COLLEGE OF TECHNOLOGY
Connecticut Community Colleges

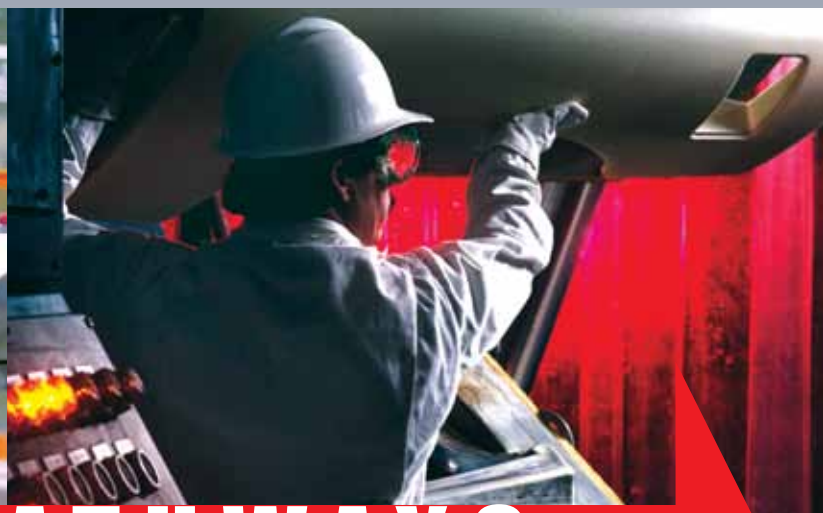
Next Generation Manufacturing Center

www.nextgenmfg.org

A National Science Foundation Center of Excellence

Manufacture Your Future 2.0

An Educator's Guide



CAREER PATHWAYS

Connecticut Community Colleges' College of Technology's Regional Center for Next Generation Manufacturing

Resources

Regional Center for Next Generation Manufacturing
www.nextgenmfg.org

Connecticut Business & Industry Association
www.cbia.com

Connecticut Technical High School System
www.cttech.org

National Association of Manufacturers
www.nam.org

Connecticut Department of Labor
www.ctdol.state.ct.us

Manufacturing Is Cool!
www.manufacturingiscool.com

Dream It, Do It!
www.dreamit-doit.com

Smaller Manufacturers Association of Connecticut
www.sma-ct.com

New Haven Manufacturers Association
www.newhavenmanufacturers.com

How Everyday Things Are Made
manufacturing.stanford.edu/hetm.html

Manufacturing Career Guide
www.khake.com/page40

Aerospace Components Manufacturers
www.aerospacecomponents.org

Career Pathways:
Manufacture Your Future 2.0

AN EDUCATOR'S GUIDE

The Connecticut College of Technology and its National Science Foundation-funded Regional Center for Next Generation Manufacturing (RCNGM) have collaborated with the Connecticut Business and Industry Association (CBIA) to present *Career Pathways: Manufacture Your Future 2.0*. This teacher's guide and DVD introduce students to contemporary manufacturing processes and products (with a special emphasis on those made in Connecticut) as well as rewarding, high-skill careers in the field.

Despite some of the economic challenges facing many businesses, Connecticut's manufacturing sector remains strong. With nearly 5,000 firms employing over 168,000 workers, manufacturing is a vital component of the state's economy and job market.

To stay competitive in a global marketplace, however, Connecticut manufacturers will need a skilled workforce. This is a critical concern now more than ever, as a large share of the industry's most experienced workers approaches retirement. CBIA's *2011 Survey of Connecticut's Manufacturing Workforce* (commissioned by the RCNGM) found that more than half of all Connecticut manufacturers surveyed reported the average age of their mid-level and management workers as 40 to 59.

Today's clean, high-tech manufacturing environment offers a wide range of employment opportunities for young people with various interests and abilities—from computer numerically controlled machine operators to aerospace technicians, machinists to mechanical engineers. Jobs are rewarding, high-paying, and increasingly dependent on technical, professional, and interpersonal skills as well as a solid foundation in science, math, and English.

We encourage you to help your students explore the opportunities manufacturing holds, supplementing the activities in this guide with segments from the enclosed DVD. The DVD includes an overview of manufacturing, employment outlook and salary data, information on educational pathways to manufacturing careers through the Connecticut Community Colleges' College of Technology, and day-in-the-life interviews with young people who work in manufacturing environments throughout our state.

Both this guide and the accompanying DVD can be downloaded at www.nextgenmfg.org and www.cbia.com/edf/careerpathways.htm. We urge you to share this free resource with students, parents, administrators, and colleagues.

Sincerely,

Karen Wosczyna-Birch

Dr. Karen Wosczyna-Birch, Executive Director
Connecticut Community Colleges' College of Technology
Regional Center for Next Generation Manufacturing

Judith K. Resnick

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Career Pathways: Manufacture Your Future 2.0

AN EDUCATOR'S GUIDE

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ANSWER KEY

Meet Today's Manufacturing Professional Workers, p. 15

a. Mike, b. A'arika, c. Beth, d. Wesley, e. Dave, f. Chris, g. Jeff, h. Curtis, i. Elizabeth, j. Jan

Contents

TEACHER REPRODUCIBLE. Use this page to help students understand manufacturing's impact on Connecticut's economy.

Part One: Exploring Today's Manufacturing

The enclosed DVD is designed to inform students about manufacturing today, what career opportunities are available, and what educational avenues they can take to succeed in the field. Before showing your students this DVD, some background information on Connecticut manufacturing will be helpful for you as an instructor.

What do you know about Connecticut manufacturing?

Today, the perception is that the majority of manufacturing jobs are being moved overseas as a cost-cutting measure; that factories are old, noisy, dark, and dirty; and that manufacturing employees tend to be older workers who stay in dead-end, repetitive jobs. So why consider a manufacturing career?

While some of these perceptions may have been true at one time, here are some facts that might change your views about manufacturing in Connecticut:

- There are more than 168,000 employees working in 4,826 Connecticut manufacturing companies.
- Although it ranks 29th in population, Connecticut ranks 18th in the nation in manufacturing production.
- Half of the top 100 companies headquartered in Connecticut are manufacturers.
- $12.4 billion in wages and salaries are earned annually by Connecticut manufacturing employees.
- Biomedical manufacturing is expanding.
- Connecticut ranks second in U.S. defense contracts, at $3,487 per capita, and provides parts for more than half of the world's commercial airplanes.
- Each new job in the key areas of Connecticut manufacturing creates 1.9 to 4 additional jobs throughout the economy.
- Average annual pay for a Connecticut manufacturing production worker is $47,000; for engineers, $80,000.
- Weekly pay for manufacturing employees averages $1,000.

Sources: CBIA Research Dept., CT Dept. of Labor, CT Dept. of Economic and Community Development, U.S. Bureau of Labor Statistics, 2009 Connecticut Manufacturers Register, salary.com, Economic Report of the Governor, U.S. Bureau of the Census: County Business Patterns (2009).

On a national level...

- The U.S. is the world's largest manufacturing economy, producing 21% of global manufactured products. China is second at 15%.
- Manufacturing supports an estimated 18.6 million jobs in the U.S.—about one in six private-sector jobs.
- U.S. manufacturers perform two-thirds of all research and development in the nation, driving more innovation than any other sector.

Manufacturers today are reorganizing to meet global competition. They're working smarter by adopting more efficient processes, such as lean manufacturing that focuses on ways companies can cut costs and production time by reducing overproduction, waiting time, transportation, processing, inventory, motion, and scrap in manufactured products. The technology is state-of-the-art, requiring higher skill levels and cross-training for employees. Jobs are no longer repetitive. There are also many opportunities for advancement, and salaries average more than $40,000 a year, with many jobs paying significantly more than that. Experienced engineers, for instance, can earn well over $100,000 a year.

Factories are modern, high-tech facilities. Today, the three largest manufacturing industries in the U.S. are chemical, industrial machinery and equipment, and electronics. Fifty years ago they were food, primary metals, and motor vehicles.

Perhaps more critical is the fact that a majority of manufacturers say they can't find qualified workers to fill positions they need. In particular, 64-87% of Connecticut manufacturers cited the most difficult positions to fill were CNC programmers, tool and die makers, CNC machinists, CAD technicians, and engineers.

Refer to the first section of the DVD for an overview of today's manufacturing.

Sources: CBIA and the College of Technology's Regional Center for Next Generation Manufacturing's 2011 Survey of Connecticut's Manufacturing Workforce; National Association of Manufacturers (January 2009)

TEACHER REPRODUCIBLE. Use this page to help students recognize the skills and education requirements for manufacturing careers.

Is manufacturing for me?

Manufacturing might appeal to you if you…

- Enjoy figuring out how things work
- Like solving practical problems
- Enjoy developing new techniques and products
- Like taking things apart and putting them back together
- Have an interest in making things—especially using technology, electronics, lasers, and robots
- Enjoy working in teams

What skills and characteristics would help me succeed and advance?

Employers cite the following characteristics and skills as important for success and advancement in manufacturing:

- Literacy and communication skills
- Ability to work with existing technology
- A desire to learn new skills/technologies
- Strong math, science, and problem-solving skills
- Teamwork/interpersonal skills
- Cross-training—the ability to transfer skills and learn new ones in order to perform many functions in the workplace
- Professionalism, including punctuality, positive attitude, and appropriate attire
- Ability to work successfully with people from diverse backgrounds and cultures

CBIA recently conducted a survey on behalf of the College of Technology's Regional Center for Next Generation Manufacturing. Manufacturers who participated in the *2011 Survey of Connecticut's Manufacturing Workforce* listed the following skills as the most essential:

- Employability, work ethic, punctuality
- Basic skills (math, reading, writing)
- Technical skills (CNC, blueprint reading, job-specific)
- Advanced skills (problem-solving, computer, scientific)

What are the education requirements and average salaries?

Salaries are based on current Connecticut averages obtained from www.salary.com.

For individuals with a high-school diploma/ apprenticeship and/or associate degree

CNC Programmer	$55,000 *(to $68,000 w/4-year degree)*
CNC Operator	$38,000
Machinist	$46,000
CAD Drafter	$55,000
Welder	$41,000
Manufacturing Technician	$40,000
Engineering Technician	$64,000
Tool and Die Maker	$60,000

For individuals with a bachelor's degree

Manufacturing Engineer	$78,000
Biomedical Engineer	$82,000
Mechanical Engineer	$81,000
Aerospace Engineer	$87,000
Electrical Engineer	$82,000
Chemical Engineer	$88,000

Considerable overtime pay is available in manufacturing, often resulting in higher earnings than those listed.

Sources: May 2010 Connecticut State Occupational Employment, Bureau of Labor Statistics, Occupational Outlook

TEACHER REPRODUCIBLE. Use this page to help students understand manufacturing career opportunities.

What are the opportunities in manufacturing?

According to the CBIA/College of Technology's Regional Center for Next Generation Manufacturing's *2011 Survey of Connecticut's Manufacturing Workforce,* the jobs most in demand in Connecticut include:

Manufacturing Engineers—Design, develop, test, and help manufacture machines, consumer products, computer software, communications systems, and more. Manufacturing engineers work with all aspects of manufacturing, from production control to materials handling to automation. Depending on your engineering specialty, you could be in charge of building everything from bridges and solar panels to computer chips and medical lasers. You'll create a plan, execute it, manage people and budgets, and report on your progress.

Manufacturing Technicians—Every product you see and use is manufactured, including cars, computers, refrigerators, music systems, bikes, video games, sports equipment, aircraft, and medical devices. As a manufacturing technician, you will operate, install, maintain, and continuously improve the machinery, processes, and production systems that produce these products. You will work in clean, modern facilities with high-tech devices such as robots, highly automated systems, computer controlled machining systems, and intricate assembly machinery.

Machinists—Basically, you'll be making things with metal and other materials, such as plastic and glass. Lathes, milling machines, shapers, and grinders will all be part of your daily work. You'll run computer-controlled machining tools that are accurate down to a few micrometers. And you'll work with finishing tools to perfect each piece you've made. You'll be in charge of metalworking projects from planning and fabrication through assembly, inspection, and testing, using knowledge of machine functions, metal properties, and mathematics.

Drafters (CADD—Computer Aided Design and Drafting)—CADD operators use computers to prepare technical drawings and plans used to build everything from manufactured products such as toys, spacecraft, and industrial machinery to oil and gas pipelines. They review engineering drawings and designs to ensure that the right specifications and standards are used.

Welders—You might be working on anything from a custom motorcycle or mountain bike frame to the wings on a private jet or even part of a bridge. Precise hand-eye coordination and a great attention to detail are a necessity to get those welds looking smooth. You'll also be creating parts from scratch, using all kinds of other tools, and checking tolerances to make sure your welds are perfect.

CNC Programmers and Operators—Work with CNC (computer numerically controlled) machines, which cut and shape metal, plastic, or glass to form a finished part. CNC programmers plot out, step-by-step, the way a machine will make auto, machine, or other parts to meet exact standards. Once the programming is done, CNC operators step in to keep an eye on the machine all the way through the manufacturing process.

Tool and Die Makers—Design, build, and repair machine tools that are used to cut, shape, and form metal and other materials. Die makers construct metal forms, called dies, that shape metal in stamping and forging operations. They make metal models for die casting of parts and work with engineers and designers to determine how best to manufacture a part. They also repair worn or damaged tools, dies, gauges, jigs, and fixtures.

Sources: May 2010 Connecticut State Occupational Employment Statistics; Bureau of Labor Statistics, Occupational Outlook Handbook

TEACHER REPRODUCIBLE. Use this page to help students understand how a product is made.

Part Two: What Is Manufacturing?

This part of the teacher's guide encourages students to think about manufacturing and the processes behind the products we use. It would be a good idea to show the "Next Generation Manufacturing" and "Advanced Manufacturing Technologies" sections of your DVD. The following activities are suggested to encourage students to think about what goes into manufacturing and how manufacturing touches our lives every day.

Before showing the DVD, remind students that almost everything in our daily lives—from our headphones to the shoes on our feet—has been created and manufactured by someone. Ask students to identify anything in the classroom that has been manufactured.

- What is the item made from?
- How do you think it was made?
- Start to finish, what types of workers were involved in the concept, design, sourcing, funding, testing, marketing, distribution, and disposal associated with this product?

Show the "Next Generation Manufacturing" section of the DVD, giving an overview of today's manufacturing.

Student activity: Team discussions of student-manufactured products

Divide students into small groups and have them discuss any product they may have created from scratch or altered for a purpose. These could include pinewood or soapbox derby cars, baked goods, science projects, jewelry, wallets, bird feeders, arts and crafts, and tie-dye or silkscreened shirts. Have students share how they came up with the idea and how they designed the product. If they sold their products, ask them to describe that process as well. Have them write down the steps they took to make their products successful. Also have them discuss any mistakes they may have made and what they did to correct the problems. Have a team leader report key findings to the class.

TEACHER REPRODUCIBLE. Use this page to help students understand manufacturing's impact on Connecticut's economy.

"Made in Connecticut" Quiz

1. This unique roundback guitar was made by Charlie Kaman, a Connecticut helicopter engineer. It was made famous by musicians like John Lennon (The Beatles), Bob Marley, Ziggy Marley, Shania Twain, Dave Mustaine (Megadeth), Yngwie Malmsteen, Al DiMeola, and Melissa Etheridge. Today, the company behind it has produced the first electric/acoustic guitar with a built-in MP3 recorder. Name the guitar and the company.

   _____

2. What nuclear-powered weapon is named after our 39th president? Name the product and the company.

   _____

3. How sweet it is! Starting out in 1946 as The Dandy Candy Company in a horse barn in Manchester, Connecticut's largest chocolate retailer now produces everything from chocolate fish to UConn Husky bars. Name the company.

   _____

4. This Canaan company is one of the world's largest suppliers of a common medical device—which has probably been used on you when you were perfectly healthy! Name the product and the company.

   _____

5. The idea for this Connecticut-made product started with a 12-year-old and a problem: Dave and his friends liked to play baseball, but their yards were too small—which meant lots of broken windows! Dave's dad came up with a "hole" new alternative to playing hardball. Name the product and the company.

   _____

6. This United Technologies Corporation (UTC) company based in Stratford manufactures a military helicopter used by more than 20 armies worldwide. Most recently, the chopper has flown in Afghanistan and Iraq. Name the product and the company.

   _____

7. This Farmington manufacturer has something in common with many of the world's tallest and most famous buildings, including Chicago's Willis Tower (formerly the Sears Tower), Toronto's CN Tower, and the Burj Dubai (pictured). Name the company.

   _____

8. In 1969, Neil Armstrong became the first person to set foot on the moon. When he took those historic first steps, he did it with the help of this Connecticut manufacturer. Name the product and company.

   _____

9. This East Hartford-based company makes engines for rockets, space shuttles, and fighter jets, and it powers about one-third of all commercial airliners. Name the company.

   _____

10. This company proves you don't have to go far to find real beauty. This Trumbull company designs some of the most recognizable health and beauty products—soaps, shampoos, and lotions with a trademark bird logo. Name the soap and skin care products and the company.

    _____

11. Heads up! This candy company in Orange is known around the world not only for its candy but also for the clever packaging it comes in. Name the product and the company.

    _____

ANSWER KEY

1. *Ovation guitar by Kaman Music in Bloomfield*
2. *The Seawolf-class attack submarine Jimmy Carter, which honors the only U.S. president qualified in submarines*
3. *Munson's Chocolates*
4. *The Plastipak is a disposable plastic syringe—the kind of needle used to deliver vaccines and other medicines to keep people healthy. Each week, BD's manufacturing facility in Canaan produces 30 million of them!*
5. *The WIFFLE ball, by Wiffle Inc., made in Shelton, since the 1950s*
6. *Sikorsky and Black Hawk*
7. *Otis Elevator manufactures not only elevators but also escalators and other "people movers." Their sophisticated equipment is found in more than 200 countries and in nearly half the world's tallest buildings.*
8. *Hamilton Sundstrand, UTC, produced Neil Armstrong's famous space suit and has been outfitting NASA astronauts ever since.*
9. *Pratt & Whitney, UTC*
10. *Dove & Unilever*
11. *PEZ candy, which is made in Connecticut and sold in more than 60 countries. It comes in plastic dispensers shaped like your favorite characters—from Mickey Mouse to Obi-wan Kenobi.*

TEACHER REPRODUCIBLE. Use this page to help students understand the procedures involved in manufacturing a product.

The Life Cycle of a Product

While there are many different processes involved in manufacturing a product, such as an MP3 player, these are the most common steps:

1) Market Analysis **3) Source Materials & Fabricate** **5) Market** **7) Recycling & Reuse**

2) Design **4) Test** **6) Distribute**

WHAT TO DO: For each step, write something that you either know **(K)** or want to know **(W)** about the process. Discuss your comments and questions with a classmate.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

TEACHER REPRODUCIBLE. Use this page to help students understand the life cycle of a product.

❶ ANALYSIS

is a response to a market need. It is a new idea that solves a practical problem.

Reasons an MP3 player is a good idea

- ☑ Allows consumer choice (e.g., which songs to listen to—instead of radio; which songs to pay for—instead of entire CD)
- ☑ Small size
- ☑ Convenient; easy to use
- ☑ Portable
- ☑ Stores multiple files
- ☑ High-quality sound
- ☑ Fast Internet/multimedia downloads
- ☑ Saves on cost of purchasing CDs

STUDENT ACTIVITY:
Brainstorm with a classmate:

- What should you think about before designing a product?
- What are some of the challenges?
- What are some products that are new to the market?
- What problems did they solve, or what needs did they address?

❷ DESIGN

takes the initial concept and transforms it into a working model.

- ✓ **What will it look like?**
- ✓ **What will it feel like?**
- ✓ **What will it sound like?**
- ✓ **How will it perform?**
- ✓ **How can it be built?**
- ✓ **What materials could be used?**
- ✓ **How much will it cost?**

In manufacturing, making ideas a reality requires engineering, computer-aided drafting and design, prototyping, and selection or development of the tools and processes that will be used to manufacture the new product.

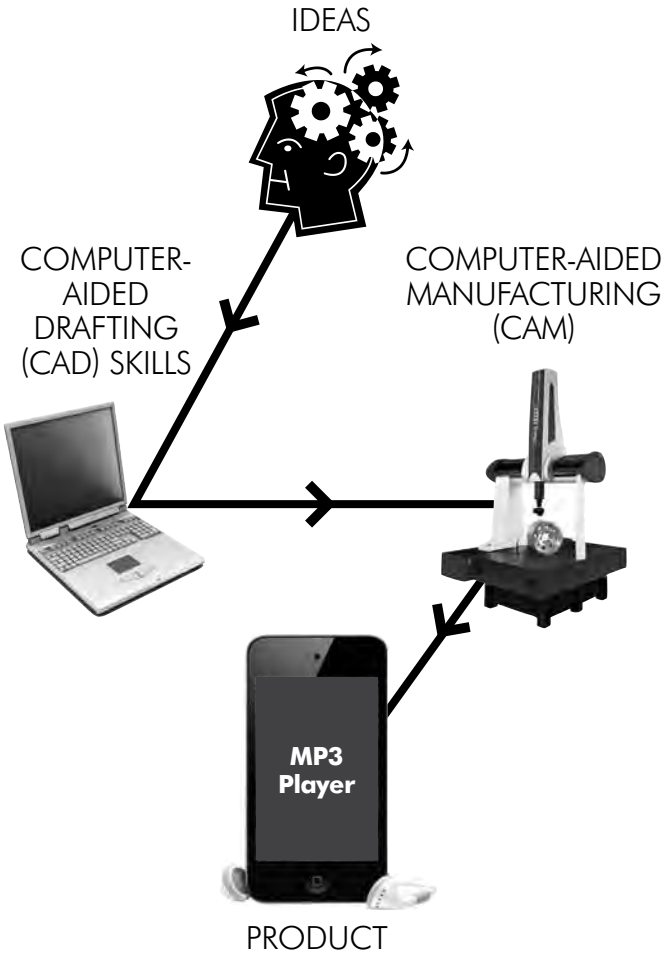
STUDENT ACTIVITY: Choose a product to research. When and where was it developed, and by whom? What purpose does it serve? How have the original design, the materials used, and the product's performance and popularity changed over time? What changes do you foresee in the future, and why?

(continued)

TEACHER REPRODUCIBLE. Use this page to help students understand the life cycle of a product.

❸ FABRICATION

requires skilled technicians to transform ideas into blueprints and into actual products.



STUDENT ACTIVITY: Make some predictions, follow up with research, and create a process flowchart illustrating the following:

- What kinds of employees would be involved in the manufacturing of a product, such as an MP3 player?
- What would each person's role(s) be?
- How does each team member depend on the others?

❹ TEST

Products must be tested to make sure they perform as designed. Both final products and their individual components are tested for such variables as the following:

- ✓ **Conformance to design specifications**
- ✓ **Durability**
- ✓ **Customer satisfaction and use**
- ✓ **Safety**

All products must be inspected and tested before they are assembled and sent to customers. In addition to the many specialized skills required to produce a product, other skills are needed for quality control.

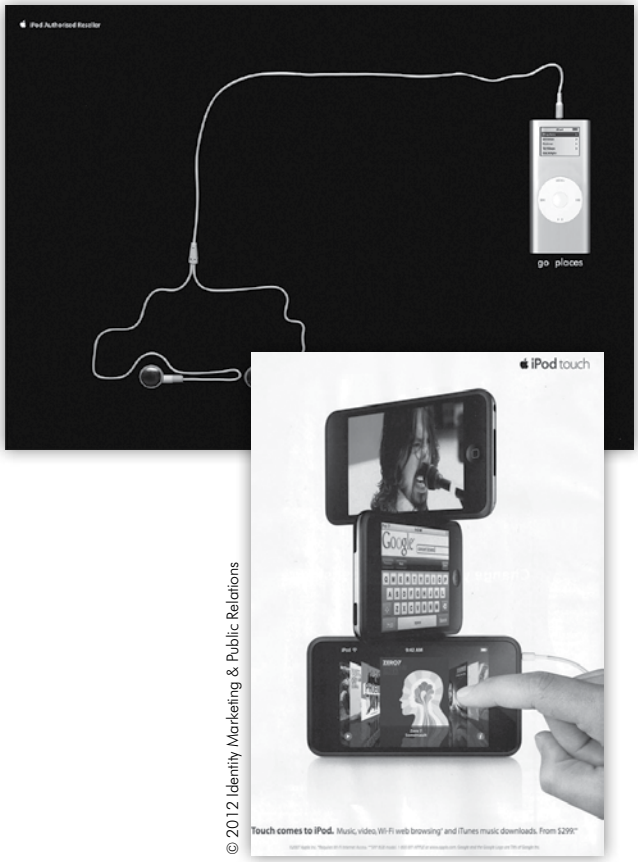
STUDENT ACTIVITY: Think of an everyday product you use. How do you think it is tested? For what variables and at what stage(s) of production is it tested? Do some research and check your predictions. Create a PowerPoint presentation or poster illustrating these testing processes.

(continued)

TEACHER REPRODUCIBLE. Use this page to help students understand the life cycle of a product.

5 MARKETING

There are many different non-manufacturing jobs that support manufacturing functions. For example, once products are produced, they need to be promoted and sold.



STUDENT ACTIVITY: In a small group or with a partner, brainstorm a new or improved product. Create an ad for your product (print, Web, TV, or radio). Who is your target audience? How will you reach these primary consumers? What message, image, or media will support your marketing goals? How will you measure the effectiveness of your marketing campaign?

6 DISTRIBUTION

involves packaging and shipping the products to consumers.

Questions to ask:

- ✓ What is the best way to package the product?
- ✓ How much volume does it need?
- ✓ How much protection?
- ✓ What materials will be used in packaging and shipping?
- ✓ What is the cost of shipping the product?
- ✓ What laws or government regulations might apply to different products?

Products need to be transported to consumers by air, land, or sea. The same transportation networks might be used to deliver the materials needed by the manufacturer.

A great deal of thought goes into the packaging and labelling of products for shipping and distribution as well as other purposes.

STUDENT ACTIVITY: Find a labeled package from an ordinary household product. Examine it for evidence of the following goals: marketing; security; physical protection (e.g., against temperature, water, shock, contaminants, oxygen); grouping and containment; information (e.g., about use, risks, recycling); convenience (e.g., added features, such as a tear strip or resealable bag); and marketing messages. Share your package/label and analysis with the class.

(continued)

TEACHER REPRODUCIBLE. Use this page to help students understand the life cycle of a product.

7 RECYCLING & REUSE

Of course, the manufacturing cycle doesn't end with distribution. Increasingly, manufactured products have a second life, meaning that their materials are recycled and reused in the production process or that they come back as other products entirely. Consider sneakers, which are turned into surface material for playgrounds, tennis courts, or running tracks. Plastic bottles become material for park benches. Empty ink cartridges are refitted, refilled, and resold for a lower price.

So, what happens at this stage of the manufacturing cycle to some of the stuff you use?

Environmental Status Report*

Apple's iPod touch is designed with the following features to reduce environmental impact:

- Arsenic-free display glass
- Mercury-free LED-backlit display
- BFR-free
- PVC-free
- Recyclable stainless steel enclosure
- Power adapter outperforms strictest global energy efficiency standards

STUDENT ACTIVITY: Choose a product to research. Is it made from recycled materials? Is the product itself recyclable? How can you raise consumer awareness of and participation in recycling efforts? What can you do in your own home and school? Share your findings and ideas with your class.

* *Source: http://images.apple.com/environment/reports/docs/iPodtouch_Product_Environmental_Report_2011.pdf*

TEACHER REPRODUCIBLE. Use this page to help students understand what it's like to work in manufacturing.

Part Three: Profiles in Manufacturing

Watch the profiles section of the DVD to get an up-close look at some manufacturing careers.

Meet today's manufacturing professional workers

Answer key on page 2.

a. Who likes to see a product from beginning to end?

_____

b. Who wanted to be an astronaut?

_____

c. Who "pieces the puzzle together" to be lean?

_____

d. Who participated in the College Connections program?

_____

e. Who started out as a professional cook?

_____

f. Who was in the National Guard?

_____

g. As a child, who took apart toys instead of playing with them?

_____

h. Who worked on the tallest building in the world?

_____

i. Who started out studying architecture?

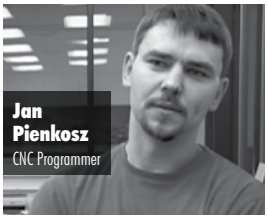
_____

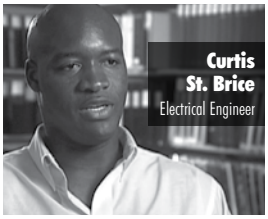
j. Who had planned on becoming an auto mechanic?

_____

On a separate piece of paper describe what each worker likes most about his/her job.

After watching the section on advanced manufacturing, name and describe two types of technologies used in manufacturing today.





TEACHER REPRODUCIBLE. Use this page to help students understand what it's like to work in manufacturing.

A Day in the Life

▶ Research a manufacturing job. In a one- or two-page report, describe the nature of the job, a typical work environment, and particular skills or training needed to do the work. Several positions are listed below. You may choose from this list or select any other job in manufacturing.

aerospace technician	first-line supervisor
bioprocess engineer	laser technician
chemical engineer	machinery installation, repair, or maintenance technician
electrical engineer	machinist
industrial engineer	quality control/quality assurance inspector
mechanical engineering technician	tool and die maker
optical engineer	welding technician
CAD drafter	
CNC programmer	

▶ Design a poster or a brochure spotlighting a particular manufacturing career. Be sure to include information about education, skills, and training needed; job responsibilities; and benefits of this job (e.g., ability to make decisions, work on a team, produce goods or materials that improve people's health, safety, or quality of life).

▶ Interview someone who works in manufacturing. Transcribe your notes and present your findings in a report. Use the questions below to guide you. Feel free to add questions of your own.

- What does your company manufacture?
- What is your role within the company?
- What are your responsibilities?
- How do you think manufacturing today is different from the way it was ten years ago? Twenty-five years ago?
- How has your job evolved?
- What technical skills do you use?
- What personal characteristics or skills are important to your job?
- How did you choose this career path?
- Is communication with others important to your work? If so, how?
- Describe a typical workday.
- What do you like most about your job?
- How did your education prepare you for this work?
- What kind of training have you received during your employment?

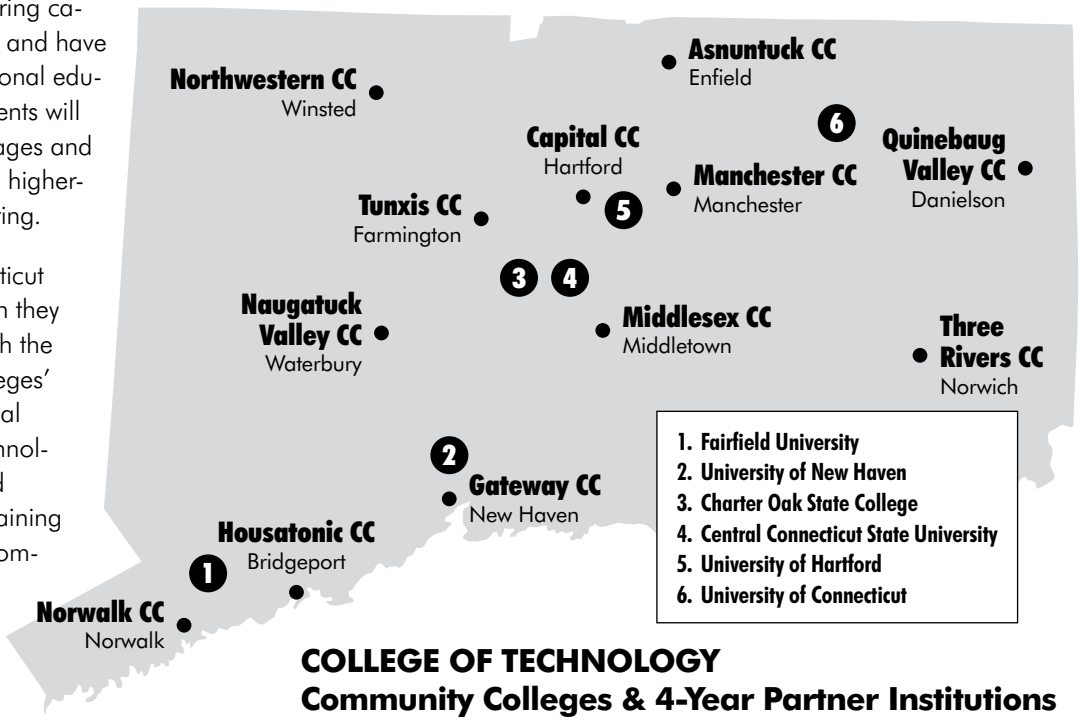
TEACHER REPRODUCIBLE. Use this page to help students understand how they can prepare for careers in manufacturing.

Part Four: Getting There—Your Career Pathway

Watch the "Pathways to Manufacturing Careers" section of the DVD. This section supports the idea that education beyond high school is becoming more essential for success in manufacturing. Innovative community college programs are a great way to get the skills necessary in today's manufacturing industry.

The technologies involved and the way that manufacturers have to do business to remain competitive require higher skill levels. Not only are strong math, science and technological skills necessary, but communicating effectively, working in a team environment, and being flexible and open to learning new skills are essential.

Anyone entering a manufacturing career would be better prepared and have more opportunities with additional education. Associate degree students will advance. They earn higher wages and can easily pursue pathways to higher-level professions like engineering.



COLLEGE OF TECHNOLOGY
Community Colleges & 4-Year Partner Institutions

One of the best ways Connecticut students can get the education they will need to succeed is through the Connecticut Community Colleges' College of Technology, a virtual organization representing technology curriculum geared toward engineering and technician training offered at Connecticut's 12 community colleges. The Regional Center for Next Generation Manufacturing (RCNGM) addresses the need for highly skilled workers in the new manufacturing workplace by building programs that provide resources to educators and students interested in learning new technologies in manufacturing. A National Science Foundation Center of Excellence, the RCNGM is directed by the Connecticut College of Technology.

This innovative program allows a student to complete an A.S. degree in Technological Studies or Engineering Science at any of the state's community colleges, with all credits completely transferring to four-year engineering and technological studies programs at select Connecticut four-year universities.

The Connecticut College of Technology works closely with industry and Connecticut universities to get the most up-to-date information on workforce needs. The associate degree programs are tailored around careers in high-growth fields, such as the following:

- Precision machining
- Fiber optics
- Precision metal fabrication

Industry-driven courses and certificate programs are offered in such areas as:

- Computer-aided design (CAD)
- Lean manufacturing and supply chain
- Plastics technology
- Biomolecular science
- Manufacturing engineering technology
- Welding technology
- Laser and fiber optic technology
- Machine technology

For engineering students, this pathway program is particularly beneficial: Upon earning their associate degree in engineering science, students accepted through the admission process can enter as juniors into four-year engineering programs at the University of Connecticut, University of Hartford, Fairfield University, University of New Haven, and Charter Oak State College, or in engineering technology or industrial technology at Central Connecticut State University.

STUDENT ACTIVITY:

After watching the video, write down two things you learned about manufacturing careers or training:

1. _____

2. _____

Write down two questions you have:

1. _____

2. _____

For more information, visit the Regional Center for Next Generation Manufacturing at www.nextgenmfg.org.

Part Five: Additional Activities & Resources for Teacher/Student Explorations in Manufacturing

The Connecticut Business and Industry Association's (CBIA) Education Foundation can help arrange externships, company visits, guest speakers, and other opportunities. For assistance, call 860.244.1900.

For Teachers:

- **Teacher Externships (or Internships):** Participate in a teacher externship program, working with a local manufacturer for a minimum of two weeks. Teacher externships are one of the best ways to experience current practices in manufacturing and update your skills. An externship also gives you the opportunity to partner with a manufacturer for future school-to-career activities. One way to get the most out of the experience is to engage your students in a work-based learning project from your own externship experience. For more information on teacher externship programs, visit the Regional Center for Next Generation Manufacturing at nextgenmfg.org.

For Teachers and Students:

- **Job Shadow:** Spend a day with an industry professional, observing what he or she does and experiencing the company's environment.
- **Guest Speakers:** Invite industry professionals to visit your class to talk about their careers, what they like about their work, what skills they bring to the job, and how they acquired those skills. To make the most of this experience, brainstorm some questions in advance.
- **Company Visits:** Arrange to have your students visit manufacturers and interact with industry professionals to get a firsthand look at what goes on in a manufacturing company.
- **Conduct a "take-apart" or "reverse engineering" workshop in class.** Ask students to bring in a non-working household appliance or electronic device and tools to work with. Carefully disassemble the appliance into the smallest possible pieces and discuss such questions as:
  - Exactly how does the appliance work?
  - What materials are used on the outside? The inside? Why, do you think, were those materials selected for those functions?
  - Are screws, rivets, and fasteners used? Where and for what purpose?
  - How is electricity used?
  - How would you improve the appliance or device?

COLLEGE OF TECHNOLOGY
Connecticut Community Colleges

Next Generation Manufacturing Center

www.nextgenmfg.org

A National Science Foundation Center of Excellence

What You Can Do

To Be Part of the Next Generation of Manufacturers

The Regional Center for Next Generation Manufacturing provides great resources for both educators and students interested in exploring opportunities in today's technology companies. Funded by the National Science Foundation and directed by the Connecticut Community Colleges' College of Technology, the Center offers:

- Industry-driven courses in next generation manufacturing, including laser manufacturing, green engineering, nanotechnology, fuel cells, and biomedical applications
- Online courses that include diverse methods of teaching
- Career marketing materials that support the recruitment and retention of students in manufacturing careers
- Courses that bridge two-year engineering technology programs with traditional four-year engineering programs
- Longitudinal studies that identify best practices and assess students' performance in the workplace and employer satisfaction with graduates
- Teacher internships in cutting-edge, next generation manufacturing companies

Start by enrolling in College of Technology programs.

The Connecticut Community Colleges' College of Technology offers a specialized curriculum that allows a student to complete an A.S. degree in *Technological Studies* or *Engineering Science* at any one of the state's twelve community colleges:

- Asnuntuck
- Capital
- Gateway
- Housatonic
- Manchester
- Middlesex
- Naugatuck Valley
- Northwestern CT
- Norwalk
- Quinebaug Valley
- Three Rivers
- Tunxis

Connecticut's community colleges are affordable, flexible, and geographically convenient for students statewide. They offer programs to prepare students for careers in high-growth fields, such as precision machining, fiber optics, and next generation manufacturing.

A.S. degree options and credit certifications include:

- **Computer Aided Design (CAD)**
- **Laser and Fiber Optic Technology**
- **Plastics Technology**
- **Precision Manufacturing**
- **Environmental Science**
- **Lean Manufacturing and Supply Chain Management**
- **Manufacturing Engineering Technology**
- **Engineering Technology**
- **Biomolecular Science**
- **Machine Technology**
- **Welding Technology**
- **Electromechanical Technology**

These programs also provide a seamless pathway for community college students to continue their program of studies as juniors in engineering programs at the University of Connecticut, Fairfield University, the University of Hartford, University of New Haven, Central Connecticut State University, or Charter Oak State College—or in engineering technology or industrial technology at the University of Hartford or Central Connecticut State University.

For more information, visit our website at www.nextgenmfg.org.

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