

What's Your Influence?

GRADES
6-8

Duration

3-4 sessions (45 minutes each)

Lesson Summary

In this lesson, students will support or refute a claim about the relationship between manufacturing and society. They will be required to use evidence, case studies, career scenarios, anecdotal stories, and other sources as part of their argument.

Essential Questions

- ◇ How do skill sets in science, engineering, and technology influence careers in advanced manufacturing?
- ◇ How has manufacturing influenced our world?
- ◇ What are the current advanced manufacturing career opportunities and trends most impactful to society?

Learning Objectives

Students will:

- ◇ Support a claim using evidence and data.
- ◇ Investigate several resources and scenarios to examine the impact of high-tech solutions, requirements, and the qualified workforce essential for advanced manufacturing.
- ◇ Identify the types of careers and skillsets involved in advanced manufacturing.
- ◇ Review data and highlight opportunity trends of advanced manufacturing careers.

Next Generation Science Standards

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

Standards for Technological Literacy

Standard 5: Students will develop and understanding of the effects of technology on the environment.

Standard 6: Students will develop an understanding of the role of society in the development and use of technology.



Background for the Teacher

Advanced manufacturing is the use of technology to improve products and processes. 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.

At one time, “manufacturing” was associated with dark factories crammed with people assembling products. However, modern 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. Humans are working with a variety of technologies to solve wants and needs of our society. From improved communication systems to exciting advancements in transportation, people’s needs and wants can drive manufacturing products and careers. Technologies can also influence how society depends on manufacturing. For example, computers were originally developed for manufacturers and businesses to make tasks easier and faster for humans. Computers were later adopted by the general public for different applications.

This lesson will 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. They will be invited to investigate different complex texts to examine how society and manufacturing can both influence innovations.

Featured careers in this lesson include:

- ◇ Supervisor
- ◇ Quality Control Technician
- ◇ Design Engineer
- ◇ Model Maker
- ◇ Environmental Engineer
- ◇ Assembler

Materials

- ◇ Pieces of various building materials (brick, cement, limestone, marble, granite, gravel, sea shells)
- ◇ Lemon juice
- ◇ Vinegar
- ◇ Magnifying lens
- ◇ Dropper

Student Activity Sheets:

- ◇ Images of Advanced Manufacturing
- ◇ Manufacturing Claims and Evidence Graphic Organizer
- ◇ Can You See Yourself in Advanced Manufacturing?
- ◇ Selecting Building Materials
- ◇ Can You See yourself in Advanced Manufacturing? Expand your Search!
- ◇ Was your design successful? How do you know?

Engage & Explore (20 minutes each)

Engage

- 1 Write the word “manufacturing” on the board. Challenge students to brainstorm everything they know about manufacturing. Ask them to capture each idea on a separate sticky note.
- 2 Create a continuum in the classroom by hanging a sign on one end that says, “very sure” and a sign on the other end that says “unsure.” Ask students to post their sticky notes on the continuum according to how sure they are about their ideas about advanced manufacturing.
- 3 Provide a simple definition of manufacturing: “Manufacturing means to make or produce something.” Display the Images of Advanced Manufacturing. Ask students to rearrange their sticky notes if any of their ideas have changed or they have new ideas after looking at the images.
- 4 Ask students to brainstorm everything they know about career roles and job titles in the field of manufacturing. What types of jobs help to make things we use every day? Ask students to capture their ideas on a different color sticky note or in a different color marker. They can then place those ideas on the same continuum.
- 5 Explain that humans have been manufacturing things for centuries, from simple tools to complex robots. We know that manufacturing means to make or produce something from earlier in the activity. Many highly skilled jobs work together to make things we use every day. Manufacturers design and develop processes to convert raw materials into physical goods. Students will re-visit their brainstorming at the end of the lesson.

Explore

- 1 Read aloud the following statements and ask students to stand if they think the statement could be supported with evidence:
 - ◇ “The moon is made of rock.”
 - ◇ “There is life on other planets.”
 - ◇ “Rap is the best kind of music.”
 - ◇ “Swimming is a dangerous sport.”
 - ◇ “There are approximately 5,000 species of mammals on Earth.”
 - ◇ “Turtles are the easiest type of pet to have.”
 - ◇ “Gum kills 99% of germs!”

Invite students that stand to share out the evidence they might use to support each statement.

Clarify with students that all of these sentences are referred to as claims. A claim is a statement that shows understanding of a topic. Claims can be true or false. We can prove that a claim is true by using evidence to support it. Invite students to brainstorm what types of evidence could be used to support claims.

- 2 Post the following four claims about advanced manufacturing on the board. Ask students to evaluate each one and decide which they are most interested in exploring.
 - ◇ Society influences manufacturing.
 - ◇ Manufacturing influences society.
 - ◇ Manufacturing requires high-tech solutions and a highly skilled and qualified workforce.
 - ◇ Manufacturing careers are influenced by changes in society and technology.

DAYS
2-3

Explain (90 minutes)

- 1 Challenge students to select one of the claims about manufacturing. Explain that their assignment is to support or refute their claim using evidence from four different sources. Sources could include readings, tables and graphs, videos, investigations, interviews, or images They will use this information to develop an explanation that supports or refutes the claim they selected. Students will use Manufacturing Claims and Evidence Graphic Organizer to capture their evidence.

Readings

Students will obtain information about the claim they selected by reading at least one of the following resources:

- ◇ <https://www.whitehouse.gov/the-press-office/2016/04/01/fact-sheet-obama-administration-announces-new-revolutionary-fibers-and>
- ◇ http://www.digitalhistory.uh.edu/disp_textbook.cfm?smtID=2&psid=3396
- ◇ <https://www3.epa.gov/climatechange/science/overview.html>
- ◇ <http://www.bls.gov/careeroutlook/2016/interview/woodworker.htm>

Invite students to capture their evidence using the *Manufacturing Claims and Evidence Graphic Organizer*.

Videos

Students will obtain information about the claim they selected by viewing at least one of the following resources:

- ◇ <http://energy.gov/articles/how-3d-printers-work>
- ◇ https://www.nsf.gov/news/special_reports/science_nation/augmentedreality.jsp
- ◇ [http://www.manufactureyourfuture.com/school \(robotics and biomechanical engineer\)](http://www.manufactureyourfuture.com/school (robotics and biomechanical engineer))

Invite students to capture their evidence using the *Manufacturing Claims and Evidence Graphic Organizer*.

Tables and Graphs

Students will review data and highlight opportunity trends of advanced manufacturing career by obtaining information about the claim they selected from at least one of the following resources:

- ◇ <http://www.bls.gov/spotlight/2012/fashion/>
- ◇ <https://www.dol.gov/dol/aboutdol/history/herman/reports/futurework/report/chapter4/main.htm>
- ◇ <http://esa.doc.gov/economic-briefings/recent-trends-manufacturing>
- ◇ <http://www.bls.gov/careeroutlook/2014/article/manufacturing.htm>

Invite students to capture their evidence using the *Manufacturing Claims and Evidence Graphic Organizer*.

DAYS
2-3

Explain (90 minutes)

- 2 Give students ample time to select their sources and capture their evidence in the graphic organizer. Explain that they will be adding to and then evaluating all evidence later in the lesson.

Investigation

Direct students to read and annotate the article: <https://www.epa.gov/acidrain/effects-acid-rain>

Invite students to brainstorm a list of individuals who have an interest, impact, or responsibility in some aspect on the issue of acid rain. Encourage students to consider specific careers and jobs.

Explain to students that they will work in teams on a short challenge advanced manufacturers could face when considering materials for a new structure. If an area experiences high rates of acid rainfall, this could influence the materials used for the structure. Students will role play an advanced manufacturing job as they work through the challenge.

Distribute the activity sheet, *Can You See Yourself in Advanced Manufacturing?* Ask students to review and rank the statements from 1-6, based on how closely each statement represent them. The statement that sounds most like them would be ranked "6." This will help assign them a role in the challenge.

Teacher note: Organize students into groups based on their top-ranked statement using the list below. For example, if a student's top personality type is a realist, they should be given the role of an environmental engineer. If possible, each group should have at least one member that represents each personality type. Students can double up on roles if smaller group sizes are preferred. Although there are several other careers that would match their personality type as well as other personality types being a fit for careers, this allow students to explore one career option with an authentic application.

Careers included in investigation:

- ◇ #1 Realist: Environmental Engineer
- ◇ #2 Investigative: Materials Analyst
- ◇ #3 Artistic: Design Engineer
- ◇ #4 Social: Quality Control
- ◇ #5 Enterprising: Supervisor
- ◇ #6 Conventional: Assembler

Distribute the Selecting Building Materials student activity sheet to each group, and display the materials. Ask students to use an annotated reading strategy to break down the investigation:

Annotated Reading Strategy

- ◇ Underline what you are going to do.
- ◇ Highlight how you are going to do it.
- ◇ Circle vocabulary you do not understand.
- ◇ Write any questions you have.

DAYS
2-3

Explain (90 minutes)

Invite student volunteers to share out what their investigation is asking them to do. Use this time to ensure that all students understand the investigation. Explain that students will be using their role cards to divide up the responsibilities, but first they need to learn more about their assigned career.

Distribute the Roles and Responsibilities table. Provide students time to review the career they were assigned using the Bureau of Labor Statistics' Occupational Outlook Handbook at <http://www.bls.gov/ooh/>. There is a tab in the Handbook titled "What they do" that students can select once their career is located. Students can capture their information using the Roles and Responsibilities handout.

Guide students to share their career descriptions with their groups. Ask students to work together to complete the Roles and Responsibilities table based on their career.

Provide 30 minutes for students to complete their investigation. Students should use the Roles and Responsibilities handout and Selecting Building Materials to complete the investigation and summary questions.

Invite students to share out responses to the summary questions.

Invite students to capture their evidence using the Manufacturing Claims and Evidence Graphic Organizer.

3 **Evaluate**

Guide students to evaluate all of the evidence they have collected throughout the lesson and determine if it supports or refutes the claim they selected to investigate. Students should construct their explanation using evidence from all four sources; lab investigation, tables and graphs, videos, and reading in their answer. Teachers may wish to have students share information that they have collected for their evidence before having students individually write a paragraph justifying their answer.

Invite students who supported or refuted the first claim to present their evidence. Challenge other students to evaluate which body of evidence most strongly supported or refuted the claim. Continue with the second, third and fourth claims.

Finally, challenge students to write a 4-5 sentence blog post that explains how advanced manufacturing shapes our world and identify at least three types of careers and skillsets involved in advanced manufacturing.

4 **Elaborate**

Invite students to explore other careers that matched their personality types using *Can you see yourself in Advanced Manufacturing? Expand your Search!*

Images of Advanced Manufacturing

Student Activity Sheet



<https://en.wikipedia.org/wiki/Manufacturing>



Manufacturing Claims & Evidence

Graphic Organizer

Directions: Complete the table below with evidence from multiple sources. Use this evidence to refute or justify your claim.

Claim:			
Evidence from readings	Evidence from videos	Evidence from investigation	Evidence from graphs and tables
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	3.
Refute or justify the claim. Make sure to link your explanation with evidence and ideas.			



Can you see yourself in Advanced Manufacturing?

John Holland's Strong Interest Survey is a tool that can help you find a career that matches your interests.

Review the six personality types below, and rank them from 1-6, with "6" matching the profile that sounds the most like you and "1" matching the profile that sounds the least like you.

Personality Type	Rating
Realistic: You prefer concrete tasks and enjoy working alone or with other realistic people. You might be interested in mechanical creativity and physical dexterity and enjoy working with machines, tools, and being outdoors.	
Investigative: You are investigative and like to use your abstract or analytical skills to figure things out. You are a "thinker" who strives to complete tasks and often prefers to do so independently. You might be interested in doing lab work, analyzing data, researching and investigation and would enjoy working with science, ideas, theories, and data.	
Artistic: You like to create things. You are imaginative and usually extroverted. You might be interested in writing and creating art and would be interested in self-expression through your work.	
Social: You are a social person that prefers interacting with people. You tend to be concerned with social problems and want to help others. You might be interested in teaching, explaining, and helping and would enjoy working as a team.	
Enterprising: You lean toward leadership roles. You are willing to take on challenges and are extroverted. You may be aggressive as well. You might be interested in selling and managing and would enjoy working in business and leadership.	
Conventional: You are someone who prefers structured tasks and tending to details. You are often conservative. You might be interested in setting up procedures, organizing, using computers, and keeping records and would enjoy working with information and finances.	

Sources:

O*Net. My Next Move. Created for the US Department of Labor, Employment and Training Administration.

Zunker, Vernon G. and Norris, Debra S. Using Assessment Results for Career Development. Pacific Grove, CA: Brooks/Cole Publishing Company. 1997.



Can you see yourself in Advanced Manufacturing?

Expand your search!

Personality Type	Rating	Advanced Manufacturing Careers
Realistic: You prefer concrete tasks and enjoy working alone or with other realistic people. You might be interested in mechanical creativity and physical dexterity and enjoy working with machines, tools, and being outdoors.		chemical engineers, electrical engineers, industrial engineers, computer engineers, mechanical engineers, environmental engineers , aerospace engineers, and mechanics
Investigative: You are investigative and like to use your abstract or analytical skills to figure things out. You are a “thinker” who strives to complete tasks and often prefers to do so independently. You might be interested in doing lab work, analyzing data, researching and investigation and would enjoy working with science, ideas, theories, and data.		materials analyst , robot technician, assembler, plant accountant, electrician, chemical engineers, and design engineers
Artistic: You like to create things. You are imaginative and usually extroverted. You might be interested in writing and creating art and would be interested in self-expression through your work.		materials analyst, design engineers , welder, and machinists
Social: You are a social person that prefers interacting with people. You tend to be concerned with social problems and want to help others. You might be interested in teaching, explaining, and helping and would enjoy working as a team.		plant human resources manager, test engineer, sales support, and quality control
Enterprising: You lean toward leadership roles. You are willing to take on challenges and are extroverted. You may be aggressive as well. You might be interested in selling and managing and would enjoy working in business and leadership.		chief manufacturing executive, chief quality control executive, facilities manager, manufacturing manager, supervisory , and plant operator
Conventional: You are someone who prefers structured tasks and tending to details. You are often conservative. You might be interested in setting up procedures, organizing, using computers, and keeping records and would enjoy working with information and finances.		assembler , shift supervisor, accounting, and manufacturing manager

Sources:

O*Net. My Next Move. Created for the US Department of Labor, Employment and Training Administration.

Zunker, Vernon G. and Norris, Debra S. Using Assessment Results for Career Development. Pacific Grove, CA: Brooks/Cole Publishing Company. 1997.



Selecting Building Materials

Background

Brick and mortar, cement, limestone, marble and granite are examples of materials used in buildings and structures. Rocks that contain the mineral calcite (calcium carbonate) bubble and give off carbon dioxide gas when reacting with a weak acid and dissolving the calcite. Materials that do not contain calcite will not react with the weak acid.

Advanced manufacturers are looking for ways to create rail ties with a new substance. They have traditionally been made of wood. An alternative material could prove to be much more durable.

In this challenge, you team will test various building materials to determine what types of materials are best for construction in areas with high rates of acid rain.

Materials

- ◇ Pieces of various building materials (brick, cement, limestone, marble, granite, gravel, sea shells)
- ◇ Lemon juice
- ◇ Vinegar
- ◇ Magnifying lens
- ◇ Dropper

Procedure

1. Measure the pH of the two acids.
2. Select a building material.
3. Drop a few drops of lemon juice on it.
4. Record observations as positive (“+” reacts or “-“ doesn’t react).
5. Drop a few drops of vinegar on another spot of the same building material.
6. Record observations.
7. Repeat the procedures with each sample of material.

Results

pH of lemon juice: _____ pH of vinegar: _____



Selecting Building Materials

<i>Material Tested</i>	<i>Reaction to Lemon Juice</i>	<i>Reaction to Vinegar</i>	<i>Rating</i> <i>(1 would not work for this project-5 would work well for this project)</i>

Follow-Up Questions

1. Which materials reacted to the acid test?
2. Why would a builder choose a material that reacts with acid at all?
3. Would it be a good idea to minimize the amount of the component that reacts with acid when making the concrete or mortar mix?
4. How did working together help you complete the investigation?
5. How did your career match with things you enjoy doing?
6. Were there other careers you would have been interested in that other group members had?
7. How did having unique roles and responsibilities help you complete the investigation?