skills associated with those jobs.

7 · PROBLEM-SOLVING IN MANUFACTURING: PACKING A SHIPPING CONTAINER

NUMERACY TIE-IN
- Estimation
- Volume
- Using Math to Support a Claim

TASC TIE-IN
Mathematical Modeling with Geometry

Students work in groups to solve a real-world math problem of determining how to arrange boxes in a shipping container to fit the maximum number of boxes.

8 · SERIES: HOW DOES TECHNOLOGY AFFECT TODAY'S LABOR MARKET?

8.1 • Technology in the Workplace
Students learn how technology both positively and negatively impacts the workplace, including the number and type of jobs available, the job search process and the need to stay current on technology to remain a valuable worker.

8.2 • Technology's Impact on Manufacturing
Students read an article about technological advances in the Manufacturing sector and how they impact employment in the sector, while working on vocabulary comprehension.

TASC TIE-IN
- Discern meaning from context clues
- Emergence of Modern America
- Industrial Revolution

8.3 • Technology's Impact on Products
Students read an article about 3D printing and the way that fabrication of products is changing. They complete a fill-in-the-blank (cloze) activity that highlights key points.

9 · EMPLOYER TYPES IN MANUFACTURING*

In groups, students read about different classifications of employers, then identify businesses they are familiar with from their own experience that fall into these classifications.

Labor Vocabulary: What Are We Talking About When We Talk About Labor?

45 MINUTES

Students learn and practice using terms common to the consideration of careers, laying the groundwork for future reading, discussions and career research.

LITERACY TIE-IN: Determine meaning through activating background knowledge

PREP

- Become familiar with the terms on the *Labor Terminology* information sheet.

MATERIALS

- *Labor Terminology* information sheet
- *Labor Terminology* worksheet
- *Labor Vocabulary Questions* worksheet

DISCUSS

1. Explain that you are going to talk about careers. Ask students what words come to mind when they think about careers. Discuss the meanings of these words.
2. Distribute the *Labor Terminology* worksheet and ask students to work in pairs to write what they think each of the terms means.
3. Discuss the definitions, using the *Labor Terminology* information sheet as a guide. Ask students where and when they have heard each term in the past, for example on the news, in readings for school, etc. Feel free to alter the language of the definitions to make them most meaningful to students. Ask students to take notes on the definitions.
4. Distribute the *Labor Vocabulary Questions* worksheet and ask students to complete it, in pairs during class or alone for homework.

Labor Terminology

Read the term in the left-hand column. Then write what you think the term means in the center column. As the class discusses each definition, take notes and write the definition in the right-hand column.

Term	What I Think it Means	Definition
Industry		
Occupation		
Profession		
Job		
Employment		
Career		
Labor Force		

Labor Terminology Information Sheet

Industry
An industry is a group of organizations that do the same type of work. It is a way of grouping employers. All of the employers in healthcare, for example, hospitals, nursing homes and physical therapy practices, provide services to keep people healthy. The word "sector" means the same thing as "industry."

Occupation
An occupation is a group of jobs that involve performing the same type of activities. It is a way of grouping workers. For example, people who work as nursing assistants or home health aides all help people who are sick. You can do this type of work in different places for example, in a patient's home, in a hospital, or in a nursing home.

Profession
A profession is a group of jobs that requires advanced degrees and qualifications, such as being a doctor, a nurse, a lawyer, or a teacher.

Job
A paid position with a particular employer. The job-holder is the employee.

Employment
A relationship between an employer and an employee in which the employee is paid to do work for the employer. Employment can be part-time or full-time. It also can be temporary or permanent.

Career
One job or a series of related jobs that a person has over a period of several years. For example, a person could be a teacher for a long time and have a career in education. Or he could have a job as a home health aide and after several years of experience and more education, he could advance to a job as a medical assistant. This would be a career in healthcare. This person has a career in healthcare. A person can have more than one career over a lifetime.

Labor Force
The United States labor force refers to all the people in this country who are 16 years of age or older who are either able to work, are looking for work or are working. Labor force can also mean all of the people who work for a particular employer or in a specific city, for example, Target's labor force or New York City's labor force. Workforce and labor force mean the same thing.

By Lesley Hirsch and Alison Richardson, The New York City Labor Market Information Service of the CUNY Graduate Center, 2015

Labor Vocabulary Questions

Use the vocabulary definitions from the *Labor Terminology* worksheet to answer the following questions.

1. What is the difference between a **job** and a **profession**?

2. Does a person with a profession likely earn more than a person with a job? Why or why not?

3. For each of the following, circle the correct definition:

   1. An **employee** is a **worker** / **boss**
   2. An **employer** is a **worker** / **boss**

   Is the boss always the same as the employer? Why or why not?

4. Healthcare, retail and construction are examples of industry sectors. Give an example of a career within each of these industry sectors:

   a. Healthcare
   b. Retail
   c. Construction

5. What is one **industry** that you might be interested in working in and why?

What is the Manufacturing Sector?

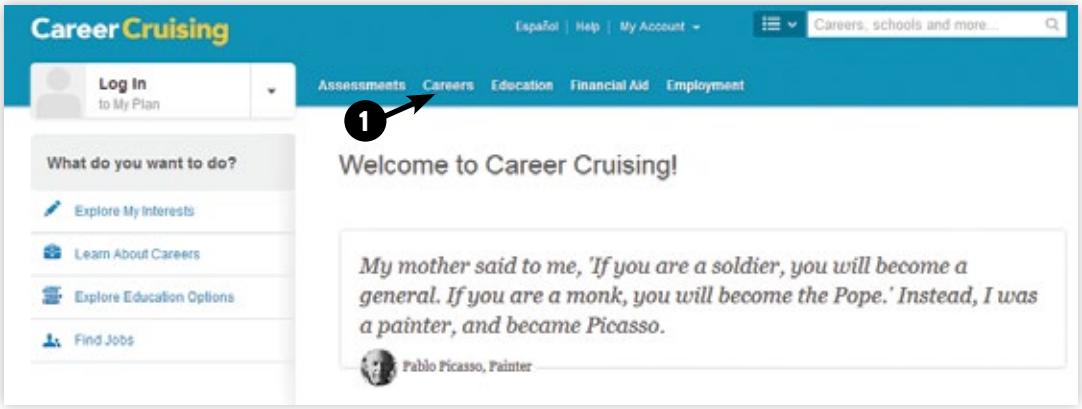
2 HOURS

Students read a description of the Manufacturing sector overall, then summarize its main points, choosing from a variety of summary formats.

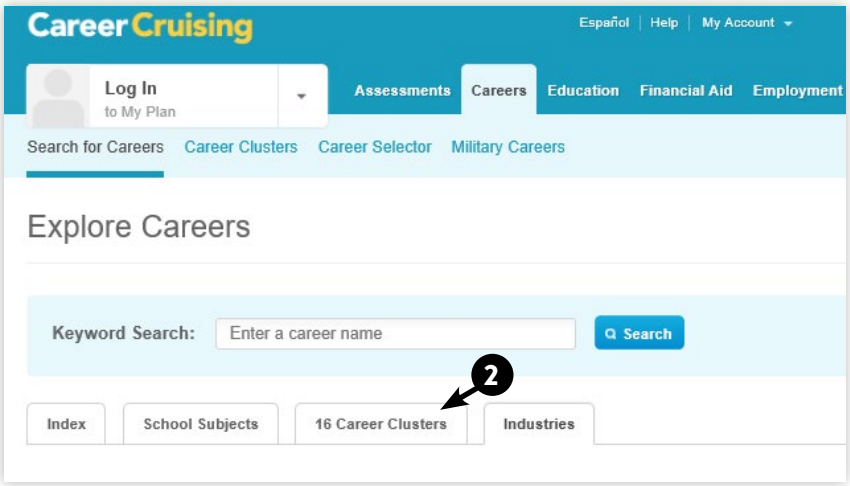
TASC TIE-IN Determine central idea

PREP

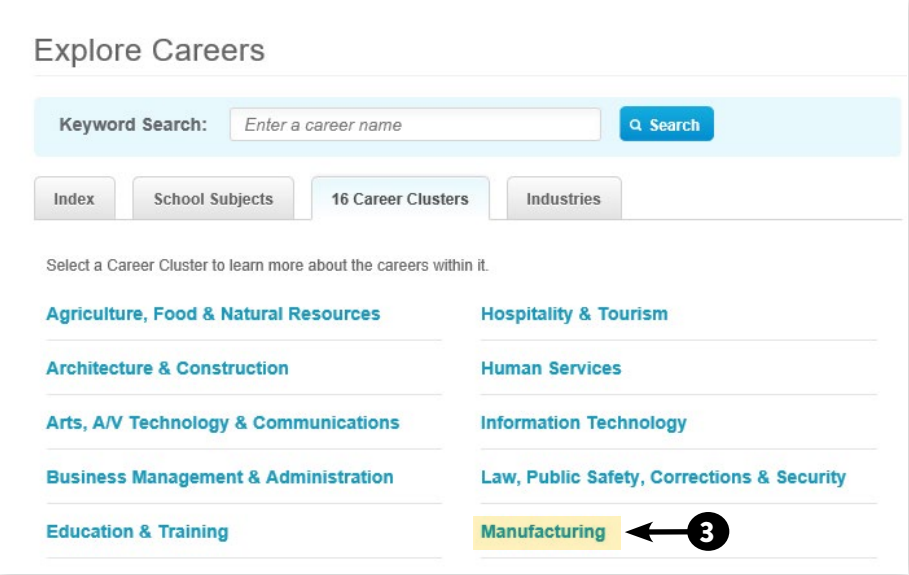
- Read *Manufacturing Sector Profile*
- Navigate to **careercruising.com**. The Career Cruising website requires a subscription username and password. If your program does not subscribe to careercruising, use the CareerZone website. Once in Career Cruising, navigate to the **Careers** section. This is a resource for the teacher to learn background information about the Manufacturing sector.



Next click on **16 Career Clusters**.



Lastly, navigate to **Manufacturing** and read about the Manufacturing Sector.



MATERIALS

- *Manufacturing Sector Profile*
- Chart paper, markers and post-it notes

DISCUSS

1. When you think of jobs in Manufacturing, what jobs do you think of:
   - *Assembly line workers, welders, engineers, designers, product testers, machinists.*

2. Where do people in Manufacturing work?
   - *Large factories, small businesses, government agencies, and anywhere that items are produced and maintained.*

3. Are all jobs that work with machines part of the Manufacturing sector? For example, are sonographers (people who operate sonogram machines) part of the Manufacturing sector?
   - *No, because the Manufacturing sector exists to produce items, using a combination of machines and human labor. Many sectors use machines, to serve the public. The Manufacturing sector uses machines to create products.*

4. Manufacturing interacts with many other industries. Although Food Production can be considered part of this sector, for our discussion, we will focus only on non-food items.

EXPLAIN

1. We're going to learn a lot about working in the Manufacturing sector and about various jobs and career pathways. Let's begin with thinking about which careers and employment settings are included in the Manufacturing sector. Distribute *Manufacturing Sector Profile*.

2. Ask students to read the article, then turn to a partner and identify the main ideas of the article.

   › *Manufacturing jobs include a variety of tasks, such as designing products, assembling products, programming machines to cut parts, maintaining machines, and doing quality control to make sure that the products are well-designed and well-made.*

3. Ask students to read the article a second time, explaining that when they are finished reading, they will write a summary of the article without looking at it. Ask students to explain what a summary is and discuss any confusions.

   A **summary** *is a brief explanation of the main points. It does not include a lot of details and uses the summarizer's own words.*

4. Ask students to put the article away and write a 3-5 sentence summary of the article.

5. Ask for a few volunteers to read their summaries aloud.

6. Divide the students into six groups and assign each group one of the profile sections.

7. Distribute chart paper and markers to each group. Each group should create a short summary about their section. It may be in the style of a traditional summary, bullet point list, word cloud, FAQ, comic, or other visual representation.

8. Post the chart paper on the walls and have students do a "gallery walk", where they walk in their groups to read all other groups' summaries. At each summary, they first read, then write on their post-its what they wonder based on what they have read, and place them on the summary. Once everyone has visited each summary, tell each group to take their own group's summary along with the post-it comments back to their seats.

9. Ask each group to read the post-it annotations on their chart papers and to discuss them in their groups.

10. Have one representative from each group share their responses to the post-it comments with the rest of the class.

Manufacturing Sector Profile

Written by the New York City Labor Market Information Service.

1. What is Manufacturing?

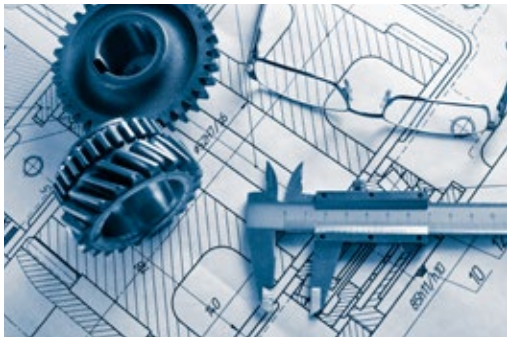


Image: http://www.nabasoft.com/wp-content/uploads/2016/04/Manufacturing-MABlogImage.jpg

Establishments that work in Manufacturing convert raw materials or parts into finished goods. For example, a paper mill turns wood from trees or recycled materials into paper. A garment manufacturer turns fabric into clothing. Some manufacturers make parts for other manufacturers to use. For example, one manufacturer may make the parts another business needs to assemble an airplane or a computer. Manufacturers make products in different ways, for example, some make items by hand, others produce items using the latest technology and/or produce large amounts of standardized products using an assembly line. Establishments in this sector use these techniques to make a wide range of products such as apparel (clothes), computers and electronic equipment, aluminum, glass, concrete, tractors and televisions.

2. The History of Manufacturing in New York State

For much of its history, New York State was a powerhouse of Manufacturing activity. New York City was its largest Manufacturing center, particularly known for apparel Manufacturing in the 'garment district', a neighborhood that is still known for fashion and design. Manufacturing jobs were also a source of economic prosperity for upstate communities that hosted large Manufacturing plants, such as Kodak and Xerox in Rochester, General Motors and the auto industry in Buffalo, and General Electric in Schenectady and Utica. Cities such as Binghamton, Elmira, Syracuse, and the Albany-Troy-Rensselaer area produced everything from shoes to aircraft simulators and automobile parts.

During the last 50 years, Manufacturing employment in New York State has steadily declined. Between 2000 and 2010, the number of jobs in Manufacturing in the State fell from 752,300 to 457,800. More recently, between December 2015 and December 2016, the sector lost 9,900 jobs. Despite these losses, Manufacturing still represents about 5% of total employment in New York State and is a significant industry in some regions. For example, the Capital Region gained 3,000 Manufacturing jobs between 2009 and 2014. These new jobs were concentrated in chemical Manufacturing, fabricated metal product Manufacturing, machinery

Manufacturing, and computer and electronic product Manufacturing. Across the State there are efforts to revive Manufacturing, and parts of the industry are expected to grow between now and 2024.

3. Who Works in the Manufacturing Sector?

The average age of workers in Manufacturing in New York State is 47 years old. This is older than the average age of all workers across all industries in the state, which is 42 years old. As these workers begin to retire and exit the workforce, new workers will be needed to take their places. Many of the jobs that will become available as these retirees leave the sector will be in the skilled trades. Examples of jobs in the skilled trades are welders, electricians and machinists. Some skilled trade jobs pay well above New York State's overall median annual wage and many do not require more than a high school degree or equivalent. People who work in the skilled trades often go through apprenticeships and receive on-the-job training.

4. Technology's Impact on Manufacturing

Employers in this sector are increasingly using high-tech production processes to make their work more efficient and precise. Manufacturers need fewer workers in today's technologically advanced factories than they did in the past because automation is replacing workers. The workers they hire need more advanced technical skills than those who worked in the industry previously. Manufacturing workers use technology at work to do tasks such as collecting, organizing and analyzing data; creating products or parts of products; managing production processes; keeping track of the hours people work; communicating with colleagues; and scheduling their appointments. Basic computer skills are needed for most jobs in the industry.

5. Outsourcing Abroad

Some manufacturers have moved their production facilities abroad or contract with companies in other countries to manufacture parts or products. In general, the cost of labor and raw materials is cheaper in these countries. Manufacturing abroad can save manufacturers money, but it reduces the number of jobs in the United States. Because Manufacturing has become so automated, some experts say that manufacturing products in the United States is becoming cheaper, so some companies are starting to do work in the U. S. that they used to do abroad.

6. Jobs in Manufacturing

Five very common occupations in Manufacturing in New York State are:

1. **Team Assemblers**—work as part of a team that assembles finished products or finished parts. Their responsibilities may include: performing quality

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checks on the items they assemble; preparing finished products for shipment; cleaning work areas; and reviewing work orders to make sure everything has been done properly. They typically need a high school diploma or equivalent. In 2016, there were 38,400 team assemblers across New York State earning an average annual salary of $31,080.

2. **First-Line Supervisors of Production and Operating Workers**—supervise and coordinate the activities of production and operating workers, such as team assemblers. Their responsibilities may include: making sure safety and sanitation rules are being followed; coordinating the employees; planning with other supervisors; setting work schedules and assignments to meet production goals; and inspecting materials, products, or equipment to detect defects. These supervisors typically need a high school diploma or equivalent. In 2016, across New York State, there were 25,650 Manufacturing first line supervisors and they earned an average annual salary of $65,860.

3. **Inspectors, Testers, Sorters, Samplers, and Weighers**—inspect, test, sort, sample, or weigh raw materials, parts or products to see if they are damaged. Their responsibilities may include measuring the dimensions of a product to make sure they are correct; reading manuals and other materials; recording data; and determining which products are acceptable and which should be rejected. They typically have a high school diploma or equivalent. In 2016, across New York State, there were 20,681 of them and they earned an average annual salary of $41,650.

4. **Machinists**—set up and operate a variety of machines to produce specific metal parts, instruments and tools. Their responsibilities may include calculating dimensions; securing tools, accessories, or materials onto machines; measuring, examining, or testing completed products to check for defects. Machinists typically need a high school diploma or equivalent. In 2016, across New York State, there were 13,480 machinists and they earned an average annual salary of $44,460.

5. **Sales Representatives**—sell products to businesses or groups of individuals. Their responsibilities include contacting existing and potential customers to tell them about the products they are selling; recommending products to customers, based on the customers' needs and interests; estimating prices and delivery dates; and following up with customers after they have purchased a product to resolve problems and to provide support. Sales representatives typically have a high school diploma or equivalent. In 2016, across New York State, there were 89,800 Manufacturing sales representatives and they earned an average annual salary of $72,640.

The specific titles and responsibility of these jobs are likely to vary by employer. All five occupations are expected to grow between now and 2024. •

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Myths and Facts About Jobs in Manufacturing

45 MINUTES

Students learn which common beliefs about Manufacturing jobs are true and which are false by completing an anticipation guide, then reading an article about the current state of jobs in the industry.

PREP

- Students may already be familiar with some of these terms. Be prepared to explain them all: **Compensation, Significant, Untold, Emerging, Shortage, Hub, High-Profile, Service-Sector, Reputation, Welder, Assembly Line, Segment, Gross Domestic Product (GDP), Male-Dominated, Board Seat, CEO, Mentoring, Workforce, Innovative, Critical**

MATERIALS

- *Myths and Facts About Jobs in Manufacturing* article
- *Myths and Facts About Jobs in Manufacturing Anticipation Guide*
- *Anticipation Guide Answer Key* teacher resource

DISCUSS

1. **Ask:** What do you think of when you hear the word Manufacturing?
   - › *Students might say: Factories, machines, products, robots, dangerous, assembly lines.*
2. Distribute the *Myths and Facts About Jobs in Manufacturing Anticipation Guide* and ask students to complete it with a partner.
3. Distribute the article *Myths and Facts about Jobs in Manufacturing*. Ask students to read and discuss the article with the same partner.

   Which information in the article was new or surprising?
4. Ask the pairs to make corrections to their anticipation guides based on information from the article. Ask the pairs which statements they changed, if what they learned surprised them, and if so, why.

VOCABULARY

- Compensation
- Significant
- Untold
- Emerging
- Shortage
- Hub
- High-Profile
- Service-Sector
- Reputation
- Welder
- Assembly Line
- Segment
- Gross Domestic Product (GDP)
- Male-Dominated
- Board Seat
- CEO
- Mentoring
- Workforce
- Innovative
- Critical

Myths and Facts About Jobs in Manufacturing Anticipation Guide

With a partner, write True or False based on your understanding of the following statements.

1. _____ Hourly pay in Manufacturing jobs is higher than in other industries.

2. _____ Manufacturing workers must be in strong physical shape.

3. _____ Between now and 2022, there are expected to be are over 2 million openings for production workers in the Manufacturing sector.

4. _____ You need an Engineering degree to work in Advanced Manufacturing.

5. _____ Women currently hold about 50% of Manufacturing jobs.

Anticipation Guide Answer Key

Adapted from "Debunking myths about manufacturing jobs" by Lauren Flick
http://www.cnbc.com/2015/06/17/debunking-myths-about-manufacturing-jobs-.html

1. **TRUE** According to the U.S. Department of Commerce, hourly compensation is 16.5 percent higher on average in Manufacturing than in other industries.

2. **FALSE** "The reality is that today's Manufacturing workers are as likely to operate robots as they are wrenches, and use math more than muscle—this isn't your grandpa's factory floor."

3. **TRUE** Between now and 2022, the Manufacturing sector will need to fill 2.2 million openings for production workers.

4. **FALSE** "You don't need an Engineering degree, or even any degree, to work in Advanced Manufacturing, although of course it is helpful."

5. **FALSE** Women currently hold a mere 27 percent of Manufacturing jobs, according to the congressional report—only 17 percent hold board seats, only 12 percent are executive officers, and just 6 percent are CEOs.

Myths and Facts About Jobs in Manufacturing

By Lauren Flick, Wednesday, 17 Jun 2015

Adapted from "Debunking myths about manufacturing jobs" by Lauren Flick
http://www.cnbc.com/2015/06/17/debunking-myths-about-manufacturing-jobs-.html

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Manufacturing jobs have a reputation—and it's often not a good one. The typical image of a Manufacturing job is of dirty, backbreaking, low-paying labor. It's also thought to be an industry dominated by men. But separating fact from fiction about the actual people behind the welder's mask and on the assembly line can be tricky.

Image: http://cdn.moneyfeedsme.com/wp-content/uploads/2016/04/13155739/Production-Workers.jpg

Manufacturing jobs are low-paying.
MYTH: According to a report by the U.S. Department of Commerce, hourly compensation is 16.5% percent higher on average in Manufacturing than in other industries. What does that translate to as an average annual salary? More than you might think. According to the U.S. Department of Commerce, the average Manufacturing worker in the United States earned $79,602 annually, including pay and benefits.

A congressional report by the U.S. Joint Economic Committee also noted that "Manufacturing jobs are more likely to come with benefits, including medical and retirement benefits, than service-sector jobs. They also are more likely to require on-the-job training than jobs in other segments of the economy."

Sen. Amy Klobuchar (D-Minn.), who led the congressional report, noted that U.S Manufacturing accounts for 12 percent of gross domestic product (GDP) and employs 12 million workers nationwide.

Manufacturing jobs tend to be low-skill positions, with limited opportunities.
MYTH: "The reality is that today's Manufacturing workers are as likely to operate robots as they are wrenches, and use math more than muscle—this isn't your grandpa's factory floor," Sen. Klobuchar said in her email.

A report released this February from Deloitte and The Manufacturing Institute, which included interviews with 84 percent of Manufacturing executives, said there is a significant talent shortage in the sector. Between now and 2022, the

Manufacturing sector will need to fill 2.2 million openings for production workers. Half a million of those openings will be for Engineers, and an untold number of job openings will be for new, emerging occupations.

In an effort to address this shortage and improve Manufacturing technologies, former President Obama created the Nationwide Network for Manufacturing Innovation (NNMI). It works with the National Institute of Standards and Technology (NIST) on a network of Manufacturing centers that receive government funding and private-matching funds and connect to colleges and universities to educate and train workers in the Manufacturing-related technology that will be necessary for the future.

Dr. Frank W. Gayle, deputy director of the Advanced Manufacturing National Program Office (AMNPO) said, "You don't need an Engineering degree, or even any degree, to work in advanced Manufacturing, although of course it is helpful. We want kids to know that these jobs are available, that they are plentiful, and they lead to a rewarding and reliable career."

Gayle said there are a handful of regional centers operational right now, but the initiative is expanding nationwide, with 45 centers planned over the next 10 years.

Manufacturing is a male-dominated industry.
FACT: Manufacturing is a male-dominated industry. Mary Barra, the Chief Executive Officer (CEO) of General Motors, might be a high-profile head of a well-known Manufacturing company, but she's an exception. Women currently hold only 27 percent of Manufacturing jobs, according to the congressional report—only 17 percent hold board seats, only 12 percent are executive officers, and just 6 percent are CEOs.

For an occupation that offers so much opportunity, why aren't more women in this sector? In August 2014, Women in Manufacturing (WiM) surveyed 877 women to uncover the divide between young women choosing a career and women with experience working in the Manufacturing industry. Less than 10 percent of women in the 17-to-24 age range selected Manufacturing among their top five career fields—less than half thought the work would be interesting or challenging.

However, among women already working in the Manufacturing sector, 82 percent said they found their field offered interesting and challenging work. Additionally, 74 percent of women in the field felt it did in fact offer multiple career opportunities. "We need to expand mentoring programs, improve workforce training and strengthen science, technology, engineering and math (STEM) education so that more women and girls can see this sector for what it is: increasingly high-tech, innovative and critical to the future of our economy," Sen. Klobuchar said. •

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45 MINUTES

Interpreting Bar Graphs: Job Losses and Gains Across Sectors*

TASC TIE-IN Interpret graphs

Students predict, then read a graph detailing how various industries fared in New York City* in 2004 and 2014.

PREP

- Read the graph, *Job Losses and Gains*

MATERIALS

- *Job Losses and Gains Graph*
- *Prediction Guide: Rising and Falling Industries* worksheet

EXPLAIN

1. Before planning a career, it helps to know which industries are growing, which are shrinking, and which are staying level. At any point in time, the number of jobs in some industries is increasing, and in others, decreasing.

   First off, what do we mean by industry?

   › *An industry is a collection of related jobs. For example, what industry a substance abuse counselor and a sanitation collector belong to? Manufacturing.*

   If a particular industry is growing, what does that mean for job seekers—people looking for jobs?

   › *There are jobs that need to be filled.*

   If it is shrinking, what happens to jobs?

   › *There are fewer jobs. Some people might lose their jobs and there won't be many new openings.*

   Which industries do you think are growing in New York City* right now?

2. Distribute the prediction guide, one per pair, and explain that in partners, students are going to predict which industries increased in 2014, which decreased and which remained level. Then ask, **Which categories do you think Manufacturing jobs fall into?**

   › *Education and Healthcare, Public Administration and Other.*

3. When students are finished, distribute *Job Losses and Gains Graph* and ask them to read it carefully.

* ADAPT TO YOUR REGION
*RAENs will provide regional adaptations.

Prediction Guide: Rising and Falling Industries

With a partner, decide whether you think each of the industries below increased, decreased or remained level between 2004 and 2014, marking a check in the corresponding boxes below. Discuss the reasons for your choices.

Industry	Increased	Decreased	Stayed Level
Manufacturing			
Public Administration			
Financial Services			
Information			
Construction			
Other Services			
Trade, Transportation and Utilities			
Professional and Business Services			
Leisure and Hospitality			
Education and Health			

Department of Labor and CareerKit Sectors

The data on labor statistics included in the CareerKits comes from the Department of Labor, which collects information on hundreds of jobs and businesses. The table below describes the intersection of Department of Labor and CareerKit sectors, which are categorized similarly in many cases, though some differences exist. When considering which sectors to study with students based on the availability of local jobs, use this table alongside the Job Losses and Gains graph.

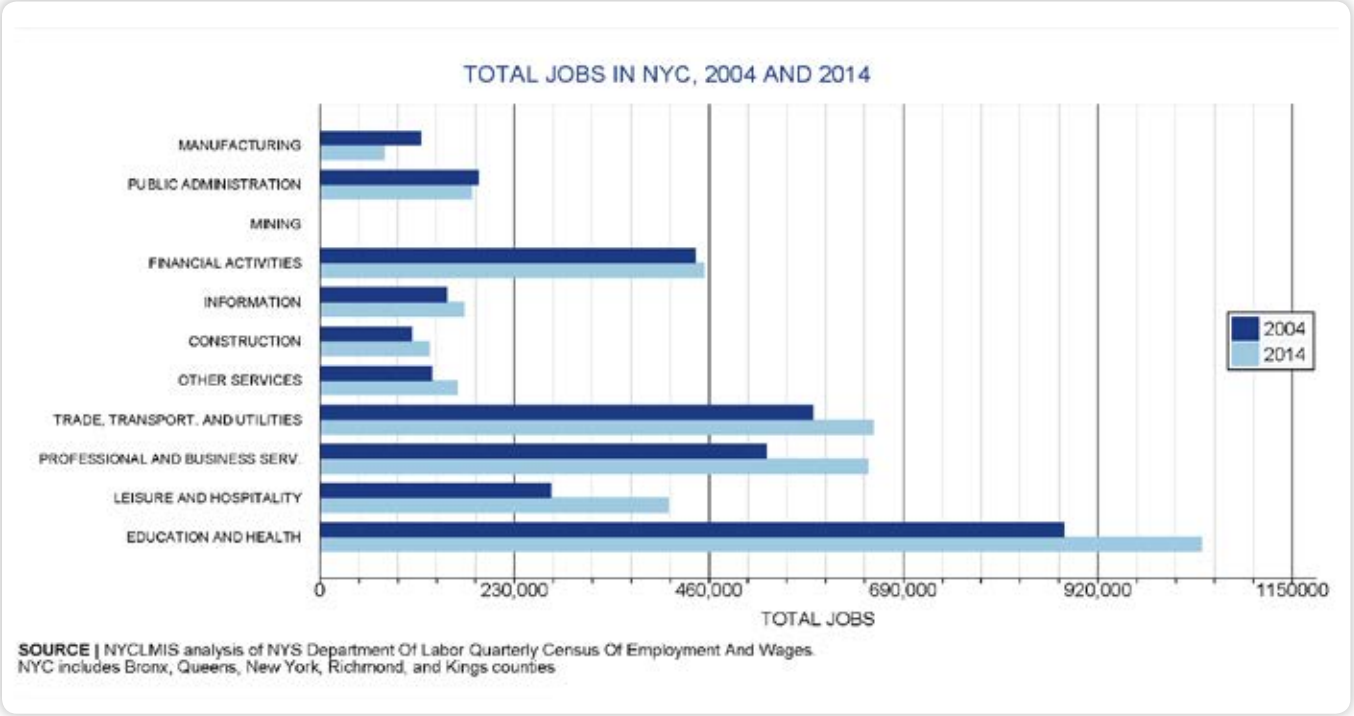
	U. S. DEPARTMENT OF LABOR SECTORS, REFLECTED IN THE JOB LOSSES AND GAINS GRAPH	CAREERKIT LOCATION
Construction	Organizations that build things. This includes organizations that build houses, office buildings, sewer pipes, power lines, highways and bridges. It includes organizations that employ people with general skills such as managing a building project and specialty skills such as carpenters, electricians and plumbers.	Construction
Manufacturing	The CareerKits divide Manufacturing into two sectors: Manufacturing, which includes organizations that make products such as clothing, machines, electronics and cars, and Food Production, which includes organizations that grow, raise and produce products such as apples, bacon, yogurt and milk.	Manufacturing Food Production
Mining and Logging	Organizations that prepare natural resources for use. Some examples of natural resources are coal, metals, minerals, oil, gas and trees.	*Does not appear in the CareerKits*
Education, Healthcare and Social Assistance	Organizations that offer childcare, education and training as well as healthcare and social assistance. This includes daycare centers, schools, colleges, hospitals, shelters and soup kitchens.	Healthcare Education and Childcare Community and Social Assistance
Government	Sometimes called “public administration” or “the public sector,” the Government sector includes local, state, and federal agencies. This includes organizations that are in charge of public housing, trash collection and national security as well as prisons, the police and the fire department, among others.	Public sector careers are addressed in every CareerKit sector.
Entertainment, Food and Hospitality	Organizations that provide art, fun, food and places to stay overnight. This includes organizations involved in theater, dance and music, as well as museums, parks, bowling alleys, restaurants and hotels.	Hospitality, Recreation and the Arts
Professional and Administrative Services	Organizations that provide support services to other organizations. This includes services such as accounting, advertising, billing, security, mailing packages and cleaning.	Organizations that are dedicated to these tasks are not included in the CareerKits, however administrative careers are included in every CareerKit.

Banking, Insurance and Real Estate	This sector includes organizations that deal with money. This includes banks as well as insurance and mortgage companies. It also includes organizations that rent property, vehicles or machinery, such as buildings, cars, refrigerators, televisions and bulldozers.	*Does not appear in the CareerKits*
Information	Organizations involved in producing, processing and distributing different types of information. This includes publishers of books, newspapers and computer software as well as producers of movies, music, radio and television programs.	Some of these careers are included in the Technology CareerKit
Trade, Transportation and Utilities	The CareerKits divide this sector into Retail and Transportation & Warehousing. Retail includes businesses that sell products such as clothing, cars, telephones and furniture. Transportation & Warehousing includes airlines, taxi and limousine companies, shipping and trucking. Some utilities are addressed in other sectors, such as phone/internet in Technology and others, and water and sewage treatment are included in the Manufacturing CareerKits.	Transportation and Warehousing Retail Technology Manufacturing
Other	This catchall includes organizations that do things not captured by the other sectors. This sector includes car, computer and shoe repair shops, beauty salons, laundromats, parking lots and religious organizations.	Manufacturing

Continued…

Job Losses and Gains Graph: How Did You Do?*

Read the graph below* noting the employment numbers for each industry sector in 2004 and 2014.



SOURCE | NYCLMIS analysis of NYS Department Of Labor Quarterly Census Of Employment And Wages.
NYC includes Bronx, Queens, New York, Richmond, and Kings counties

DISCUSSION

Before we think about how the data compares to your predictions, let's discuss how to read this graph.

- According to the title, what is this graph about?
- What do the words going down the left side of the page tell you?
- What do the numbers across the bottom of the page tell you?
- What do the dark blue and light blue lines represent?
- What do the heavy black vertical lines represent?
- What do the fine black vertical lines represent?
- Where on this graph is the key? What does it tell you?
- Why are there two years shown on this graph?
- What does it mean when a dark blue line is longer than its partner light blue line?
- What does it mean when a light blue line is longer than its partner dark blue line?
- The heavy black vertical lines represent an increase of 200,000 jobs. How much of an increase does each fine black vertical line represent? How did you arrive at that answer?
- Ask students to find the corresponding industry sectors from the graph listed on their worksheets and discuss how these numbers compare to their predictions.

PAIR ACTIVITY

In pairs, write three statements about the graph, two that are true and one that isn't. When you are finished, share with another pair. Each pair should determine which of the other pair's statements are true and which is false.

FOLLOW-UP DISCUSSION

1. Which sector showed the most job growth from 2004 to 2014? How do you know?
2. Which sector showed the least job growth from 2004 to 2014? How do you know?
3. Why are the industries listed in this order?
4. How is the information in this graph by relevant to a job-seeker?

2.5 HOURS

Interpreting Graphs: Total Employment and Compensation in Manufacturing*

Students interpret a series of graphs examining various aspects of the Manufacturing industry. They learn the representation of Manufacturing workers in New York State by subsector (and what those subsectors are), compare average salaries and benefits of Manufacturing and Non-manufacturing workers, and learn about the impact educational attainment has on Manufacturing employment and wages.

NUMERACY TIE-IN
- Calculations with percents
- Graph interpretation

TASC TIE-IN
Cite evidence from the text to support your analysis

PREP

- Complete all worksheets for this activity to be used as answer keys.
- Be prepared to discuss the terms: **petroleum, textile, mineral, apparel, production, consumption, transformation, sector, cluster, benefits, wage, compensation**.

VOCABULARY

petroleum
textile
mineral
apparel
production
consumption
transformation
sector
cluster
benefits
wage
compensation

MATERIALS

- It is helpful, but not necessary, for students to use calculators for this activity.
- *New York State Jobs in Manufacturing* worksheet
- *New York State Manufacturing Employment, 2000 & 2014* graph
- *Average Employee Compensation per Hour by Industry, 2010* graph
- *Average Employee Compensation per Hour by Industry, 2010—Matching the Questions and the Calculations* worksheet
- *Percent of Workers with Medical Care and Retirement Benefits, March 2011* graph
- *Benefits for Manufacturing Employees* cloze passage
- *Manufacturing Workers and Educational Attainment* graph
- Index cards (one for each student)

NOTE TO TEACHERS

This lesson introduces students to the Manufacturing job market in New York State and some of the benefits of working in the sector. Students should see that although the number of jobs in Manufacturing has declined, there are still a lot of Manufacturing jobs available. On average, these jobs tend to pay better and have benefits more often than do jobs outside of Manufacturing. This lesson explores

* ADAPT TO YOUR REGION
*RAENs will provide regional adaptations.

the conclusions of *The Benefits of Manufacturing Jobs* (2012), a report from the U.S. Department of Commerce, which states:

> *"The United States' manufacturing sector has long been a source of well-paid jobs for relatively less-educated workers and thus has helped support a strong middle class. Today, the sector continues to provide good paychecks as well as important fringe benefits. While the premium exists for both low- and high-skilled workers, it does rise with educational attainment. The educational attainment of the manufacturing workforce has been increasing over time, as more than half of manufacturing workers have completed at least some college and those who enter with a high school diploma are likely to continue their education through extensive on-the-job training."*

We indicate points in the lesson at which the teacher may read quotes from this paragraph, for students to consider in combination with graphs showing relevant data from the Manufacturing job market.

WHAT ARE THE NEW YORK STATE JOBS IN MANUFACTURING?

1. **Brainstorm:** Manufacturing is about making things. What do you think is made in New York State? Give students some time to brainstorm goods or industries. Write their responses on the board. If students have trouble coming up with ideas, you can ask if they know anyone who has worked in Manufacturing or in a factory. What did they make?

2. Distribute the worksheet *New York State Jobs in Manufacturing*. Ask for volunteers to read aloud the descriptions of the Manufacturing clusters.

   Ask: Which of these industries are you familiar with? Which are new to you? Which industries do you think employ the most people?

   Point out the 370,000 total employees at the bottom of the page. Ask students to make predictions about how many people are employed in each subsector, and write their predictions in the prediction column of the worksheet. Remind students that a prediction is an educated guess, and they will be learning the actual numbers soon. When they have each come up with numbers for most of the clusters, ask students to talk to each other and compare their numbers. Remind them that there are no wrong answers at this point, but their predictions should add up to a total of 370,000 employees.

3. Distribute the graph, *New York State Manufacturing Employment, 2000 & 2014*. Ask students to write at least three statements that are true based on the graph. Students should write in full sentences. If students struggle to write sentences, you might give them one or two of the following as models:

- The chart shows different kinds of Manufacturing.
- The chart compares Manufacturing employment data for the years 2000 and 2014.
- Each line on the vertical axis represents 5,000 jobs.
- There were about 45,000 jobs in Transportation Equipment Manufacturing in 2014.
- There were fewer Textile, Apparel and Leather jobs in 2014 than there were in 2000.

After students have written their statements, ask them to share them with a partner, then share with the full group.

Ask: Why are the Manufacturing clusters in this order on the graph? Is it alphabetical?

› *No.*

Is it in order by the industries with the largest number of employees?

› *Not exactly.*

Ask students to talk to each other to see if they can figure it out. If no one has an idea, you can ask them how many jobs there were in Textile, Apparel and Leather in 2000. And how many there were in 2014. And how many jobs were lost. Ask students to describe where on the graph this job loss is shown. It's the difference between the two bar graphs for Textiles, Apparel and Leather manufacturing.

What about Petroleum, Chemical, Plastic and Mineral Manufacturing?

Did the number of jobs go up or down from 2000 to 2014?

How much did they go down?

Eventually, students should notice that the industries are ordered according to the number of jobs lost, from greatest to smallest.

Then say, "*Almost 75,000 New Yorkers worked in Petroleum, Chemical, Plastic and Mineral Manufacturing in 2014.*"

Ask: Do you agree with this statement? Using the graph, explain why it's true or if it's not true, what the correct number is. Students should be able to use the minor grid lines to count up from 60,000 or down from 80,000 to see that, in 2014, there were just below 75,000 jobs in Petroleum, Chemical, Plastic and Mineral Manufacturing.

Ask students to compare this total of 75,000 with their prediction on the *New York State Jobs in Manufacturing* worksheet. **How close was your prediction?** Students should now use the graph to estimate the number of employees in 2014 for each Manufacturing cluster. They should write their estimates under the *Actual number of NYS employees*.

You can use the following table of data to check students' estimates:

Manufacturing Clusters	2000	2014
Computers & Electronics	86,885	56,555
Food & Beverage	54,966	52,756
Furniture & Related Products	23,227	13,257
Metals & Machinery	138,161	93,402
Petroleum, Chemical, Plastic & Mineral	122,863	73,936
Textile, Apparel & Leather	76,728	22,145
Transportation Equipment	45,078	20,439
Wood, Paper & Printing	71,146	37,601

4 We looked at the number of people employed in the Manufacturing industry. Now we're going to look at how they get compensated (paid) for their work.

Note to teachers: The takeaways from this graph are that both the average hourly earnings and the additional benefits for Manufacturing workers on average are higher than those in Non-manufacturing industries.

Distribute the graph *Average Employee Compensation per Hour by Major Industry, 2010* and ask students to write on a separate piece of paper, 1) what they notice and 2) what they wonder. After a few minutes, ask them to share what they notice and write their answers on the board. Then do the same for what they wonder. Students may notice things like:

- *The bar is higher for Manufacturing workers.*
- *Each bar is broken up into two parts.*
- *Manufacturing workers make $38.27 an hour.*
- *Manufacturing workers make more than Non-manufacturing workers.*
- *I don't work in Manufacturing but I don't make $27.47 an hour.*

5 If it doesn't come up in their wondering, some questions you might ask students:

Do Manufacturing workers earn an average hourly wage of $38.27?

- *No. The average hourly wage of all Manufacturing workers is $29.75.*

Does this mean that all Manufacturing workers earn $29.75 an hour?

› *No, some earn more and some earn less. It gives us a general idea.*

What does the $8.52 represent?

› *Additional compensation workers earn on top of their hourly wages through benefits. (We'll talk more about this in the next graph.)*

6 Distribute *Average Employee Compensation per Hour by Industry, 2010—Matching the Questions and the Calculations* (worksheet). Ask students to work for at least five minutes on their own before letting them work in groups of 2-3 students.

Note to teachers: The Math section of the TASC frequently presents a series of procedures and asks students to determine which ones can be used in a particular situation. Students are not required to make any calculations here, but rather to choose which operations to use.

Students may especially struggle with the second question. Give them some time to try to make sense of it. For students who need additional support, ask them to do all the calculations (using a calculator is fine). Sometimes knowing what the number is might provide a clue as to what that number means. You may also write the possible answers on the board, so that students can have something to choose from:

- What is the total salary, including hourly earnings and benefits for Manufacturing workers?
- What are the average weekly earnings of Non-manufacturing workers?
- What is the difference in the average annual salaries between Manufacturing and Non-manufacturing workers?
- What is the percentage difference between the hourly earnings of Manufacturing and Non-manufacturing workers?
- What is the percentage difference between the benefits earned by Manufacturing and Non-manufacturing workers?

7 Ask students to share their answers and give an explanation of their reasoning.

8 Employees receive wages from employers and many, especially those who work in Manufacturing, also receive benefits, such as health insurance and retirement savings, from their employers.

Ask: Can you explain what *percentage* means without using the word percent? A student may be able to explain how to calculate percent without defining it. That's helpful, but it's important that all students understand

what it is before making calculations. An explanation should include the idea that percentage means "for every 100." 30% means 30 out of 100. If 30% of a group of 100 students in a program take the bus to school, that means 30 students in that program would take the bus to school.

In the last graph, *Average Employee Compensation per Hour by Industry, 2010*, we saw that Manufacturing workers on average receive $8.52 per hour in benefits.

Is that cash that the employee receives?

› *No.*

Where is that money going? What benefits do you think it could be paying for?

› *Students may come up with possibilities such as medical insurance, transportation benefits, vacation time, education, childcare, employee discounts, etc.*

In the next graph, we'll learn more about the benefits Manufacturing employees receive.

The next graph we read is going to compare Manufacturing jobs with jobs in service-providing industries. **What jobs are part of service-providing industries?**

› *Almost any job where a service is provided. Retail, transportation, real estate, financing, hospitality, education, health services, etc. It's a very broad category that describes industries that provide services to customers or clients, as opposed to Manufacturing that describes an industry which produces items, often called "goods."*

9 Distribute the graph, *Percent of Workers with Medical Care and Retirement Benefits, March 2011*.

Ask: What benefits are included here?

› *Medical care and retirement.*

Ask: What information is included about medical care and retirement?

Students may struggle with this question. Read the title together and talk about what it means.

What does the 90% refer to? We know that 90% means 90 out of 100. What is the 90%?

› *The percent of the total number of Manufacturing workers who have medical care benefits included in their compensation for work.*

Ask: How is the third category (medical care and retirement benefits) different from the first two?

› *It refers to workers who receive both medical care and retirement benefits.*

10 Now we are going to use the data on this graph to complete a passage comparing the percentages of workers with medical care and retirement benefits. Distribute *Benefits for Manufacturing Employees* cloze passage and ask students to work on it, either individually or in pairs. If any students finish early before you are ready to move on, ask them to use any of the leftover words/numbers from the sheet and write statements with them based on the information included in the graph.

11 Review the passage and answer any student questions.

12 We've looked at the number of employees in Manufacturing, the wages and benefits. Now we're going to learn about how education levels affect earnings in this sector.

Write on the board:

> "The United States' Manufacturing sector has long been a source of well-paid jobs for relatively less-educated workers and thus has helped support the middle class."

What does this sentence mean? Can someone say it in their own words?

13 We've looked at graphs that show persistent higher average wages and total compensation in the form of benefits for Manufacturing workers. These average higher wages and benefits exist for both low-skilled and high-skilled workers in Manufacturing, but they do increase with educational attainment. Distribute the *Manufacturing Workers and Educational Attainment* graphs to each student. Ask students to write three true statements based on the data for each graph (six total) on a piece of paper.

14 Ask students to get into pairs, then give each pair an index card. Have students share their statements and choose the best two (one from each student) to write on their index card. Collect all the index cards.

15 Read through the index cards quickly and choose a few statements you'd like the class to discuss.

16 Write one statement on the board and ask the class if they agree the statement is true. Take a vote and see who thinks it's true and if anyone thinks it is false. Ask for some volunteers to use the data in the graph or chart to make their case and explain why they think the statement is true or false. Repeat this process for as many statements as you like.

If it hasn't come up, ask students what happened when the two lines cross (in the *Share of Workers* graph).

› *That is where the share of workers entering the Manufacturing workforce was 50% workers with a high school education or less and 50% workers with some post-secondary education. It is also the first time (around 2007) when there was a higher percentage of Manufacturing workers entering with some post-secondary education.*

If it hasn't been mentioned, ask students to share some ideas about why there has been a flip in the educational attainment in the share of workers entering the Manufacturing workforce.

› *As Manufacturing becomes more and more automated, fewer jobs require simple assembly such as screwing together parts, and more require operating and even programming complex computerized equipment.*

Ask students the difference in the annual wage of a Manufacturing worker with a high school diploma or less and a Manufacturing worker with a bachelor's degree or higher. (based on the averages in the *Hourly Earnings* graph)

17 Ask students to write a description of either graph, to explain it in words so someone who can't see the graph can understand what it is about.

18 Ask a few volunteers to share their descriptions.

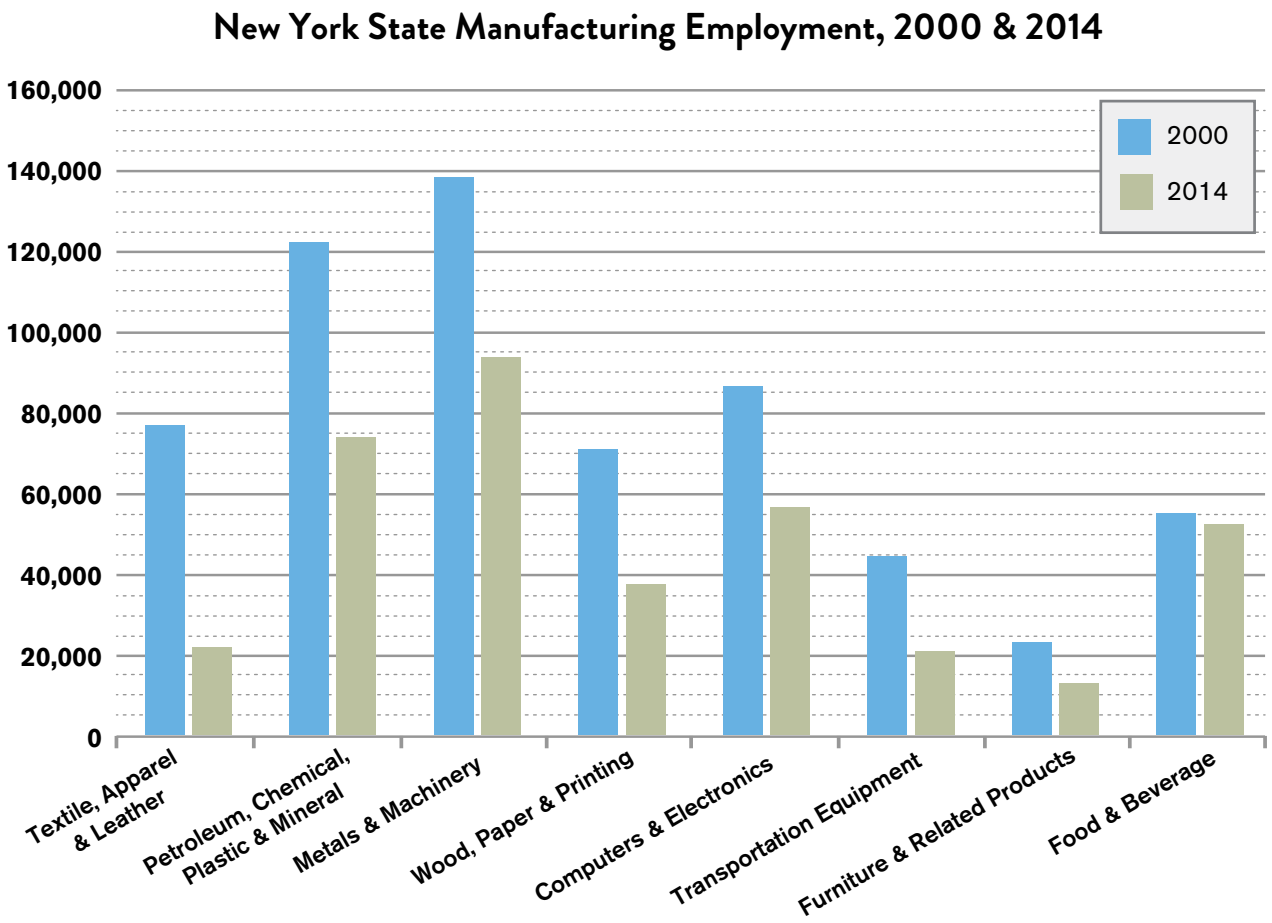
New York State Jobs in Manufacturing

Read the descriptions of Manufacturing clusters below, then make predictions about the number of New York State (NYS) employees in each cluster and write your predictions in the "Predicted" column below. There are a total of about 370,000 Manufacturing workers in New York State.

After reading the graph, *New York State Manufacturing Equipment, 2000 & 2014,* write the most recent number of Manufacturing workers in each industry in the "Actual" column.

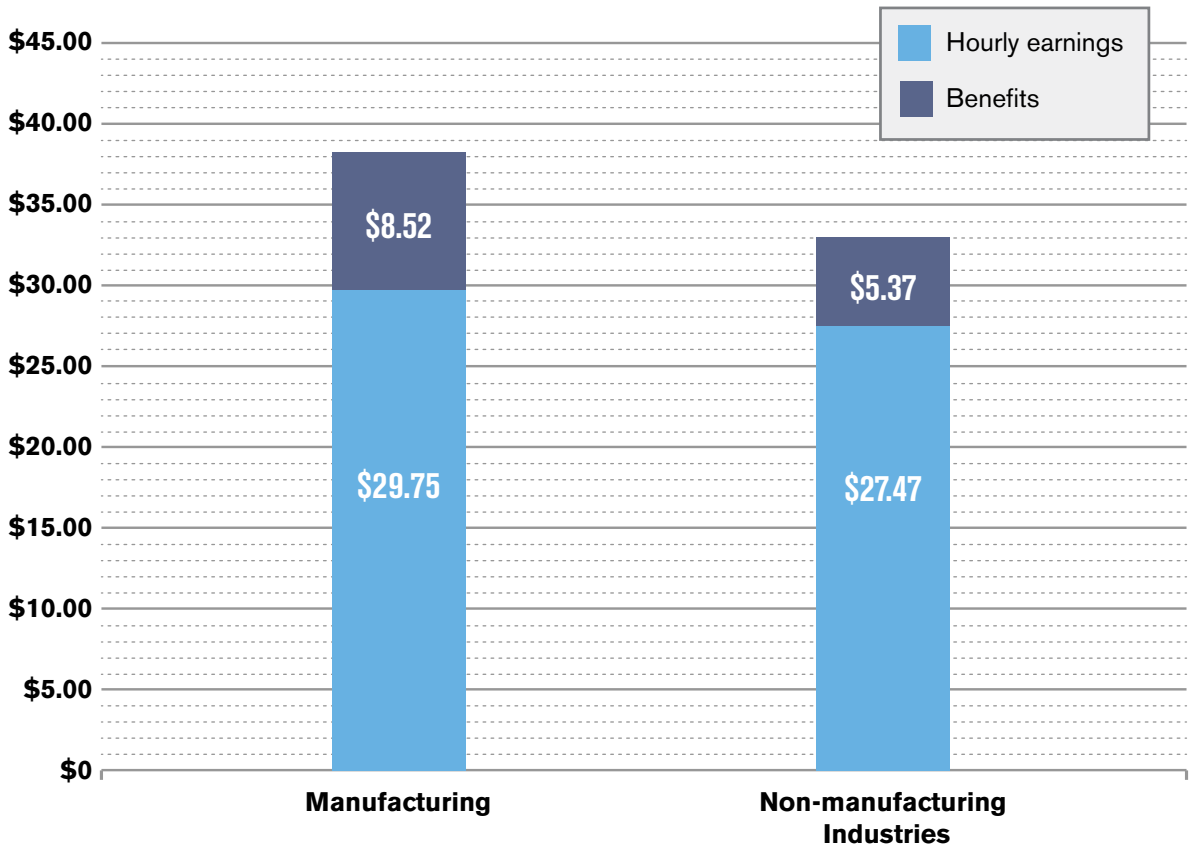
Descriptions of Manufacturing Clusters		Predicted number of NYS employees	Actual number of NYS employees
	**Computers & Electronics** Production of computers and electronics or their components		
	**Food & Beverage** Transformation of livestock & plants into products for consumption, including alcohol and tobacco.		
	**Furniture & Related Products** Production of furniture and related articles, including design and development of such products		
	**Metals & Machinery** Transformation of ore into metal products by way of refining, smelting, heat treating, assembly et al.		
	**Petroleum, Chemical, Plastic & Mineral** Transformation of raw materials such as petroleum, minerals & rubber into usable products		
	**Textile, Apparel & Leather** Production of apparel or materials for apparel, including weaving, tanning, cutting and sewing		
	**Transportation Equipment** Production of equipment for transporting people and goods, including cars, trains and trucks		
	**Wood, Paper & Printing** Production of wood products, converting pulp to paper products & printing, such as newspapers		
Total number of employees		*about 370,000*	

GRAPH:
NYS Manufacturing Employment, 2000 & 2014



Source: Manufacturing in NYC: A Snapshot, Center for an Urban Future

GRAPH:
Average Employee Compensation per Hour by Industry, 2010



Source: Benefits of Manufacturing, U.S. Dept. of Commerce
Note: Wages and Salaries include paid leave, such as overtime and premium pay.

Average Employee Compensation per Hour by Industry, 2010 Matching the Questions and the Calculations

The numbers below all come from the bar graph *Average Employee Compensation per Hour by Industry, 2010*. Each of the calculations below can be used to answer different questions about the graph. Read each calculation to answer the questions below.

A. $\frac{(29.75 - 27.47) \times 100}{27.47}$

B. $(29.75 \times 2080) - (27.47 \times 2080)$

C. 27.47×40

D. $\frac{(8.52 - 5.37) \times 100}{5.37}$

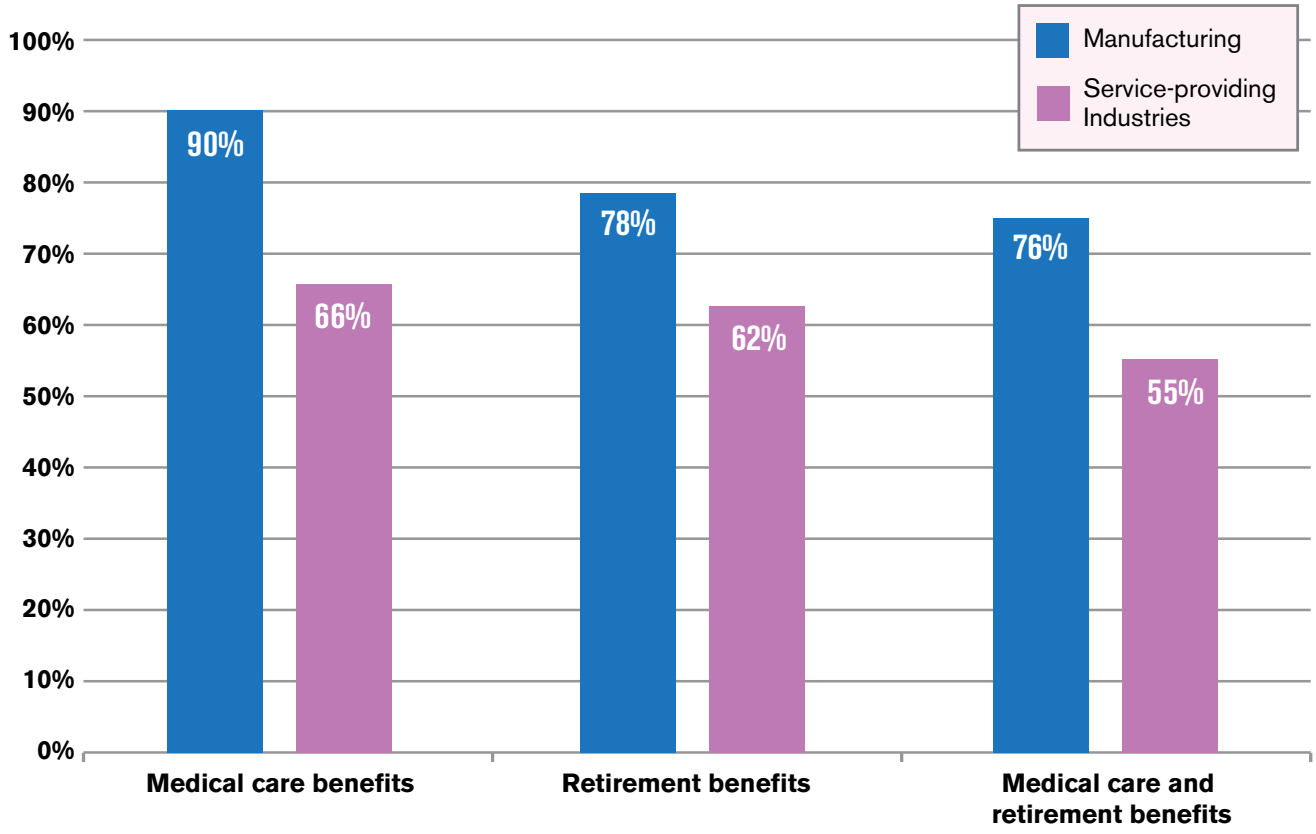
E. $29.75 + 8.52$

1. Which of the above calculations can be used to figure out the difference of the annual salaries between Manufacturing and Non-manufacturing workers?

2. Write the questions that the other calculations answer.

GRAPH:

Percent of Workers with Medical Care and Retirement Benefits, March 2011



Source: Benefits of Manufacturing Jobs, U.S. Dept. of Commerce

Benefits for Manufacturing Employees

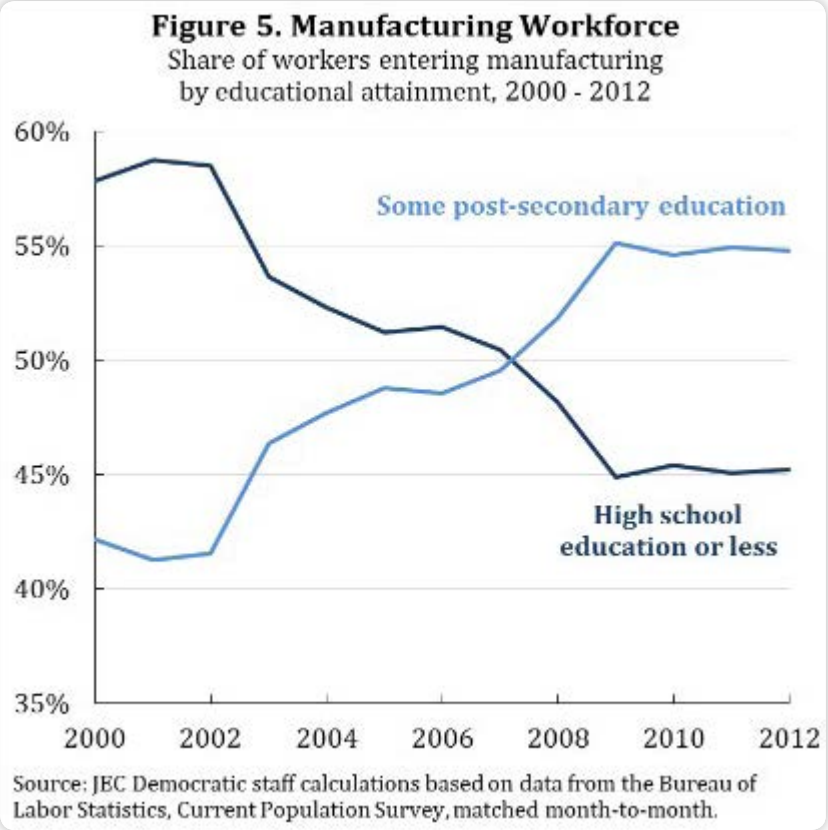
Based on the graph, use the numbers and words below to fill in the blanks. (Note: you will have some left over!)

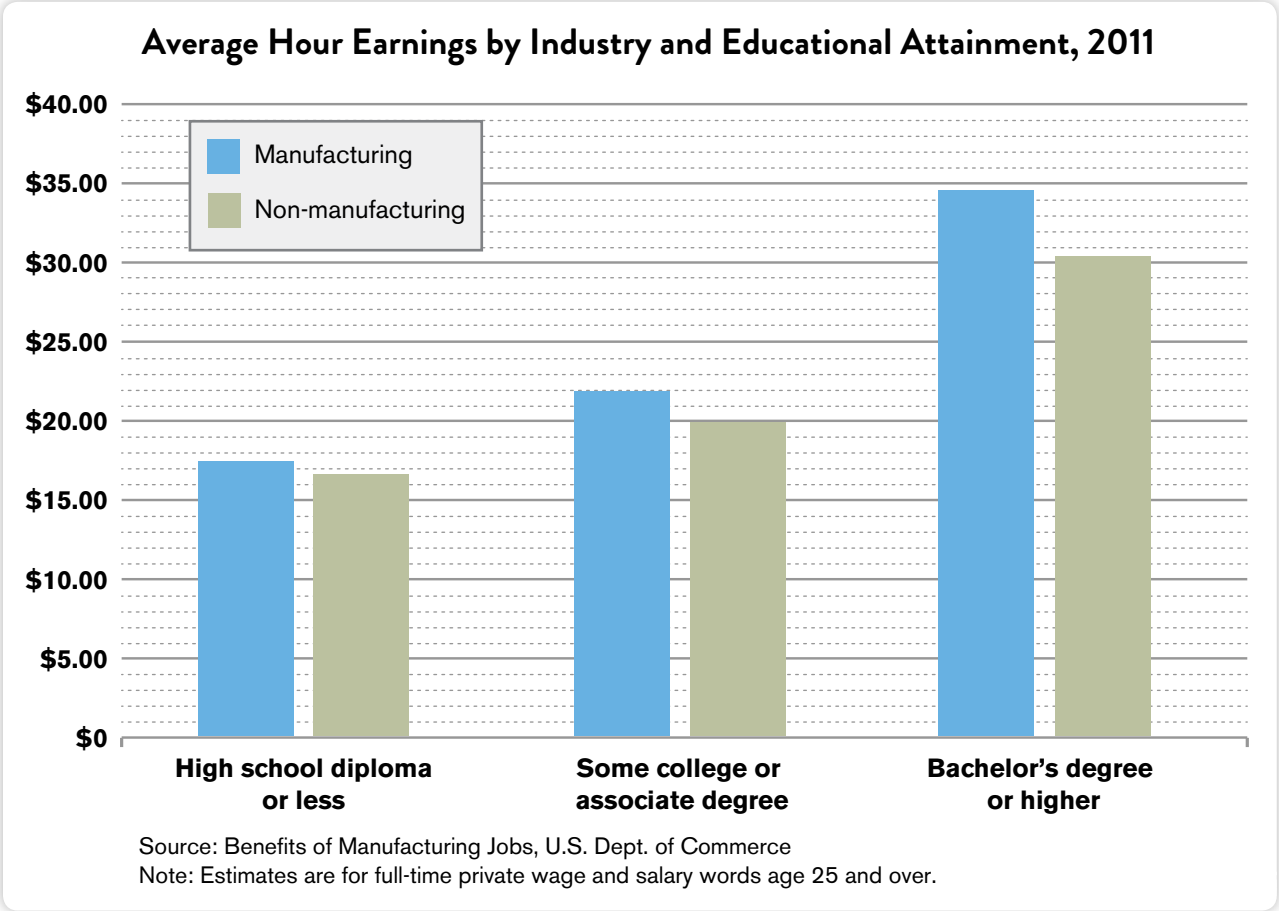
21	2	76
62	66	14
78	A little more than half	16
90	24	Most
11	12	55

_____ out of every 100 manufacturing workers receive medical care through their employers! Only _____% of workers in service-providing industries get medical benefits. _____% of workers in service-providing industries get retirement benefits. That is _____% less than the percentage of manufacturing workers who receive retirement benefits. _____% of manufacturing workers get both health coverage and retirement benefits. That is _____% more than workers in service-providing industries. Only _____ of workers in service-providing industries receive medical care and retirement benefits.

Bonus: _____% of manufacturing workers receive medical care benefits but not retirement benefits.

GRAPHS:
Manufacturing Workers and Educational Attainment





Developing a Manufacturing Vocabulary

45 MINUTES

Students use context clues to determine the meaning of Manufacturing vocabulary, then answer questions and write original sentences using the new terms.

TASC TIE-IN Discern meaning from context clues

PREP

- Be prepared to explain the vocabulary terms listed on the definitions handout, as well as **welder, technician, factory, assembly line, product, warehouse**.

Note: It can be helpful to prepare at least one additional sample sentence for each vocabulary word to offer students during the clarifying discussion.

MATERIALS

- *Developing a Manufacturing Vocabulary* worksheet
- *Manufacturing Vocabulary Definitions* handout

DISCUSS

1. Ask students to brainstorm words that relate to Manufacturing. Write student responses on the board as they brainstorm. If they have trouble coming up with words, give suggestions such as welder, technician, factory, assembly line, product, warehouse. Discuss the general meanings of the words (without reading from the answer key).

2. Manufacturing has changed in the past 20 years, mostly due to increased use of technology in the manufacturing process. Today we're going to learn some vocabulary words that Manufacturing professionals often use. Distribute the *Developing a Manufacturing Vocabulary* worksheet and ask students to work in pairs to complete it.

3. When students are finished, discuss their answers as a class. Clarify students' understanding of the terms and offer additional sample sentences or information from the *Manufacturing Vocabulary Definitions*.

4. After the discussion, distribute the *Manufacturing Vocabulary Definitions* to students and clarify any remaining questions.

5. Ask students to write an original sentence for each of the vocabulary words. Each sentence should include the vocabulary word and give enough detail to demonstrate their understanding of the term.

VOCABULARY

welder
technician
factory
assembly line
product
warehouse

Developing a Manufacturing Vocabulary

Read each sentence and try to guess the meaning of the underlined vocabulary word using the context clues. Explain the meaning in your own words.

1 Prototype

Manufacturing companies must work hard to test and improve upon the **prototype** of a new product before they attempt to sell it to consumers.

Meaning of the word: _____

2 Warehouse

John was offered a job in the **warehouse** of an electronics manufacturing company. His job duties will include loading and unloading boxes of electronic parts as they are delivered from the factory, counting and stacking the boxes in designated areas, and keeping his work areas clean and safe.

Meaning of the word: _____

3 Production

After the chemical manufacturing company made sure their new cleaning product was the best it could be and safe to use, they began **production** on their first order to be sold in stores.

Meaning of the word: _____

4 Welding

When workers are **welding** pieces of metal together to create products, they must wear protective gear such as helmets and gloves that can withstand high heat.

Meaning of the word: _____

5 Assembly

When customers buy furniture directly from manufacturers, it might be delivered in many individual pieces which require some **assembly**.

Meaning of the word: _____

6 Automation

Many manufacturing jobs that used to be done by people, such as packaging or labeling, are now done using **automation**.

Meaning of the word: _____

7 3D Printing

The hospital used **3D printing** to create an artificial hand for a person who had lost her hand in a car accident.

Meaning of the word: _____

8 Quality Control

The **quality control** department at the toy manufacturing company was held responsible when one of the company's toys malfunctioned and injured a child.

Meaning of the word: _____

Manufacturing Vocabulary Definitions

1. **Prototype**

   An early, sample model of a product, to test the design and create a standard.

2. **Warehouse**

   A building used for the storage of goods and merchandise.

3. **Production**

   The process of making, growing, or creating something for sale or use.

4. **Welding**

   The process of applying heat to soften and then unite or fuse pieces of metal together.

5. **Assembly**

   Connecting parts together to make a whole.

6. **Automation**

   Machinery that does work that used to be performed manually.

7. **3D Printing**

   The creation of three dimensional solid objects using a computer and printer.

8. **Quality Control**

   A system for identifying and maintaining a desired standard in a product or service.

The Manufacturing Cycle

90 MINUTES

Students learn about the steps involved in taking a product from idea to production, and finally distribution. They work in groups to identify tasks in each phase required to produce and distribute a product.

PREP

- Be prepared to explain the phases of the manufacturing cycle as per *The Manufacturing Cycle: Terms and Definitions* answer key

MATERIALS

- *The Manufacturing Cycle* handout
- *The Manufacturing Cycle: Terms and Definitions* answer key

DISCUSS

1. When you think of how a product goes from an idea in someone's head to an object in someone's home, what are the different parts of the process that come to mind?

   › *Identifying a consumer base for the product—who would want to buy it; the design it will have; what it will be made of; how it will be produced; where it will be sold; how it will arrive to consumers.*

2. Although "Manufacturing" is sometimes thought of as the actual process of building or creating something, it also refers to the entire industry sector of product creation, and this industry sector is complex. There are many steps a product goes through before it is ready to be shipped and sold. Each step works with the others to create a process, or a cycle.

3. We're going to look at the manufacturing cycle, and see how the different steps, or phases, work together. First let's look at a graphic that shows the different phases in the manufacturing cycle and clarify what each term means. Distribute *The Manufacturing Cycle* handout.

4. Ask students to work in pairs to define each phase of the cycle and write a short definition of each term inside its circle. It's ok to take a guess.

5. Read each term aloud and ask for a few pairs to read aloud their definition of that term. Clarify all terms and definitions using *The Manufacturing Cycle: Terms and Definitions* answer key

6. Ask each pair to join another pair, to create groups of four. Distribute a blank sheet of paper to each group of four.

7. Write the name of the following product on the board:

> SELF-HEATING COFFEE MUG

Ask each group to write one task for each phase of the cycle needed for the manufacturing of a self-heating coffee mug. Tell the groups not to label the task with the phase of the Manufacturing Cycle it pertains to—write only the task. The tasks should not be in the order in which the phases appear on the diagram. Explain to students that once they are finished, they will exchange papers with another group, and determine which phase of the Manufacturing Cycle each task belongs to. For example:

- *"Send flyers to kitchen and home goods shops telling them about this new product" might be labeled "marketing phase."*
- *"Test the mug's safety and comfort by making sure it won't burn people's hands" might be labeled "design and development."*

8. Once the groups have finished, collect the sheets of paper. Redistribute them so that each group has a paper from one of the other groups.

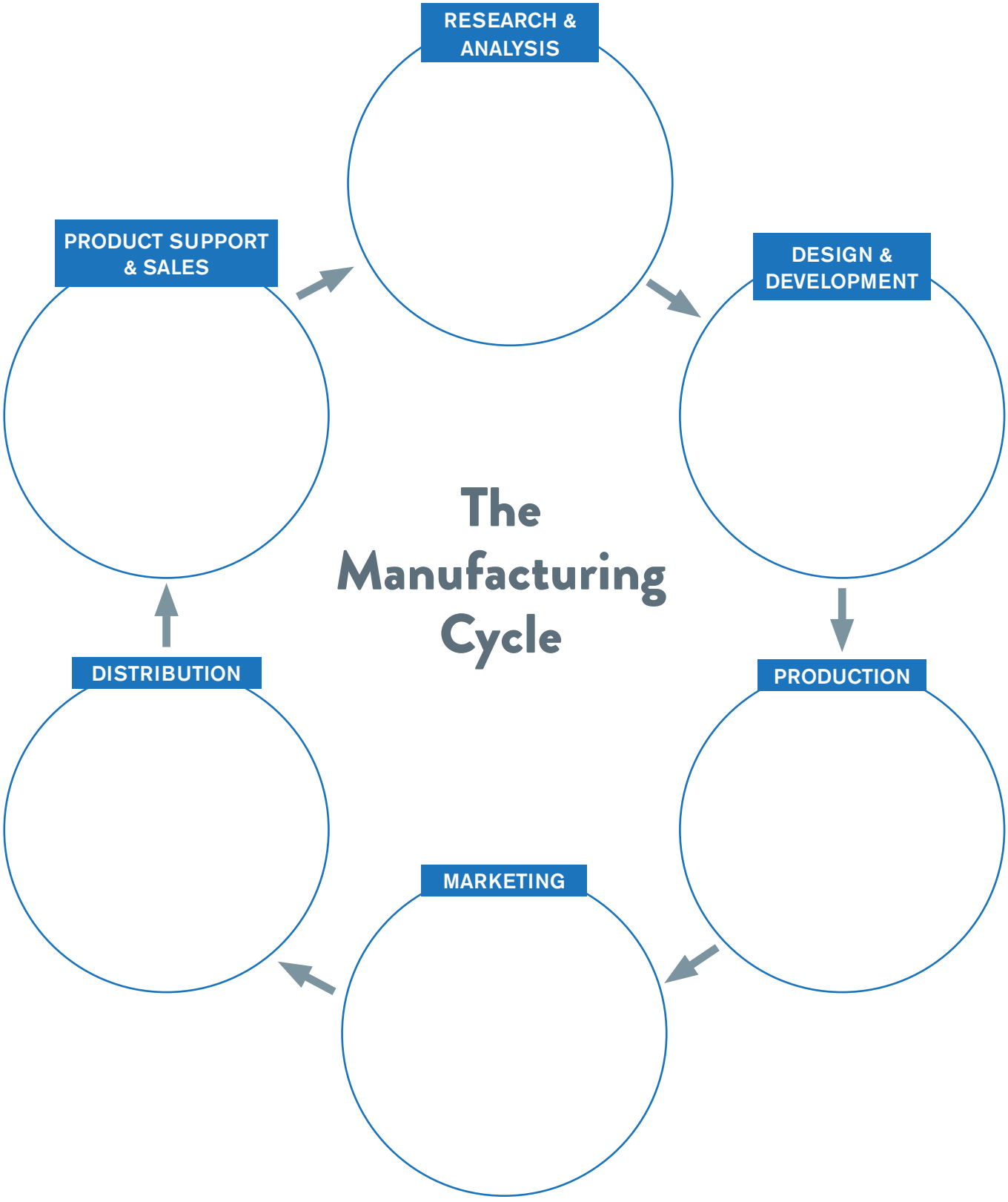
   The groups should read the statements that they now have in front of them and write the phase of Manufacturing alongside each task, and explain their reasoning.

9. Ask students to share aloud the tasks on their paper, along with the phase of the manufacturing cycle they think each belongs to, and their reasoning for why.

10. Ask students which phase of the manufacturing cycle they would be most interested in working in, and why.

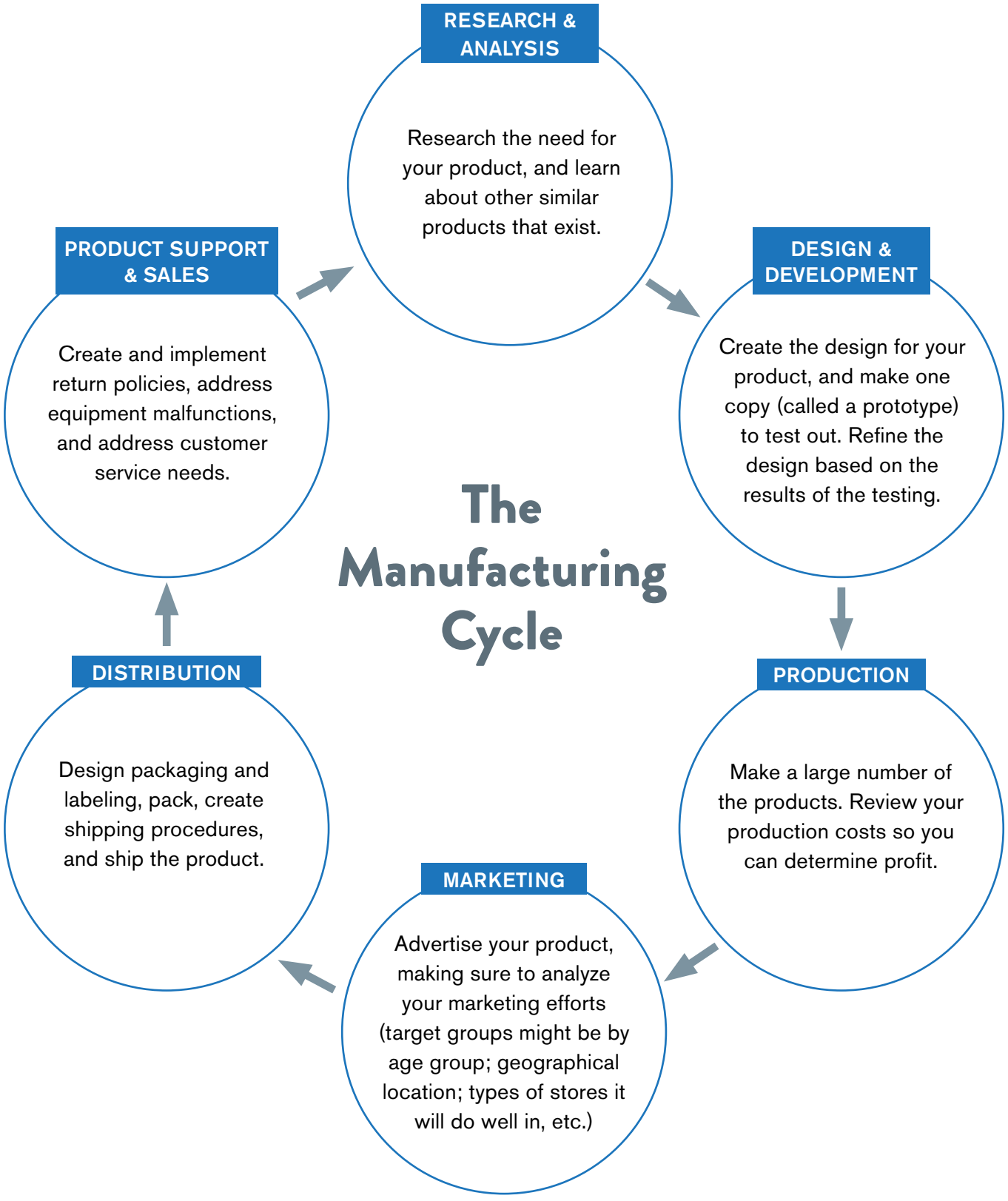
The Manufacturing Cycle

Graphic and terms adapted from: *An Introduction to Manufacturing in Minnesota Teacher Guide; Minnesota Dream it Do it.* http://www.dreamitdoitmn.com/teacher-guide/



ANSWER KEY:

The Manufacturing Cycle: Terms and Definitions



Manufacturing Jobs and Skills

45 MINUTES

After learning about the phases of the manufacturing cycle, students identify job skills needed for workers in each phase of the cycle.

NOTE: This activity is a good follow-up to the previous activity on the cycle of Manufacturing, though the previous activity is not a prerequisite for this one.

PREP

- Be prepared to explain the phases of the manufacturing cycle (see *Manufacturing Cycle Terms and Definitions*)

MATERIALS

- *Manufacturing Jobs and Skills* worksheet
- *Manufacturing Cycle Terms and Definitions* handout

DISCUSS

1. There are a variety of careers in Manufacturing, and they are changing all the time as technological advances bring about innovation in design, fabrication, distribution, and other areas of the industry. Manufacturing has changed drastically since the days of dirty and dangerous factories, and jobs in Manufacturing have changed as well.

2. The Manufacturing cycle has six phases. Can anyone name one?
   - › *Research and analysis, design and development, production, marketing, distribution, product support and sales.*

3. Distribute *Manufacturing Cycle Terms and Definitions*. Review with students and provide clarity as needed.

4. What are some of the duties of someone who works in product support and sales?
   - › *Answer customer service phone calls, take orders from customers and stores.*

5. What are some important skills to have for this job?
   - › *Communication skills, writing skills, listening skills.*

6. These skills are different from what are called technical skills (welding, operating a machine, etc.) or basic skills (reading, writing, math). What are these kinds of skills called?
   - › *Soft skills, or professional skills, or workplace skills.*

7. Distribute the *Manufacturing Jobs and Skills* worksheet. With a partner, list as many duties as you can in the center column, then write the skills needed to accomplish those duties in the right-hand column. Remember to think about technical skills, basic skills, and soft skills. All are important!

8. Ask students to share their responses aloud with the class.

The Manufacturing Cycle: Terms and Definitions

RESEARCH & ANALYSIS:
Research the need for your product, and learn about other similar products that exist.

DESIGN & DEVELOPMENT:
Create the design for your product, and make one copy (called a prototype) to test out. Refine the design based on the results of the testing.

PRODUCTION:
Make a large number of the products; and review your production costs so you can determine profit.

MARKETING:
Advertise your product, making sure to analyze your marketing efforts (target groups might be by age group; geographical location; types of stores it will do well in, etc.)

DISTRIBUTION:
Design packaging and labeling, pack, creating shipping procedures, and ship the product.

PRODUCT SUPPORT & SALES:
Create and implement return policies, address equipment malfunctions, and address customer service needs.

Manufacturing Jobs and Skills

For each phase of the Manufacturing cycle, list the duties or tasks in the center column, then write the skills needed to accomplish those duties in the right-hand column. Include technical, basic and soft skills.

Manufacturing Phase	Duties (what they do)	Skills needed for this job
Research and Analysis		
Design and Development		
Production		
Marketing		
Distribution		
Product Support and Sales		

Problem-Solving in Manufacturing—Packing a Shipping Container

2 HOURS

Students work in groups to solve a real-world math problem of determining how to arrange boxes in a shipping container to fit the maximum number of boxes.

NUMERACY TIE-IN
- Estimation
- Volume
- Using Math to Support a Claim

TASC TIE-IN
Mathematical Modeling with Geometry

NOTE

One of the standards assessed by the TASC exam requires students to solve real-world and mathematical problems involving volume of three-dimensional objects composed of right prisms. This problem allows students to develop an understanding by applying geometric methods in modeling a real-word situation. Students at multiple levels can contribute and develop mathematical understanding. In preparation for this task, it is helpful but not essential for students to have been previously introduced to volume calculations. In the course of the lesson, they will understand that volume is a measurement of the space inside an object, in this case a shipping container in the shape of a rectangular prism.

As a baseline, the answer you are looking for is the greatest number of boxes that any group can fit into the container. The discussion guidelines below offer suggestions for facilitating student learning. The first goal is making sure all students can come up with some number of boxes to fill the container. From there, some students can explore all the possible arrangements with boxes all in the same orientation to find the one that most efficiently fills up the space. From students who are ready, the problem can be extended further - each of the solutions with the boxes facing the same direction leaves some unfilled gaps. Is there a way that more boxes could be packed in those gaps? An extension problem for faster students challenges them to find ways to fit more boxes in the unfilled spaces. See *Note to Teachers: Orientation of the Boxes* below for more support.

PREP

- Solve the *How Many Boxes Can You Fit?* problem.
- Think about strategies your students might use.

MATERIALS

- It is helpful, but not necessary, for students to use calculators for this activity.
- Rulers or tape measures may also be helpful when students think about how to translate feet measurements into inches.

- You may even want to bring a few empty cardboard boxes that students can use a manipulatives to imagine how the boxes would be stacked.
- *Girl Scout Cookies in a Trunk* (worksheet)
- *Write Everything You Can about This Figure* (worksheet)
- *How Many Boxes Can You Fit?* (worksheet)
- Chart paper (one sheet for every 2-3 students in the class)
- Colored markers (for student use)
- Two different color pads of post-its

EXPLAIN

Notice/Wonder Launch Activity

1. Once products are manufactured, they need to be shipped to the store where they will be sold, or to another manufacturer or business who might use them to create a new product. This area of the Manufacturing Cycle is called Distribution.

   What tasks are involved in the Distribution phase of the Manufacturing cycle?

   › *Packaging, packing, labeling, sorting, shipping—either by land, air or sea.*

   Which careers are involved in the Distribution process?

   › *Packers, Weighers, Shippers, Designers, Truckers, Order Clerks, Vehicle Mechanics, Logisticians.*

   What kind of math do you think workers involved in Distribution might need to use on the job?

   › *Addition, subtraction, volume, weight, percents, fractions*

   Distribution represents a significant cost to manufacturers, so they'll need to find the most efficient way to safely distribute the greatest number of products in order to be profitable.

2. Distribute the *Girl Scout Cookies in a Trunk* handout and ask students to take 2 minutes to write down everything they notice. (If you have the technology, as an alternative to the handout, you can show students the following video: **https://vimeo.com/157324585**)

3. Ask students to take another 2 minutes to share what they noticed with a partner.

4. Ask students to report back all the things they noticed and record them on the board. Ask clarifying questions if needed (i.e. *What did you notice that made you realize that?*).

5. **How many boxes can fit in the trunk of this car?** Ask students to write down an estimate on their paper. What's their best guess for how many boxes of cookies are in the trunk. Give them 1 minute to make their guess—you want them to go with their gut, not with calculations.

6. Have students share their best guesses and record them on the board, writing down each student's name next to her guess. As students share their guesses, ask them to talk a little about how they made their estimates.

7. Reveal the total number of boxes (924) or play the following video, which reveals the actual answer: **http://bit.ly/TrunkfulofCookies**. Ask students whose guess came closest to the correct answer.

   Notice/Wonder–Girl Scout Cookies in a Trunk activity adapted from:
   http://www.101qs.com/3675-girl-scout-cookies

Collecting student background knowledge

8. Now let's look a little closer at a figure that is similar to the boxes of Girl Scout Cookies. Distribute *Write Everything You Can About This Figure* and have students write for 5 minutes.

9. Bring students together and ask students to share what they know.

Discussion Guidelines:

Some things to raise if they don't come up:

Does anyone know the name of this figure?

› *The figure is called a rectangular prism.*

This figure has perimeter, area, and volume, depending on what part of it you are talking about measuring. If we are talking about the volume of this figure, what are we talking about?

› *When we talk about volume, we talk about how many cubic units fit inside of an object. (It might help to have a rectangular prism available for students to explain their thinking—a trash can, a cereal box, etc.)*

What is the difference between an inch, a square inch and a cubic inch?

› *An inch is a measure of length. A square inch is a square that measures an inch on each side. When we talk about area, we are talking about how many square units are needed to cover a surface. A cubic unit is a 3-dimensional shape with the length, width and height of the unit (inch, feet, cm, mile, etc.). So a cubic inch is a cube that measures one inch by one inch by one inch.*

How could we find the volume of this figure?

› *You can find the volume of a rectangular prism by multiplying the length by the width by the height.*

Problem-Solving in Manufacturing—Packing a Shipping Container

10. Distribute *How Many Boxes Can You Fit?* worksheet. Ask students to focus on the side with the picture and the numbers. Give students a few minutes to read the problem a few times and write down what they notice and what they wonder.

11. Ask students to take another 2 minutes to share what they noticed and what they wondered with a partner.

12. Ask students to report back all the things they noticed and record them on the board. Ask clarifying questions if needed (i.e. *What did you notice that made you realize that?*). Repeat the process for what they wondered.
A few important things to notice:

    - The dimensions of the shipping container are in feet and inches. The dimensions of the box are in inches only. Students should eventually recognize that they will need to convert everything to either feet or inches to figure out how many boxes fit. Once students realize this, you might ask about 7'8". How tall is that in inches?
    - All the boxes are the same size.
    - The boxes can be arranged in any way that fits.

13. For any clarifying questions that come up, ask other students to respond. If a student asks how many boxes will fit, ask them to hold on for a few minutes before we all explore that question further.

14. Ask students to flip the page and read the instructions on the back. If you think it is necessary, ask a few students to restate the instructions in their own words.

15. Ask students to work independently on the problem for 5 minutes, explaining that they will continue their work in a group next.

16. Ask students to form groups of 3 people, and spend 20-30 minutes continuing to work on the problem together. Each group member should share strategies, then work together to solve the problem.

17. As each group finishes, ask them to prepare a poster that expresses their answer and instructions for packing the container. Ask them to include words, pictures, anything that will make it clear enough for a team of Packers to follow. After about 20 minutes of group work, even if a group has not finished, give them a sheet of newsprint and ask them to write up their process and share what they've been working on.

18. Once the posters are done, ask students to put them on the wall. Ask each group to share how many boxes they think they can fit into the container and record their answers on the board.

Support Questions for Student Groups During Problem Solving

- If a group doesn't know where to start, you might ask a few of these questions:
  - What have you tried?
  - How do you plan to stack the boxes?
  - How many boxes can you stack before you hit the top of the shipping container? Explain how you know.
  - Is there any empty space above the boxes?
  - How many boxes could you fit lengthwise? Explain how you know.
  - How many boxes could you fit across the width of the shipping container? Explain how you know.
- Circulate to check in with each group, asking them to explain their calculations.
- One potential student misconception is to merely calculate the volume of the container (4,099,152 cubic inches) and divide it by the volume of the box (15,552 cubic inches). That number, 263, is helpful because the answer has to be smaller than that, but it isn't possible to pack that many boxes in. Make sure they are considering the dimensions of the boxes and thinking about how to write specific instructions for how to arrange the boxes.
- If students have found one answer, encourage them to find others. They are looking to fit the most boxes in and they will need to try out a few different configurations for stacking the boxes to be able to say theirs is the most. Ask questions like: Is there another way to stack the boxes? What are all the different ways you can position the box? How do you know that is the most boxes that will fit in the container?
- If students have found all of the different ways of packing the shipping container with all the boxes facing the same orientation, you can ask:
  - Is there any space left over? Can you fit any boxes in that gap?
  - I found a way to fit 235 boxes into the shipping container. Can you figure out how I did it?

19 **Explain:** We are going to do something called a gallery walk. We are going to walk around and look at the posters created by your classmates. I'm going to give each of you a few post-its. On one color, please write something you appreciate about that poster. On the other color, please write one question you have for the group about their poster. Please put at least one appreciation note and one question note up on each poster.

20. After students have had a few minutes to look at other groups' work and write some post-its, ask for a few volunteers to share what they wrote in their appreciation notes. Then ask the group whose plan can pack the most boxes to come up and present their work.

21. Then ask which group came closest? Congratulations!

22. As a final reflection, please write your name on a piece of paper. Think back to all the things you've done during today's class and complete the following two thoughts:

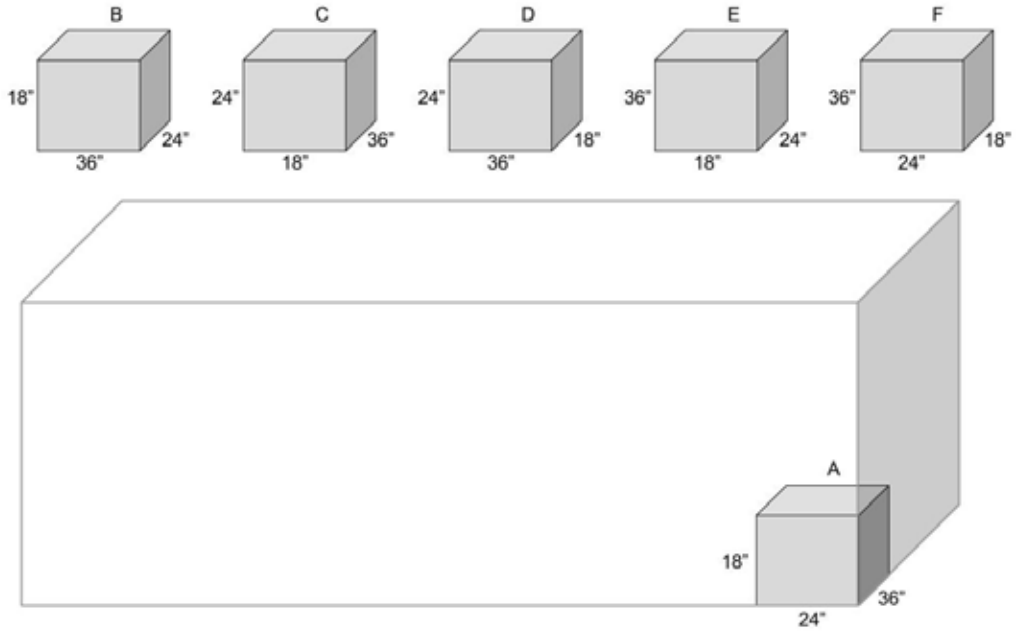
    - I am proud of how I…
    - I can do an even better job next time by...

NOTE TO TEACHER: ORIENTATIONS OF BOXES

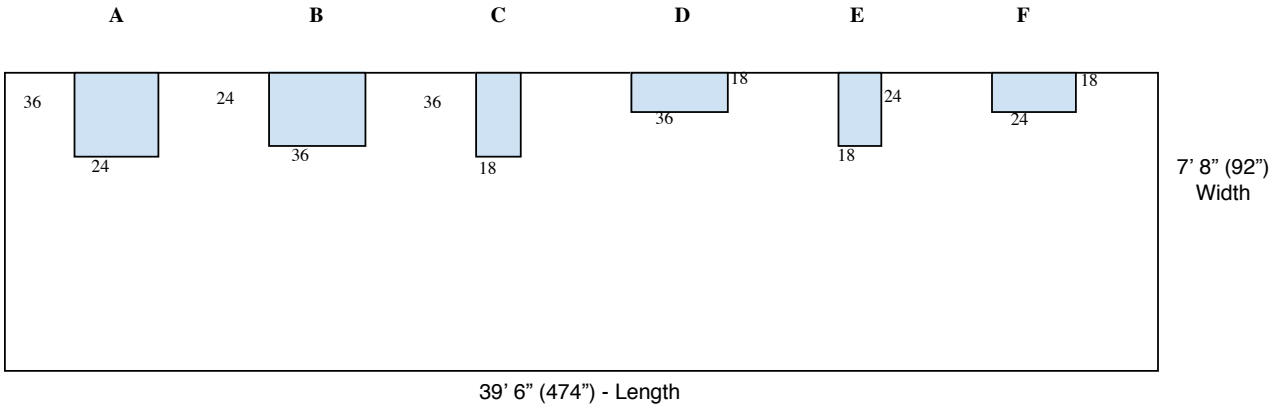
There are six possible ways to configure the boxes when all the boxes are facing the same direction. The illustration below shows the box positioned in each of the six possible orientations.

A 3-D View of Possible Orientations

The illustration below shows the same six orientations from above.



A View from Above of Six Possible Orientations of the Box



The following table shows the number of boxes that would fit in the container for each of the six possible orientations. For example, if the box is in the A position, this would allow for 2 boxes to be laid side by side across the width of the shipping container, with a row 19 boxes long extending the length of the container, and stacks 5 boxes high, comprising a total of 190 boxes fitting in the container.

	Number of Boxes with Each of Six Possible Orientations					
Shipping Container	**A**	**B**	**C**	**D**	**E**	**F**
92” (width)	2	3	2	5	3	5
474” (length)	19	13	26	13	26	19
94” (height)	5	5	3	3	2	2
Total Boxes	**190**	**195**	**156**	**195**	**156**	**190**

There are two different ways to fit 195 boxes. This is the highest number of boxes you can fit in the container using an arrangement where all the boxes are facing the same direction. This is the solution we hope students will be able to determine.

However, it turns out that there are ways to fit more than 195 boxes into the container if you don’t arrange all of the boxes in the same direction. For an example, see below for how to fit 235 boxes in the container.

235 boxes solution

First, arrange boxes in the F orientation: The width of the truck is 92". You can fit 5 boxes across the width of the shipping container. This will leave you with a 2" gap in the width. That doesn't leave you any room for extra boxes. You can fit 19 boxes along the length of the container. That would leave a gap of 18" (more on that in a minute). Currently, we have 5 rows of 19 boxes for a total of 95 boxes. Since the height of the container is 94" and we have the 36" side of the box remaining, we can fit a second layer of 95 boxes on top of the first, with a gap of 22". That brings us to a total of 190 boxes.

Second, fill in the gaps: We have a gap of 18" in the length of the container. We can fill that gap if we flip the box into the E orientation (36" high, 24" wide, 18" long). With the 18" side down and the 24" side as the width, this allows us to fit 3 more boxes in a row along the bottom of the container. That leaves the 36" side for the height, which means we can stack two layers high before reaching the top of the container. That gives us 3 more boxes in the second row, with a gap of 22".

The gap of 22" matches the gap of 22" we have in the height with the rest of the boxes packed in the container (original F orientation). We can fill that 22" gap across the top of the entire container if we turn the boxes and use orientation B (36" long, 24" wide, 18" high). Since the width is 24", we can fit 3 boxes across the width of the container. That leaves the 36" side of the box oriented along the length of the container. The length of the container is 474", 13 boxes in each row of 3, which amounts to 39 more boxes. If we add 39 (additional orientation B boxes) and 6 (additional orientation E boxes) to our original number of 190, we were able to pack 235 total boxes

Girl Scout Cookies in a Trunk

What do you notice? What do you wonder?

Write Everything You Can About This Figure

Write down as many things as you can about this figure.

How Many Boxes Can You Fit?

You need to pack as many boxes of socks as you can into a shipping container.

* Pictures are not to scale

The available space in the container measures 7’8” wide by 7’10” tall by 39’6” long.

The boxes are all the same and measure 24” by 18” by 36”.

You can arrange the boxes any way you want in the shipping container.

How Many Boxes Can You Fit? (pg. 2)

You are the Logistics Manager for a clothing manufacturer. You need to determine how many boxes of socks can fit into one shipping container. You also need to write instructions for how you want to arrange the boxes in the container so as to fit the greatest number of boxes into each shipping container. Your directions must be clear for your team of Packers to follow.

What is the greatest number of boxes that will fit and how should they be arranged?

Series: How Does Technology Affect Today's Labor Market?

ACTIVITIES IN THIS SERIES

8.1 • Technology in the Workplace

8.2 • Technology's Impact on Manufacturing

8.3 • Technology's Impact on Products

60 MINUTES

Technology in the Workplace

Students read an article and consider the positive and negative effects of technology on the workplace across labor sectors.

MATERIALS

- *Technology Opinionaire*
- *Technology in the Workplace* reading
- Chart paper and markers

INTRODUCE

1. Distribute the *Technology Opinionaire*. Ask students to read each statement, and circle whether they agree or disagree. Then they should choose one of the statements to explain (in writing) their reasoning.

2. Write on the board:

> How has technology changed the labor market?

3. Distribute *Technology in the Workplace*, and ask students to read and annotate it, making sure to take notes about how technology has changed how people look for jobs, what kinds of jobs are available, and what their lives are like at work.

4. Put students in groups. Tell them to turn over the article (so they're not looking at it), and make a list on chart paper of all the ways they can remember from the article how technology has changed the world of work. Groups share findings with the class.

5. When the groups are finished, ask them to look back at the article, and see if they missed anything. If they did, they can add to their lists.

6. Point students back to their opinionaires. Ask if anyone has changed their mind. For example, did anyone who started out feeling positively about technology start to feel more negatively, or the other way around?

Technology Opinionaire

For each of the statements below, circle whether you agree or disagree.

1. Overall, technology is improving our world today more than technology is hurting our world.

   Agree / Disagree

2. Technology these days makes it easier to find a career.

   Agree / Disagree

3. I would rather be looking for a job in today's job market than I would 20 years ago.

   Agree / Disagree

Choose one of the above statements, and explain why you agreed or disagreed:

Technology in the Workplace

Technology has affected the world of work since the rise of factories in the 19th Century. For example, a machine called the cotton gin, that removes seeds from cotton after it is picked, made cotton manufacturing quicker and easier. When we talk about technology today, we usually mean hardware, such as hard drives and monitors; software, such as word processing programs; the internet; or networks, which allow computers to communicate with one another. Technology also refers to data collection, analysis and storage. It affects today's labor market in many ways: the way we find work, the types of jobs we do, the education and skills we need, the way we do work, and the way companies operate.

1. **The way we find work**
   Long ago, people often looked for jobs in local newspapers, but today they use technology. Job search websites such as Monster, Indeed.com and Glass Door have become popular. People use social media sites like LinkedIn and Facebook to make themselves known, connect to others and find opportunities. Employers use these sites too, to find employees and research job applicants.

2. **The type of jobs we do**
   Advances in technology have made some jobs disappear and others appear. For example, because companies like Netflix can offer movies on the internet, there are fewer video rental stores. We used to see a travel agent, baggage collector, porter and ticket agent when we traveled by plane or train. There are fewer of those jobs now that we use websites to book our tickets, and electronic machines to get our tickets and to check our bags. Advances in technology create new jobs too, like 'app developers', social media specialists, and health information managers.

3. **The education and skills we need**
   A lot of work relies on technology. We use it to do simple tasks like answering phone calls. More and more employers rely on people to do more difficult work that requires innovative thinking, flexibility, creativity, and social skills. You need a person to plan the layout of products in a store so customers can find them easily and you need a person to provide hands-on care for sick patients. You need technology, for cashiers to use during transactions and to store medical information of patients. In this technology driven labor market, individuals who want

Source: NYC LMIS LABOR MARKET INFORMATION SERVICE
CUNY Graduate Center
365 Fifth Ave, Rm 6202
New York, NY 10016
www.gc.cuny.edu/lmis

to get, keep and advance in a good job need to make sure that they have the education and skills that employers are looking for. This means knowing how to use technology and learning the skills that must be done by people.

4. The way we do work

Technology has also changed the way we work, by:

- **Making workers more productive**—Using technology can help you do your job better. You can complete more tasks, do them faster and sometimes more accurately. For example, with programs like Word, you can create and edit a letter more quickly than if you were to do it by hand or on a typewriter.
- **Reducing the tasks workers do themselves**—Some tasks that workers used to do themselves are now done by technology. For example, lawyers can use computer programs to search through thousands of documents to find certain information. This allows them to spend more time doing work computers can't do, such as developing arguments for the courtroom.
- **Replacing some workers**—More and more, we rely on machines to do work without any help from humans. This is called automation. Many people wonder if machines or even robots will one day replace workers. Right now, machines can assemble car parts, answer customer calls and check passengers in at airports. Robots can work together to fulfill warehouse orders. Experts disagree on what kind of impact automation will have on work in the future.
- **Making some workers more mobile**—Mobile phones, computers and the internet have allowed employees to do work from almost anywhere at almost any time. For example, some office workers can work from home for a local company or for a company based in another country. And, they can check email after the official end of the workday. Because of videoconferencing, we can even have meetings with people who are in different places around the world.
- **Directly connecting people who need goods or services to people who can offer it**—Businesses like Uber, Airbnb and Ebay allow sellers to connect with customers in moments. They offer transportation, accommodations and products to potential buyers through the internet.

page 2

5. The way companies operate

With technology, organizations can produce goods and provide services more quickly, more accurately, on a larger scale and in new and improved ways. They can reach more customers. And, they can use huge amounts of information about individuals—known as 'big data'—to help them sell more to customers. For many organizations, the way they use technology is what sets them apart from the rest.

Technology has changed the world of work in these five ways, but not all types of technology have the same impact. Some technologies totally transform the way people and organizations work. The internet is a good example; it changed everything. Other technologies that may transform our lives include driverless cars and advanced robots that can work alongside or replace employees altogether. And, some jobs seem to be effected by technology more than others. For example, jobs that involve activities such as data entry, assembly line work or routine design work have all become reliant on technology.

Technology has had many positive effects, but it has also had some negative. For example, the internet has allowed a wide range of individuals to access an incredible amount of information quickly, but it has made security and privacy an important issue. Hackers now can get confidential information that they were not intended to have. Governments are catching up to these changes by making new laws and regulations to keep people more safe.

Jobseekers and employees in today's labor market must make sure they are tech-savvy. This can include:

- knowing how to operate a computerized cash register
- being proficient in Microsoft Office including Word and Excel programs
- operating medical technology that can require ongoing training as the technology evolves

Employees can raise their awareness by staying current with technological trends in their field, by reading online or print materials about their industry. Jobseekers can prepare for interviews doing job research and getting training. Jobseekers who are not tech-savvy may be at a disadvantage to their more tech-savvy peers. •

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Technology's Impact on Manufacturing

45 MINUTES

Students read an article about the impact of technology on the Manufacturing sector, discuss key points and highlights, then discuss vocabulary in the article and write sentences about the article using the terms.

NOTE TO TEACHERS

The reading in this lesson includes references to the advent of the moving assembly line and other important industrial innovations that occurred in the early 20th Century. These historical references mark a period of time discussed in the Social Studies section of the TASC exam and can be used to supplement and extend your current activities in this content area by combining the study of U.S. history with career exploration.

TASC TIE-IN
- Discern meaning from context clues
- Emergence of Modern America
- Industrial Revolution

PREP

- Read the article, *The Impact of Technology on Manufacturing* and annotate it by underlining parts of the article that mention specific ways technology has impacted Manufacturing careers, in preparation for class discussion.
- Be prepared to discuss the vocabulary terms: **farriers, rivets, customized/ customization, nanotechnology** defined in footnotes of the article.

MATERIALS

- *Manufacturing: The Third Industrial Revolution* article
- *Terms from Manufacturing: The Third Industrial Revolution* worksheet

DISCUSS

1. Ask students about the ways technology has changed the workplace.
   - › *Most businesses use computerized technology, such as warehouses tracking items in transit, builders using computerized building plans, or cashiers using computerized cash registers. Even many factories use digital equipment these days to cut and assemble products.*
2. Ask students how they think technology has impacted Manufacturing careers. Write their responses on the board.

VOCABULARY

farriers

rivets

customized/ customization

nanotechnology

- *Production is more automated. Products are designed by computer. 3D printers can "print" products without the need for tools or other equipment.*

3. Distribute *Manufacturing: The Third Industrial Revolution* article and ask students to read and annotate it. They should underline parts of the article that discuss the specific ways technology is impacting Manufacturing.

4. Ask students to share these details with the class.

5. Distribute the *Terms from Manufacturing: The Third Industrial Revolution* worksheet. Ask students to skim the article and put a star by the vocabulary words on the worksheet as they find them in the article.

6. Review the first vocabulary word with the class, asking for a volunteer to provide a definition, or to try to define the word using context clues from the article.

7. Have students continue with the remaining words, using context clues from the language in the article to write definitions for each word in the center column.

8. Review the worksheet with the class, providing clarity as needed. If the student's understanding of the word was correct, they should copy it into the right-hand column. If they need to make an adjustment, they should write the new definition in the right-hand column.

9. Divide students into pairs and ask each pair to write three questions that can be answered by the article and three speculations about Manufacturing and technology beginning with "I wonder…"

Manufacturing: The Third Industrial Revolution

Adapted from
http://www.economist.com/node/21553017

The first industrial revolution began in Britain in the late 18th century, in the textile industry. Tasks previously done by hand in hundreds of weavers' cottages were brought together in a single cotton mill, and the factory was born. The second industrial revolution came in the early 20th century, when Henry Ford mastered the moving assembly line for car production and ushered in the age of mass production. The first two industrial revolutions made people richer and more urban, since the new jobs were located in cities. Now a third revolution is under way. Manufacturing is going digital.

Today, a number of remarkable technologies are coming together: creative software, new types of materials, improved robots, new processes (notably 3D printing) and a whole range of web-based services. The factory of the past was based on churning out billions of identical products, because that was the cheapest way to do it. However, the cost of producing smaller batches of customized products is dropping, thanks to these new technologies. The factory of the future will focus on mass customization—and may look more like those weavers' cottages than Ford's assembly line.

Toward a third dimension

The old way of making things involved taking lots of parts and screwing or welding them together. Now a product can be designed on a computer and "printed" on a 3D printer, which creates a solid object by building up layers of material. The digital design can be tweaked with a few mouse clicks. The 3D printer can run unattended, and can make things that are too complex for a traditional factory to handle. In time, these amazing machines may be able to make almost anything, anywhere—from your garage to a rural village.

The applications of 3D printing are almost unbelievable. Already, hearing aids and high-tech parts of military jets are being made on 3D printers. Distribution methods will also change. An engineer working in the middle of a desert who lacks a certain tool no longer has to have it delivered from the nearest city. He can simply download the design and print it. The days when projects come to a halt while everyone waits for a part, or when customers complain that they can no longer find spare

parts for things they've bought, will one day be nonexistent.

There are other huge changes in Manufacturing.

- New materials are lighter, stronger and more durable than the old ones. For example, carbon fiber is replacing steel and aluminum in products ranging from airplanes to mountain bikes.
- Nanotechnology is giving products enhanced features, such as bandages that help heal cuts, engines that run more efficiently and dishes that clean more easily.
- Everything from shoes to soccer balls are becoming "smart", with the ability to generate power as they're being used.

And with the internet allowing designers to collaborate on new products, it's easier than ever to get started. Henry Ford needed loads of money to build his huge River Rouge factory; inventors and manufacturers today can begin with just a laptop and a hunger to invent.

Like all revolutions, this one will have many bumps along the way. Digital technology has already had a huge impact on the media and retail industries, just like cotton mills sent weaving looms out of existence and the Model T automobile put farriers[1] out of work. Many people will be shocked when they see the factories of the future. The factories will not be full of dirty machines run by men in oily overalls. Many will be squeaky clean—and almost deserted. Some carmakers already produce twice as many vehicles per employee as they did only a decade or so ago. Most jobs will not be on the factory floor but in the offices nearby, which will be full of designers, engineers, IT specialists, logistics experts, marketing staff and other professionals. The manufacturing jobs of the future will require more skills. Many dull, repetitive tasks will become obsolete: you no longer need riveters[2] when a product has no rivets.

The revolution will affect not only how things are made, but where. Factories used to move to low-wage countries to cut labor costs. But those costs are growing less and less important: a $499 first-generation iPad included only about $33 of manufacturing labor, of which the final assembly in China accounted for just $8. Offshore production is increasingly moving back to rich countries, not because Chinese wages are rising, but because companies now want to be closer to their customers so that they can respond more quickly to changes in demand. And some products are so sophisticated that it helps to have the people who design them and the people who make them in the same place. The Boston Consulting Group[3] believes that in areas such as transport, computers, fabricated metals, and machinery, 10-30% of the goods that America now imports from China could be made at home by 2020, boosting American output by $20 billion–55 billion a year. •

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[1] A specialist in horse hoof care, including the trimming of horses' hooves and the placing of shoes on their hooves, if necessary.

[2] A metal that holds two pieces of a cloth, metal or plastic product together.

[3] A global management consulting firm that serves as an advisor on business strategy to many companies.

Terms from Manufacturing: The Third Industrial Revolution

Complete the chart by writing in the center column what you think the words below mean.

Term	What I Think It Means	Definition
Textile		
Remarkable		
Churning		
Batches		
Application		
Distribution		
Collaborate		
Logistics		
Obsolete		

VOCABULARY DEFINITIONS:

Manufacturing: The Third Industrial Revolution

Term	Definition
Textile	A type of cloth or woven fabric.
Remarkable	Worthy of attention; striking.
Churning	Produce at a rapid pace (from the vigorous movement of churning butter).
Batches	A quantity or group of goods.
Applications	The action of putting something into operation.
Distribution	The action of sharing something out among a number of recipients.
Collaborate	Work jointly on an activity, especially to produce or create something.
Logistics	The management of how resources are acquired, stored, and moved to their final destination.
Obsolete	No longer produced; out of date.

Technology's Impact on Products

45 MINUTES

Students read an article about 3D printing and its impact on the manufacturing of objects, and complete a cloze (fill-in-the-blank) activity to check their comprehension.

PREP

- Read the article *3D Printers: No Ink Here!*

MATERIALS

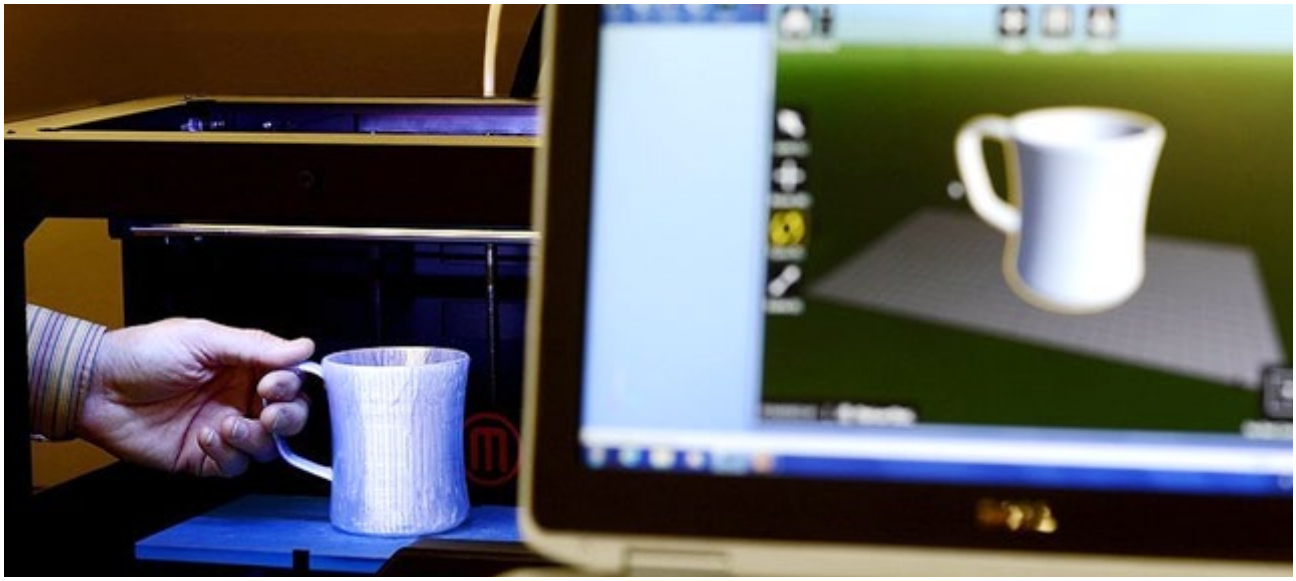
- *3D Printers: No Ink Here!* article
- *3D Printers: No Ink Here!* cloze activity sheet
- Answer Key: *3D Printers: No Ink Here!*

DISCUSS

1. Ask students if they have heard of 3D printing. Ask for volunteers to share what they know.
   - › *3D printing can create solid objects; everything from toothbrushes to artificial hearts can be "printed."*
2. Distribute *3D Printers: No Ink Here!* article and ask students to read and annotate it. They should underline any parts of the article that they find interesting, confusing, or surprising.
3. Ask students to share these details with the class.
4. After discussing students' reactions to the article, distribute the *3D Printers: No Ink Here!* cloze activity sheet. Have students work independently or in pairs to complete the worksheet.
5. Ask for volunteers to read the completed sentences aloud.

3-D Printers: No Ink Here!

Adapted from https://newsela.com/articles/manufacturing-3d/id/573/



It took five hours and ten minutes to "print" this coffee mug at the Prototype Studio at Hallmark in Kansas City, Missouri. Like cell phones and laptops, three-dimensional printerts are already transforming the way we live and think.

Rich Sugg/ Kansas City Star/MCT

EAST HARTFORD, Conn.— For decades, airplane part manufacturers like Pratt & Whitney have made engine components by taking steel or another material and molding it, or carving it, or melting it. Now, they're printing it. Unlike your laser printer at home or school, there is no toner, no paper, and no paper jams! Instead of ink, these printers—called 3-D printers—use lasers to heat pieces of plastic or metal to build up three-dimensional parts, layer by layer. They can build anything, no matter how complicated. Pratt & Whitney and other companies are pushing the limits of this technology to make parts for their latest engines. This process is letting manufacturers design components that would have been impossible to make in yesterday's factories. The companies also save money.

Saving Time and Money

The fact that 3-D printing has passed the test of the heat of a jet engine is a good sign. Tom Maloney of the Connecticut Center for Advanced Technology, which helps manufacturers who want to use the technology, said, "It's definitely progress…even call it a milestone."

Pratt has put more than two dozen 3-D-printed parts on its latest turbofan engine, said Thomas Prete, the company's head of engineering. More are expected to be added soon. Pratt's main competitor, GE Aviation, is using 3-D printing to make complex fuel nozzles for an engine.

Pratt and Whitney's designers can now make an engine part in one step. In the past, it would have taken a lot longer, as five or ten pieces

needed to be attached and heat-treated before they were ready. That improvement alone saves time and money.

3-D Printers Make It Easy

But the main advantage is that engine designers can do things that used to be impossible, he said. In the past, an engineer could design something that might have been too complicated to make. With the new technology, it's just as easy to make something complicated as it is to make something simple. It's like firing up the printer to make a copy of "The Mona Lisa" compared to using it to print a solid color. It doesn't take more time or more ink to print out the one that is more complex.

Meanwhile, the military likes being able to print replacement parts and supplies with just a machine and a supply of material. That ability could transform an aircraft carrier into a "floating factory" that could supply replacement parts to a broken tank or an aircraft.

Pratt bought a fleet of 3-D printers in 1988 to help design engine parts. The machines spat out plastic samples for testing and development. Once they created what they considered to be the best design, engineers made a metal version the old-fashioned way. Now, the 3-D printers don't print samples; they can print the real thing! This speeds things up and saves money.

Some of the 25 parts Pratt prints are simple, such as brackets. Others are more complicated pieces in the engine's air pathway. That part of the engine faces high temperatures and constant stress. Getting to the point that the parts will withstand the jet engine environment has been quite a process, experts say. Materials and processes must be perfect. Costs need to make sense, and companies need to be able to print enough parts to keep up with traditional manufacturing methods. For Pratt, 3-D printing parts at production speed is the next big step. The company is determining how many machines it needs and how they need to be arranged.

Adding and Subtracting

Additive manufacturing and subtractive manufacturing are the two main ways of making things. Think of additive like building something with Lego blocks—you put small pieces together to make something larger. Subtractive manufacturing, which includes milling and lathing, is more like sculpting. You start with a block or marble, and chip and shave away until a statue, or engine part, emerges.

Much of manufacturing currently falls in this second category, but that's changing. In 2012, the 3-D printing industry had a $2.2 billion slice of the economy, according to an analysis released in May by Wohler Associates. By 2021, the firm expects the industry to be worth $10.1 billion. Putting these parts into jet engines is just what the advanced manufacturing industry has been waiting for: evidence that shows that mainstream manufacturers have figured out how to make the materials and the process work. •

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3-D Printers: No Ink Here!

1. 3D printing uses materials like _____ or _____ to fabricate objects. They build the objects by heating the material in _____, one on top of the other.

2. One company, Pratt and Whitney, is using more than _____ 3D printed parts on its latest engine. 3D printers can make an engine part in just one step, instead of the _____ or _____ pieces needed for the traditional method.

3. There were many tests to make sure the printed engine parts could withstand high _____ and constant _____. The next step is to increase the _____ so that production can happen faster.

4. The two types of 3D printing are called _____, which consists of putting smaller pieces together, and _____, which starts with a large piece and involves carving parts of it away.

ANSWER KEY:

3-D Printers: No Ink Here!

1. 3D printing uses materials like **plastic** or **metal** to fabricate objects. They build the objects by heating the material in **layers**, one on top of the other.

2. One company, Pratt and Whitney, is using more than **two dozen** 3D printed parts on its latest engine. 3D printers can make an engine part in just one step, instead of the **five** or **ten** pieces needed for the traditional method.

3. There were many tests to make sure the printed engine parts could withstand high **heat** and constant **stress**. The next step is to increase the **speed** so that production can happen faster.

4. The two types of 3D printing are called **additive**, which consists of putting smaller pieces together, and **subtractive**, which starts with a large piece and involves carving parts of it away.

75 MINUTES

Employers Types in Manufacturing

Students learn about classifications of employers—corporations, nonprofits, owner-operated or self-employed businesses, cooperatives and civil service.

PREP

- Be prepared to discuss the following terms, defined below: **Corporation, Nonprofit, Self-employed, Cooperative** and **Civil Service**, also known as the **Public Sector**.

VOCABULARY

Corporation
Nonprofit
Self-employed
Cooperative
Civil Service
Public Sector

MATERIALS

- *Sample Employer Types* worksheet
- *My Local Employers* worksheet

EXPLAIN

1. Sometimes the word *employer* refers to an individual, but it is also used to describe a company or organization. We are going to look at five different types of employers that exist in the Manufacturing sector—corporations, nonprofit organizations, owner-operated or self-employed businesses, cooperatives, and civil service.
2. Distribute *Sample Employer Types* worksheet. Have students get into pairs and complete the worksheet together.
3. When they are finished, have students share their answers with the class.
4. After each workplace type is reported back, discuss the corresponding definition below to clarify and answer any questions. The descriptions on the next page are intended for use by the teacher.
5. Distribute the *My Local Employers* worksheet and have pairs work together to list employers that they think belong in each category.

6 Students can complete them based on their existing knowledge or use the following websites for research:

www.greatnonprofits.org and **www.nycworker.coop**

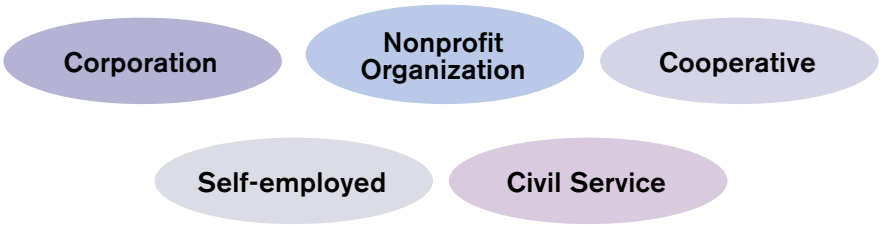
- If they use websites for research, discuss the importance of paraphrasing.
- Another option is to have them complete this worksheet individually for homework.

Workplace Types

- A **Corporation** is a business that sells goods or services. Many corporations have one person in charge at the top, the CEO or President, then a layer of middle managers who supervise people with lower levels of responsibility. If a corporation makes a large profit, that money might go to the high level managers, or they may choose to share it among the employees. Many, though not all, corporations have a hierarchy with some people holding more power to make decisions than others.
- **Nonprofits** or **Not-for-profits** generally prioritize providing services over making money. For example, they might provide shelter or counseling to homeless or low-income people, people with disabilities or other groups of people who need assistance. They are governed by a Board of Directors, a group of people interested in the success of the organization, which guides the decision-making. Users or clients often do not pay for the services. Instead, the organizations apply for and receive grants from the government or private funders. This is money that does not have to be repaid and often comes with requirements on the services provided, such as a certain number of people served or certain results of the services provided.
- **Self-employed** businesses are often a business of one, for example, a handyperson who makes repairs in people's homes or someone who does hair in their own or other people's homes. They set their own hours, prices, get their own clients and run the business themselves. They might hire someone to help with certain aspects, such as a bookkeeper to help manage the finances or an assistant to help them provide the service.
- **Cooperatives** are businesses that are owned by a group of people together, instead of having one owner or president. They make decisions about the business together and have equal decision-making power. Profits earned often go back in to supporting the business or go to the worker-owners themselves. There are many new cooperatives in New York City.
- **Civil service** is also known as the public sector or the government. Civil servants are public employees who work in a variety of fields such as teaching, sanitation, health care, management, and administration for the federal, state, or local government. There are standardized prerequisites for employment such as minimal age and educational requirements and residency laws. Employees enjoy job security, promotion and educational opportunities, comprehensive medical insurance coverage, and pension and other benefits often not provided in comparable positions in private employment.

Sample Employer Types*

Read the descriptions of employers below and determine whether each one is a corporation, a nonprofit organization, cooperative, self-employed or civil service.



Overview:

1. The city of Albany's **Department of General Services (DGS)** was created in October 1995 through the consolidation of Albany's previous Department of Public Works, Department of Engineering, the Department of Parks & Recreation (excluding the recreation programs & play structures) and the Division of Special Events & Volunteer Services and Sign Fabrication. The Department's mission is to insure that the City's streetscape, park infrastructure, public facilities and public open spaces are maintained to be functional, safe, clean, attractive and convenient for residents and visitors to the city of Albany.

   Business Type _____

2. **Eastman Kodak Company** was founded by George Eastman and Henry A. Strong in Rochester, NY, in 1880. After much experimentation in his mother's kitchen, Eastman created several generations of photographic materials, known today as film. Eastman Kodak is now a multi-billion dollar multinational technology company. Known to most people as simply, Kodak, the company employs over 6,000 workers today and is still best known for its innovations in manufacturing photographic film.

   Business Type _____

3 **Isthmus Engineering & Manufacturing** designs and builds custom automation equipment, helping customers digitize existing manufacturing equipment. The workers at Isthmus collectively own the company. Management decisions are made democratically: every member gets a vote when making decisions. Each member shares in the responsibility of managing the business.

Business Type _____

4 The **Greenpoint Manufacturing and Design Center (GMDC)** is an industrial development organization in New York City. Their primary focus is redeveloping empty industrial buildings into small business centers and then operating these as centers for small manufacturing businesses. GMDC is also active in working with city government to help develop and maintain manufacturing neighborhoods in New York City. The small businesses that occupy GMDC's buildings provide over 600 quality jobs to a diverse group of local New York residents. These businesses do not pay a fee to GDMC. Instead, GDMC operates using donations and grants from both private and public sources.

Business Type _____

5 **Peter and Abram Minor** were two brothers in Interlaken, NY, who, while on the road home from fighting in the Civil War, decided that the family business of agriculture wasn't for them—that they wanted something new and exciting to invest their time and talents. They wanted to create a business that would help people and make a lasting impression on the country they fought so hard to defend. Having served in the infantry for the Union Army, they experienced first-hand how important a soldier's boots were to their survival. The brothers soon discovered that there was a market for well crafted, stylish and comfortable women's boots and shoes in America and so they decided to go into business for themselves. Shortly thereafter, Minor Brothers Boots and Shoes was created with 20 employees.

Business Type _____

My Local Employers

List as many local employers as you can in the boxes below, providing the name and what they provide. Use businesses near class, near your home, and ones you are familiar with. If no employers come to mind for a category, do some research. Use readings from class or search online.

Corporation	
Name:	**Product or Service:**

Nonprofit Organization	
Name:	**Product or Service:**

Cooperative	
Name:	**Product or Service:**

Self-Employed	
Name:	**Product or Service:**

Civil Service	
Name:	**Product or Service:**