

**SOLUTION SEEKER ACTIVITY**

Quality Control

OBJECTIVES

During this lesson, students will:

- **Explore** concepts related to manufacturing and quality control testing.
- **Investigate** and analyze the results of various forms of quality control testing.
- **Consider** the implications and importance of quality control testing across different industries.

OVERARCHING QUESTION

What role does quality control play in manufacturing?

STANDARDS

ITEEA Standards for Technological Literacy

- **Standard 9: Engineering Design.**

In order to understand engineering design, student should learn that:

- **F.** Design involves a set of steps, which can be performed in different sequences and repeated as needed.
- **H.** Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.

- **Standard 11: Design Process.**

Students will develop abilities to apply the design process. As part of learning how to apply design processes, students should be able to:

- Specify criteria and constraints for the design.

Next Generation Science Standards

- **MS. Engineering Design:**

- **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Common Core English Language Arts

- **Writing:**
 - **W.6:** Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- **Speaking and Listening:**
 - **SL.1:** Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
 - **SL.2:** Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Instructional Note:

The following activity has been designed so you can tailor it to your current mode of instruction.

- The *Introduce*, *View & Reflect*, and *Conclude* sections can be presented virtually, by video, or through a shared document.
- The partner component may be removed from the *View & Reflect* section, if needed.
- The *Challenge* section is designed for students to complete at home using the accompanying *Challenge* handout. Students can either print and fill out the handout or answer the questions separately in a format that can be shared with you.
- The design and production line components included in the *Introduce* and *Challenge* sections may be completed using group breakout rooms and a collaborative document if your class is not meeting in person.

ACTIVITY OVERVIEW

Introduce

1. Divide students into teams of five and ask each group to come up with a team name.
2. Distribute a piece of blank paper and drawing materials to each group. Encourage each group to create a design that includes their team name and an accompanying logo.

Tip: If students are stuck, encourage them to think about sports team logos.

3. Ask students to pretend that they work for a manufacturing company and explain they will be responsible for producing these designs in mass quantity. Prepare students for the activity using the following steps:
 - Distribute several additional pieces of blank paper to each team.
 - Explain that teams will now work together to form a production line and develop as many designs as possible in five minutes.
 - Every design that they produce should look like the original and include the team name and logo.
 - Give groups several minutes to discuss their production line strategy?

4. Set a timer for five minutes and encourage teams to begin manufacturing their product. When five minutes have passed, instruct the production lines to stop.
5. Once each team has reviewed their completed designs, guide groups through discussing the following questions:
 - How many designs did you create?
 - Compare your original design with those that you just created.
 - How many of the new designs look exactly like the original?
 - How many resemble the original?
 - How many do not look like the original?
 - What could you do to make sure all of the products you produce are of the same quality?
6. Wrap up the discussion by explaining that students are about to watch a short video that highlights how one company, General Motors, ensures quality for a very important product.

View & Reflect

1. Before playing the video, explain to students that they will not be taking notes during the first viewing. Instead, they should listen for: How does General Motors ensure quality control and *why* is this quality control important?

Tip: It may be helpful to write these focus questions on the board.
2. Play the GM/ASME Solution Seeker video once and instruct students to watch and listen carefully.
3. Play the video a second time and encourage students to take notes on a piece of scrap paper. This time, they should jot down at least five ideas that are important in answering the focus questions and summarizing the main idea of the video. Encourage them to write words and phrases and not full sentences.
4. When the video is complete, give students three minutes to turn to a partner and discuss their lists. For each item on their list, they should explain how it helps answer one of the focus questions.
5. Provide an additional minute for pairs to combine their ideas into one list of six or seven of their most important ideas.
6. Give pairs two minutes to write a one-sentence summary of these ideas.
7. Wrap up by asking the focus questions (How does General Motors ensure quality control? Why is this quality control important?) and encouraging pairs to share their one-sentence summaries with the class.

Challenge

1. Explain that students will now be challenged to consider how quality control, like that used by GM to create ventilators, could be applied to ensure quality on a range of manufactured products. They will begin by applying what they learned to the manufacturing of their own designs, and then they will consider where else these lessons can be applied.
2. Share the *Challenge* handout and review the instructions. Remind students that they will work on Parts 1 and 2 with their group members before they complete Part 3 independently.

Conclude

1. Once the *Challenge* activity is complete, invite students to share what they learned during the quality control testing. Which form of testing was most efficient and the most effective?
2. Wrap up with a full-class discussion around the importance of quality control across all manufacturing.
Ask:
 - Why is quality control testing necessary?
 - How may quality control testing differ depending on the product being produced?
 - Why may quality control testing be important in:
 - household product manufacturing (cleaning supplies, soaps, etc.)?
 - food manufacturing?
 - medical device manufacturing?
 - What role does quality control play in keeping the public safe?

Directions: Read the Background section below. Then complete Steps 1–3 as you consider the importance of quality control throughout the manufacturing process.

Quality Control Background

Thanks to quality control, manufacturers can ensure that the products they produce—and eventually share with the public—are of the quality they intend.

Quality control includes one or more testing check points during a product’s production. A quality control standard is established for each check point, and the product is carefully checked at this checkpoint to make sure it adequately meets the criteria.

What is checked at each checkpoint depends on the product being produced. Many products have guidelines and regulations that they have to uphold. For example, the U.S. Food and Drug Administration states that all food, drugs, and medical devices must adhere to the Current Good Manufacturing Practices (CGMPs). The CGMPs ensure safe and quality products by issuing mandatory guidelines for each of the 5Ps: people, premises, processes, products, and procedures (or paperwork). These guidelines ensure that the food or product is safe to consume and/or use.

Sometimes, the manufacturer decides to test 100% of the goods they produce. This is called a **detailed inspection**. If less than 100% of the goods are inspected, this is called a **sampling inspection**. No matter what, inspections help ensure that the highest possible quality product is produced.

Step 1—Evaluation Criteria

1. Work with your group to review the designs that you worked together to manufacture. How are your manufactured designs different from the original? Make a list below:

2. When performing quality control testing, the manufacturer decides how often the product should be checked throughout the manufacturing process. Two different inspection options are included below. Read each one and then work with your group to prepare criteria for each type of inspection.

- **Option 1: Final Inspection Only**—This consists of only one inspection, to be completed at the end of the manufacturing process.
- **Criteria:** What characteristics should the inspector look for during the final inspection of your team name and logo? (Note: If a design does *not* meet one or more of these criteria, it will be set aside.)

✓ _____	✓ _____	✓ _____
✓ _____	✓ _____	✓ _____
✓ _____	✓ _____	✓ _____

- **Option 2: Multiple Inspection Checkpoints**—This consists of several inspections, completed at specific points throughout the manufacturing process.
- **Criteria:** In the boxes below, draw or explain what the design should look like at three or four different points throughout the manufacturing process.

Check #1	Check #2	Check #3	Check #4

Step 2—Testing

Now it is time to put your two types of inspection to the test, so you can determine which type of quality control testing works best for your product.

Test 1: Final Inspection Only:

1. Work with your group to decide who will perform each task in the production line. No one will need to be in charge of inspecting because this will occur at the very end.

Remember: The production goal is to produce products as efficiently as possible while strictly adhering to quality.

2. Set a timer for five minutes and produce as many designs as possible in this time.
3. When the timer goes off, work together to review the completed designs using your Final Inspection Criteria from Step 1. Any designs that do not meet the criteria should be set aside. Then fill out:

 **Final Inspection Results:** _____ products were produced. _____ of these products passed quality control.

Test 2: Multiple Inspection Checkpoints:

1. Work with your group to decide:
 - Who will perform each task in the production process, including each of the inspection checkpoints? Each group member may be in charge of one part of the production line and one inspection checkpoint.
 - What should you do if your product does not meet the inspection criteria at one of the checkpoints? Should it be fixed or set aside? Agree on this as a group.

2. Then set a timer for five minutes. This time, your team will produce and inspect your products at the same time.
Remember: The production goal is to produce products as efficiently as possible while strictly adhering to quality.

3. When the timer goes off, review your completed designs. Then fill out:

 **Multiple Inspection Checkpoint Results:** _____ products were produced. _____ of these products passed quality control.

Step 3—Independent Reflection

1. Moving forward, would you recommend that quality control testing for your product be performed as a final inspection, multiple inspections, or a combination of the two? Why? Be sure to discuss the results of your testing.

2. Imagine your design was going to be printed on stickers or t-shirts. To be as efficient as possible, would you recommend that this quality control testing be performed as a sampling inspection or a detailed inspection? Why?
*Tip: The **Background** section covers the differences between these two types of inspections.*

3. Should quality control differ depending on what is being produced? Why or why not? Think about the range of goods that are manufactured, such as food, clothing, medical goods, household goods, toys, and more.