Careers in Advanced Manufacturing and Engineering Curriculum

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Curriculum Structure

The *Careers in Advanced Manufacturing and Engineering Curriculum* is composed of the following lessons. Approximate lesson times are included.

Lesson	Title	Approximate Time
One	Introduction to Advanced Manufacturing and Engineering	60-75 minutes
Two	Engineering in Advanced Manufacturing	65-85 minutes
Three	Technicians in Advanced Manufacturing	55-75 minutes
Four	Industry 4.0 and Advanced Manufacturing	70-85 minutes
	Total	**4-6 hours**

Lesson Structure

Each lesson begins with a Lesson Overview, Lesson Objectives, and a Lesson at a Glance table, which lists the lesson activities, materials required, suggested preparation steps, and approximate class time.

Lesson Sections

The actual lesson follows the overview, which will contain some of the sections described below.

FOCUS
Every lesson begins with a FOCUS activity intended to capture participants' attention. This may be in the form of a small or large class discussion, game, review of previous lesson information, or demonstration. During this activity, participants are introduced to the topic of the lesson.

LEARN
The LEARN activity in each lesson varies in its presentation mode. It may be a slide presentation, group activity, or demonstration.

REVIEW
The majority of lessons end with a REVIEW activity intended to briefly review the lesson's key messages or main points.

Lesson One – Introduction to Advanced Manufacturing and Engineering

Lesson Overview

In this lesson, participants will be introduced to the world of manufacturing, what processes and technologies are used, and how manufacturing has changed over time.

Lesson Objectives

After completing this lesson, participants will be able to:

- Identify processes and technologies used in manufacturing
- Understand the changes that have occurred in manufacturing over time

Lesson at a Glance

Activity	Materials	Preparation	Approximate Class Time
FOCUS	• None	1. Prepare to share video.	15-20 minutes
LEARN	• Library and internet resources • *Key Technologies and Processes* worksheet	1. Print/photocopy the *Key Technologies and Processes* worksheet (one per participant)	15-20 minutes
REVIEW	• None	1. Prepare to share videos.	15-20 minutes

Lesson One – Introduction to Advanced Manufacturing and Engineering

FOCUS: Introduction to Manufacturing Processes

15-20 minutes

Purpose:
Participants will develop an introductory understanding of what manufacturing is and what it involves.

Materials:

- None

Facilitation Steps:

1. Begin by posing the following question to the class: What do you think modern manufacturing looks like?

2. List student answers on the board.
3. Watch the "How Crayons Are Made" video and have students create a production outline while watching.
    a. How Crayons are Made
    b. A production outline can be imagined as a flow chart, starting with the beginning of the manufacturing process (input of ingredients) and showing how each step plays a role in making the product

4. Bring the class together to create a class version of the crayon's production outline.

5. Reflecting on the class's process, discuss how many machines and people were involved in making a single crayon.

Lesson One – Introduction to Advanced Manufacturing and Engineering

LEARN: Key Technologies and Processes

15-20 minutes

Purpose:
Build students' understanding of key technology and manufacturing processes.

Materials:

- Library and internet resources
- *Key Technologies and Processes* worksheet

Facilitation Steps:

1. Working in pairs, have students use their research skills to complete the *Key Technologies and Processes* worksheet.

Name: _____ Date: _____

Key Technologies and Processes Worksheet

Complete the table below using your research skills.

Concept	Definition	Example:
Automation		
Additive Manufacturing		
Subtractive Manufacturing		
CAD (Computer-Aided Design)		
CAM (Computer-Aided Manufacturing)		
PLC		
IoT		

Lesson One – Introduction to Advanced Manufacturing and Engineering

REVIEW: Traditional Versus Advanced Manufacturing

15-20 minutes

Purpose:

Develop an understanding of how manufacturing processes have changed over time.

Materials:

- None

Facilitation Steps:

1. Have students create a T-chart with "Traditional Manufacturing" on one side and "Advanced Manufacturing" on the other.
2. Watch these videos:
    a. Socks in 1950: Hometown - Wolsey (1950-1959)
    b. Advanced Manufacturing - Assembly | Careers In Demand | KET - YouTube
3. As they watch, have students make observations about the similarities and differences between what the two videos show about manufacturing.
4. As a class, discuss what students observed.

Lesson Two – Engineering in Advanced Manufacturing

Lesson Overview

In this lesson, participants will explore what engineering is, what types of engineers are involved in advanced manufacturing, and investigate what the daily life of an engineer can look like.

Lesson Objectives

After completing this lesson, participants will be able to:

- Identify common types of engineers involved in advanced manufacturing
- Understand what an engineer's job duties and tasks may include

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• None	1. Prepare for a class discussion.	5-10 minutes
LEARN	• *Engineers in Advanced Manufacturing* worksheet	1. Print the *Engineers in Advanced Manufacturing* worksheet (one per participant).	25 minutes
REVIEW	• *A Day in the Life: Engineer* worksheet	Print the *A Day in the Life: Engineer* worksheet (one per participant).	10-15 minutes

Lesson Two – Engineering in Advanced Manufacturing

FOCUS: What Is Engineering?

5-10 minutes

Purpose:
Participants gain an overview of what engineering is and how it connects to advanced manufacturing.

Materials:

- None

Facilitation Steps:

1. Facilitate a discussion with the class using this prompt, which may be presented or written in the front of the classroom: What does it mean to be an engineer or to engineer something?
2. Collect student responses, encouraging them to think beyond the obvious. Draw on personal experiences and connections to contribute to the discussion.

Lesson Two – Engineering in Advanced Manufacturing

LEARN: Types of Engineers Connected to Advanced Manufacturing

25 minutes

Purpose:
Build awareness of the different types of engineers that are involved in the advanced manufacturing world.

Materials:

- *Engineers in Advanced Manufacturing* worksheet

Facilitation Steps:

1. Provide students with a copy of the *Engineers in Advanced Manufacturing* worksheet.
2. Have students use their research skills to complete the worksheet.

Name: _____ Date: _____

Engineers in Advanced Manufacturing

A. In general, what does it mean to "engineer"? Where did you find this answer?

B. Use your research skills and the U.S. Bureau of Labor Statistics' "Occupational Outlook Handbook" to research these types of engineers.

Type of Engineer	What Do They Do?	Type of Education Needed	Job Outlook
Mechanical Engineer			
Manufacturing Engineer			
Industrial Engineer			
Electrical Engineer			
Mechatronics Engineer			
Materials Engineer			

Lesson Two – Engineering in Advanced Manufacturing

REVIEW: A Day In The Life of an Engineer

10- 15 minutes

Purpose:
Participants will seek out a real-world view of what it means to be an engineer.

Materials:

- *Day in the Life: Engineer* worksheet

Facilitation Steps:

1. Using the *Engineers in Advanced Manufacturing* worksheet from the last section, have students choose the type of engineer that seems most interesting or relevant to them.
2. Have students search for an online video using the prompt "Day in the life _____ engineer", filling the blank with their selected engineer type. Students should choose a video that meets these requirements:
    a. Minimum of 4 minutes long
    b. From a reliable source
    c. Uses a live, human narrator, not a computerized text narrator
3. As students watch their selected video, have them record their observations and thoughts on the *Day in the Life: Engineer* worksheet.

Name: _____ Date: _____

A Day in the Life: Engineer

1. What type of engineer did you choose to focus on?

2. What is the source of the video? Who produced it? Why do you believe this is a reliable, trustworthy source of information?

3. What are 5 interesting observations about this type of engineer that you made while watching the video?

    1)

    2)

    3)

    4)

    5)

4. What is one observation you made that excites you about this career opportunity?

5. What is one observation you made that does not excite you about this career opportunity?

Lesson Three – Technicians in Advanced Manufacturing

Lesson Overview

In this lesson, participants will explore what a technician is, what types of technicians are involved in advanced manufacturing, and investigate what the daily life of a technician can look like.

Lesson Objectives

After completing this lesson, participants will be able to:

- Identify common types of technicians involved in advanced manufacturing
- Understand what a technician's job duties and tasks may include

Lesson at a Glance

Activity	Materials	Preparation	Approximate Class Time
FOCUS	• None	1. Prepare for a class discussion.	5-10 minutes
LEARN	• *Technicians in Advanced Manufacturing* worksheet	1. Print the *Technicians in Advanced Manufacturing* worksheet (one per participant).	30-45 minutes
REVIEW	• *A Day in the Life: Advanced Manufacturing* worksheet	1. Print the *A Day in the Life: Advanced Manufacturing* worksheet (one per participant).	10-20 minutes

Lesson Three – Technicians in Advanced Manufacturing

FOCUS: What is a Technician?

5 - 10 minutes

Purpose:

Participants gain an overview of what a technician is and how it connects to advanced manufacturing.

Materials:

- None

Facilitation Steps:

1. Facilitate a discussion with the class using this prompt, which may be presented or written in the front of the classroom:
    a. "What does it mean to be a technician or mechanic?"
    b. Collect student responses, encouraging students to think beyond the obvious, drawing on personal experiences and connections to contribute to the discussion.
2. Videos to stimulate discussion:
    a. On Youtube at the CareerOneStop Channel; search for "technicians" or click this link here: CareerOneStop - YouTube

Lesson Three – Technicians in Advanced Manufacturing

LEARN: Types of Technicians in Advanced Manufacturing

30-45 minutes

Purpose:
Build awareness of the different types of technicians that are involved in the advanced manufacturing world.

Materials:

- *Technicians in Advanced Manufacturing* worksheet

Facilitation Steps:

1. Distribute the *Technicians in Advanced Manufacturing* worksheet.
2. Have students use their research skills to complete the worksheet.

Name: _____ Date: _____

Technicians in Advanced Manufacturing

Use your researching skills and the U.S. Bureau of Labor Statistics' "Occupational Outlook Handbook" to research these types of technicians.

Type of Technician	What Do They Do?	Type of Education Needed	Job Outlook
Aviation/Aerospace Technician			
Mechanical Engineering Technician			
Mechatronics Technician			
Semiconductor Technician			
Maintentance Technician			
Machine Operator/CNC Machinist			
Robotics Technician			

Lesson Three – Technicians in Advanced Manufacturing

REVIEW: A Day in the Life of an Advanced Manufacturing Technician

10-20 minutes

Purpose:
Participants will seek out a real-world view of what it means to be an advanced manufacturing technician.

Materials:

- *Day in the Life: Advanced Manufacturing Technician* worksheet.

Facilitation Steps:

1. Using the *Technicians in Advanced Manufacturing* worksheet from the previous section, have students choose the type of technician that seems most interesting or relevant to their possible future.
2. Have students search for an online video using the prompt "Day in the life _____ technician", filling the blank with their selected technician type.

   Students should choose a video that meets these requirements:
   a. Minimum of 4 minutes long
   b. From a reliable source
   c. Uses a live, human narrator, not a computerized text narrator
3. As students watch their selected video, have them record their observations and thoughts on the *Day in the Life: Advanced Manufacturing Technician* worksheet.

Name: _____ Date: _____

A Day in the Life:
Advanced Manufacturing Technician

1. What type of advanced manufacturing technician did you choose to focus on?

2. What is the source of the video? Who produced it? Why do you believe this is a reliable, trustworthy source of information?

3. What are 5 interesting observations about this type of technician that you made while watching the video?

    1)

    2)

    3)

    4)

    5)

4. What is one observation you made that excites you about this career opportunity?

5. What is one observation you made that does not excite you about this career opportunity?

Lesson Four – Industry 4.0 and Advanced Manufacturing

Lesson Overview

Participants will identify the four industrial revolutions, careers that will be common in industry 4.0 fields, and reflect on careers that might be a good fit for them.

Lesson Objectives

After completing this lesson, participants will be able to:

- Understand the four industrial revolutions
- Identify career opportunities that exist in the industry 4.0 world

Lesson at a Glance

Activity	Materials	Preparation	Approximate Class Time
FOCUS	• *Evolution of Industry* worksheet	1. Print the *Evolution of Industry* worksheet (one per participant).	5-10 minutes
LEARN	• *Industry 4.0 Careers* worksheet	1. Print the *Industry 4.0 Careers* worksheet (one per participant).	20-30 minutes
REVIEW	• All the career exploration worksheets from this curriculum	N/A	20 minutes

Lesson Four – Industry 4.0 and Advanced Manufacturing

FOCUS: What Is Industry 4.0?

5-10 minutes

Purpose:
Define industry 4.0.

Materials:

- *Evolution of Industry* worksheet

Facilitation Steps:

1. Distribute the *Evolution of Industry* worksheet.
2. Divide the class into four groups and assign each group an industrial revolution.
3. Provide students with 10 to 15 minutes to research their assigned revolution, recording their findings on the worksheet.
4. Have students get into groups of four, each containing a student who researched a different revolution. Students should share their research, filling in the rest of the worksheet's table.
5. Discuss, as a class, the answer to question two: What is the biggest difference in the occupations that existed pre-industry 2.0 compared to now, in industry 4.0?

Name: _____ Date: _____

Evolution of Industry

Use your research skills to gather information about your assigned stage of industrial revolution.

Revolution	When?	Defining Characteristics/Driving Technology	Change It Produced
Industry 1.0			
Industry 2.0			
Industry 3.0			
Industry 4.0			

What is the biggest difference in the occupations that existed pre-industry 2.0 compared to now, in industry 4.0?

Lesson Four – Industry 4.0 and Advanced Manufacturing

LEARN: Careers in Industry 4.0

20-30 minutes

Purpose:
Students will choose four industry 4.0 careers and research their roles, salaries, and employment outlook.

Materials:

- *Industry 4.0 Careers* worksheet

Facilitation Steps:

1. Distribute the *Industry 4.0 Careers* worksheet.
2. Provide students with 15 minutes to research careers that will be common in industry 4.0 fields.
3. Students should document their research on the worksheet.

Name: _____ Date: _____

Industry 4.0 Careers

A. Use the resources you have been provided with to identify careers that are common in modern advanced automation and represent industry 4.0 trends.
    a. Indeed's article (https://www.indeed.com/career-advice/finding-a-job/industry-4-jobs) is a trustworthy source, as is Interview Prep's article (https://interviewprep.org/9-leading-industry-4-0-jobs-for-the-future/
B. For each career path, use the U.S. Bureau of Labor Statistic's Occupational Outlook Handbook to research answers for each of the posted questions.

Industry 4.0 Career	Job Duties	Average Salary	Job Outlook

Lesson Four – Industry 4.0 and Advanced Manufacturing

REVIEW: Reflection

20 minutes

Purpose:
Participants will share and reflect on the different careers opportunities and identify employment trends that can inform future career decision-making.

Materials:

- Career explorations worksheets completed in this curriculum

Facilitation Steps:

1. Have participants access all the career exploration worksheets they have completed in this curriculum.
2. Instruct participants to complete a short, reflective essay that summarizes which career choice might be the best fit for them and why.
3. Allow participants to share their thoughts about a career in advanced manufacturing before wrapping up this lesson. Specific questions can be: What would you find most interesting? What would be most challenging for you?