

Designing Your Future Career

GRADES
3-5

Duration

4-5 sessions (45 minutes each)

Lesson Summary

In this lesson, students will explore modern (advanced) manufacturing careers as they identify required skill sets, apply innovative thinking and creativity, and connect the application of modern manufacturing to daily products and use. In the final activity, students role-play a select modern manufacturing career to complete a design challenge.

Essential Questions

- ◇ How do science, engineering, and technology apply to modern manufacturing careers?
- ◇ How does manufacturing impact our lives?
- ◇ What would the world be like without manufacturing?
- ◇ Why is manufacturing vital to innovation and improvement?

Learning Objectives

Students will:

- ◇ Describe modern manufacturing
- ◇ Describe select modern manufacturing careers.
- ◇ Connect modern manufacturing to innovation, technology, and futuristic products.
- ◇ Role-play a career in advanced manufacturing to learn and apply a vast skill set for product development.

Next Generation Science Standards

Cross Cutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- ◇ People's needs and wants change over time, as do their demands for new and improved technologies.
- ◇ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Standards for Technological Literacy

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

E. Creative thinking and economic and cultural influences shape technological development.

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

D. Invention and innovation are creative ways to turn ideas into real things.



Background for the Teacher

Manufacturing has been defined as “the process of converting raw materials, components, or parts into finished goods that meet a customer’s expectations or specifications.” Prior to the Industrial Revolution, manufacturing meant creating products or goods by hand. Most families worked from their farms or homes. The Industrial Revolution brought a change in the way goods were manufactured. Instead of producing items by hand at home, manufacturers began using machines to produce multiple quantities in less time.

Now, modern (advanced) manufacturing is inspired by innovation, technology, and the collaboration of people working to build the future. Advances in 3-D printing, human-robot interactions, and extreme customization are now shaping the world of manufacturing. Professionals involved in advanced manufacturing processes and systems must be able to identify problems, create solutions, think critically, effectively communicate as part of a team, and apply new technologies and skills. Many of today’s students use skills like this every day, and this lesson can help them see how their skills and interests may align with one or more of the career paths that make up modern manufacturing.

This lesson will begin to introduce students to the processes and careers that now innovate and manufacture many of the products they use every day as well as the products of the future. Featured careers within the lesson include:

- ◇ Quality Control Technician
- ◇ Engineer
- ◇ Model Maker
- ◇ Environmental Scientist
- ◇ Robotics Technician
- ◇ Supervisor
- ◇ Welder

Materials

Student Activity Sheets:

- ◇ NASA Concept Images (one per student)
- ◇ Future of Manufacturing Graphic Organizer (one per student)
- ◇ What Do You Like? (one per student)
- ◇ Career Descriptions (one per student)
- ◇ Engineering Challenge (one per team)
- ◇ Roles and Responsibilities (also includes answer key) (one per team)

For Challenge:

- ◇ Popsicle sticks
- ◇ String
- ◇ Drinking straws
- ◇ Masking tape
- ◇ Tubs of water for testing

Engage (30 minutes)

Teacher Note: Depending on students' previous knowledge about modern manufacturing, teachers can customize steps 1-5

- 1** Provide each student with a card that has a green side and a red side. Read the statements below. If a student believes this is an example of the statement read, they should flip their card to green. If they do not believe this is an example of the statement read, they should flip their card to red. If time allows, invite student volunteers to explain their choices. After some discussion, share the correct answers.
 - ◇ Manufacturing means to make something. Leaf, pencil, dog, shoes
 - ◇ Manufacturing can be high-tech. Computer, paper/pencil, robots, highlighter
 - ◇ Manufacturing processes are always changing. Robots, 3D printer, simple calculators, dark factory
 - ◇ You can now manufacture jewelry, instruments, and parts for radio controlled helicopters using just your computer and a 3-D printer. Bracelet, peanut, earbud holder, meat
- 2** Clarify with students that humans have been making things for centuries, from simple tools to complex robots. This is called manufacturing. Manufacturing is the process of converting (changing) things found in nature into physical goods. Ask students to look around the classroom and point out items that have been manufactured. Students might point out furniture, technology, or clothing. Invite students to complete the sentence, "Manufacturing is..." as a check for understanding.
- 3** Explain that the people who manufacture goods change what is made and how they make them as new technologies emerge and better processes develop. As an example, ask students to think about how many different cell phones and cars there are.
- 4** Distribute or display the *NASA Concept Images*. This resource includes concept images illustrating how NASA (The National Aeronautics Space Agency) views the future of human colonies and aviation.
- 5** Invite students to describe what they see in the images. Students can sort the types of things they are observing into categories of people/careers, places, and things. A *Future of Manufacturing* graphic organizer is provided for students to organize their thinking. This includes questions to prompt students to write down their observations. As students are working, the following guiding questions can be used to help students elaborate on their observations:
 - ◇ Do you notice any other living things besides people?
 - ◇ With what types of objects are people interacting?
 - ◇ What types of objects are visible in the images?
 - ◇ What do you think the objects in the images are used for?
 - ◇ Where do you think these settings are?
 - ◇ Do you think these environments are moving?
 - ◇ Are objects in the images moving?
- 6** After students have captured their general observations, ask students to develop their own questions based on their observations of the different images. What would they want to ask to find out more information about the futuristic designed worlds they see in the images? Students can use the *Future of Manufacturing* graphic organizer to write down their questions.
- 7** Invite students to share out their questions. Ask students what types of jobs they think would be involved in bringing these concepts to life. This can include jobs students observed in the images themselves. Record their ideas to revisit later. (At this point in the lesson sequence, this question is assessing their background knowledge).

Explore (60 minutes)

- 1 Ask students what it means to be a problem-solver and invite them to share examples of problems they have solved. Explain that one of the many things that people who manufacture products need to do is to be a good problem solver, and they often work in teams to solve problems together.
- 2 Distribute the *What Do You Like To Do?* activity sheet to each student. Invite students to read and rank the statements from 1-4 with 1 being the profile that sounds most like them and 4 being the profile that sounds least like them. Teacher note: Organize students into groups of four based on their ranking. Try to give each student their first or second ranking when sorting groups.
- 3 Distribute the *Career Descriptions* activity sheet. Provide students time to review the career they were assigned and ask any clarifying questions. Students will assume this role in an upcoming engineering challenge. More information about the careers can be found at <http://www.bls.gov/ooh/>.
- 4 Distribute the *Engineering Challenge* and display the provided materials. Ask students to use an annotated reading strategy to break down the challenge:
 - ◇ Annotated Reading Strategy
 - ◇ Underline **what** you are going to do.
 - ◇ Highlight **how** you are going to do it.
 - ◇ Put a box around **why** this is important.
- 5 Invite students to summarize the challenge in 1-2 sentences and to share that summary with a partner. Then, invite student volunteers to share summaries with the class to ensure that all students understand the challenge.
- 6 Distribute the *Roles and Responsibilities* table. Guide students to share their career description with their group. Ask teams to work together to complete the table. An answer key is provided. More than one career may fit in a role and can work together on that task.
- 7 Distribute the materials, and give teams 25-30 minutes to complete the challenge. This includes time for the supervisor to gather materials sketched in the design and the quality control technician to test the product. Students should work through the challenge using their defined roles. Small tubs of water should be provided in the classroom for students to test their designs. Teacher note: If time allows, invite student groups to share their designs with the class. Students can compare designs by timing how long each is able to be in the tub of water without the tea bag coloring it. They can also compare how many materials were used in each design. A product that used fewer materials may be cheaper to manufacture.
- 8 Pose the following questions to summarize the challenge with students:
 - ◇ Was your design successful? How do you know?
 - ◇ Is there anything you would do differently if you were given the same challenge?
 - ◇ How did working together help you complete your challenge?
 - ◇ How did your career match with things you enjoy doing?
 - ◇ Were there other careers you would have been interested in that other group members had?
 - ◇ How did having unique roles and responsibilities help you with the challenge?

Explain (25 minutes)

- 1 Invite students to revisit the *NASA Concept Images*.
Ask: How could the careers you role-played help with solving some of the questions you posed earlier?
- 2 Introduce three new advanced manufacturing careers by writing these names on the board: model maker, environmental scientist, and robotics technician. Ask students what they think each of these careers does. Capture answers.
- 3 Display the descriptions of each career on a Smart Board or chart paper and compare to the student brainstorming.
 - ◇ **Model Makers** create three-dimensional representations of a design or concept before building a larger version.
 - ◇ **Environmental Scientists** develop solutions to environmental problems. This might include improving recycling, providing clean water, and air pollution control.
 - ◇ **Robotics Technicians** build, maintain, and program robots to perform tasks.

Ask students: How could these careers have helped with the box design? What types of roles would each one likely have had in the challenge? How could these careers solve some of the questions about the *NASA Concept Images*?

- 4 Display the careers students brainstormed at the start of the lesson. Ask students to revisit this list and make changes, based on what they have learned.

Evaluate (5 minutes)

Invite students to summarize what they have learned by completing the following statements:

- ◇ Manufacturing impacts my daily life because...
- ◇ One career in manufacturing is...This is an important job because...
- ◇ One career I learned about that matches my interests is...

Elaborate (20 minutes)

Ask students to take on the role of a hiring team. Explain to students they have been asked to hire a team to design a box that can travel from Earth to a space station. They should use what they have learned about different careers in manufacturing to design their team. Students should pick at least four careers and explain why they would want those professionals to be part of their team.

NASA Concept Images Student Activity Sheet



Photo: NASA



Photo: NASA Ames Research Center

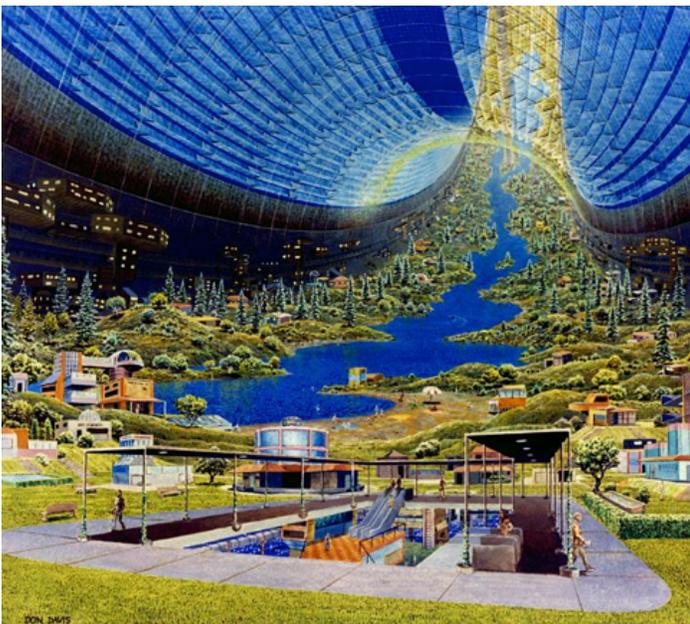


Photo: NASA Ames Research Center



Photo: NASA Ames Research Center



Future of Manufacturing Student Activity Sheet

Brainstorm different questions you have about the images.

People/Careers

What types of jobs do you think people in the images have?

What are questions you have about the people in the images?

Places

What types of places do you see in the images?

What are questions you have about the places in the images?

Things

What types of things do you see in the images?

What are questions you have about the things in the images?

Other

What other questions do you have about what you see in the images?



What Do You Like To Do? Student Activity Sheet

Review the four statements below, and rank them from 1-4, with 1 matching the profile that sounds the most like you and 4 matching the profile that sounds the least like you.

<i>Statements</i>	<i>Ratings</i>
I like to figure things out and work out problems.	
I like to create things and use my imagination.	
I like to take on challenges and be a leader.	
I like to be organized and follow the rules.	



Career Descriptions

Student Activity Sheet

<i>Description</i>	<i>Matching Career</i>	<i>Role in Challenge</i>
I like to figure things out and work out problems.	You might be interested in being an Engineer. They design, develop, build, and test products.	Design and support building the box.
I like to create things and use my imagination.	You might be interested in being a Welder. They use different tools to create products out of iron.	Build the box based on instructions from engineer.
I like to take on challenges and be a leader.	You might be interested in being a Supervisor. They provide leadership and directions to make a product.	Keep everyone working and support when needed.
I like to be organized and follow the rules.	You might be interested in being a Quality Control Technician. They test out products to make sure they do what they are supposed to.	Test out the final box.



Engineering Challenge

Student Activity Sheet

Have you ever left something outside when it rained? Water can ruin something that should stay dry! Water can ruin things that are shipped, too. Even if the box is wet on the outside, the inside should be dry.

Teams of people in modern manufacturing jobs work together to solve many different types of problems. One of their problems may be to design a box that keeps what is inside dry.

Your team's challenge is to create a box that will protect a tea bag inside from getting wet. You have been assigned a job to help your team complete this challenge. You can only use the following materials to make your box:

- ◇ Popsicle sticks
- ◇ String
- ◇ Drinking straws
- ◇ Masking tape

The box will be put in a tub of water. If the tea bag is able to color the water, you will need to try again. Good luck!

Draw your design ideas in the box below:



Roles and Responsibilities Student Activity Sheet

Which careers do you think match with each role?

- ◇ An engineer will design, develop, build, and test products.
- ◇ A welder will use different tools to create products out of iron.
- ◇ A supervisor provides leadership and directions to make a product.
- ◇ A quality control technician will test out products to make sure they do what they are supposed to.

<i>Roles</i>	<i>Person(s) Responsible</i>
Organize materials	
Sketch out ideas	
Build the box	
Keep time	
Place the tea bag into the box and seal the box	
Test out the design by putting the finished product in the tub of water	



Teacher Notes

<i>Roles</i>	<i>Person(s) Responsible</i>
Organize materials	Supervisor
Sketch out ideas	Engineer
Build the box	Engineer and Welder
Keep time	Supervisor
Place the tea bag into the box and seal the box	Engineer and Welder
Test out the design by putting the finished product in the tub of water	Quality Control Technician