**Manufacturing: Maximizing Production, Minimizing Cycle Time**

**Lesson Overview**

In this lesson, students will work on an assembly line to create beaded bracelets. After the first test run, students will determine strategies to improve their group’s production process. Additional test runs will be completed to continue improving the process.

**Disciplinary Literacy Best Practices**

Think-Pair-Share

Partner Dialogue

Brainstorming

Quick Write

**Lesson Plan**

Time Required: One 90-minute Class Period

Disciplinary Vocabulary: manufacturing, assembly line, work station, cycle time, station cycle time, bottleneck, line balance

Materials Needed:

* Video: Manufacturing a Boeing 787
* Data recording sheets
* Materials for bracelets (beads, leather, instructions, stop watches)
* Video: Lucy in the Chocolate Factory (optional)
* Calculators

21st Century Skill Focus: Collaboration

Classroom Organization:

Student groups of 8 students, seated in 2 rows of 4 facing one another. Activity can be modified to groups of six if needed.

|  |  |  |  |
| --- | --- | --- | --- |
| Station 1 Timer | Station 2 Timer | Station 3 Timer | Station 4 Time |
| Station 1 Worker | Station 2 Worker | Station 3 Worker | Station 4 Worker |

**Engage (15 minutes)**

* Think-Pair-Share: “When you hear the word “manufacturing” what kinds of things pop in your head? If you were to have a job in manufacturing, what kinds of things might you do?” Individually, students think and record their own thoughts. After two-three minutes, students pair with a neighbor and share their thinking. After two-three minutes to pair, ask for volunteers to share with the whole class what they already know about manufacturing.
* “Today’s manufacturing often relies on the assembly line processes from the past, but engineers work to make the process as efficient as possible. Let’s view one of our SC manufacturing plants in action—Boeing in Charleston, SC—to see how they put together an airplane.” (Video: <http://youtu.be/2NLVSLi0VNg>)
* Neighbor Check-in: “How does the manufacturing in the video compare to what you thought before about manufacturing?” Allow two-three minutes dialogue, then ask for thoughts from the group about the Boeing video compared to their previous understanding of manufacturing as a work field.
* Presenter: briefly share connections to experiences in the manufacturing field, as applicable.

**Explore**

Test Run 1 (15 minutes)

* “Today we’re going to experience life in the manufacturing workforce by creating our own assembly line to manufacture beaded bracelets like this one. In an assembly line, parts are added in a specific order to create a final product. How long might it take to create a replica of this bracelet?”
* “We will have three assembly lines in the class and each line will have four stations. Each station will have two people—one person to do the task and one person to keep track of the time it took for the task each time. “
* Student groups of 8 will form assembly lines at four stations. Each station will have a defined task and materials, as well as a timekeeper with a stopwatch.
* Each assembly line crafts 5 bracelets, making note of the time required for each station and for the full cycle on the data recording sheet.

Test Run 2 (25 minutes)

* “You’ve just been in the role of assembly line worker…you had a specific task at a specific station to complete. Another role in the manufacturing world is that of the engineer that tries to find ways to make the process more efficient because the faster we can make bracelets, the more money we can make. Now, you will be an engineering team…what might YOUR team do to make your process more efficient?”
* Brainstorming: Teams discuss and modify their assembly lines to be more efficient.
* Now let’s test our modifications to see if it made our assembly lines more efficient. Build five more bracelets. Keep track of the time it takes to make them.

**Explain**Analysis (15 minutes)

* Compare the cycle times for your first run and second run using the percent change.

$$\% Change= \frac{[Original Value-New Value]}{Original Value}$$

* How did the improvements you made improve the cycle time? Why would a company want to improve the cycle time for stations on an assembly line? When might it not be beneficial to improve the cycle time for the company?
* Collaboration: How did working together make your work more efficient? Why might companies find the assembly line approach to manufacturing a beneficial strategy for production?

**Extend (15 minutes)**

**Option 1:**

* Watch the video of Lucy at the Chocolate Factory. What seems to be going wrong with this assembly line? What improvements might help Lucy better perform her job?
* Suppose you are an engineer hired to streamline this assembly line. Quick Write: Write recommendations for the company to make this station at the candy factory more efficient.

**Option 2:**

* Given the analysis of your cycle times and comparison of station cycle times, where might you further adjust your process to make it more efficient?
* Teams discuss and modify their assembly lines to be more efficient.
* Test Run 3: Build five more bracelets. Have the adjustments you made created a more efficient process? How do you know?

# Work Station Assignments: First Run

|  |
| --- |
| Station #1:Tie a knot in the cord approximately two inches from one end of the cord. String three white beads onto the long end of the cord.  |
| Station #2:String the following beads in the given order: 3 green beads, “B”, 1 green bead, “H”, 1 green bead, “S” |
| Station #3:String 3 green beads onto the bracelet. |
| Station #4:String 3 white beads onto the bracelet. Tie a knot into the cord after the last one.  |

**Data Collection Sheet**

**Station # \_\_\_\_\_\_\_\_ Data Collected by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**First Run Second Run**

**Station Cycle Times Station Cycle Times**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Keychain #1 | \_\_\_\_\_\_\_secs |  | Keychain #1 | \_\_\_\_\_\_\_secs |
| Keychain #2 | \_\_\_\_\_\_\_secs |  | Keychain #2 | \_\_\_\_\_\_\_secs |
| Keychain #3 | \_\_\_\_\_\_\_secs |  | Keychain #3 | \_\_\_\_\_\_\_secs |
| Keychain #4 | \_\_\_\_\_\_\_secs |  | Keychain #4 | \_\_\_\_\_\_\_secs |
| **Average Station Cycle Time** | **\_\_\_\_\_\_\_secs** |  | **Average Station Cycle Time** | **\_\_\_\_\_\_\_secs** |

**Average Cycle Time for the Entire Line:**

**First Run: \_\_\_\_\_\_\_\_\_\_\_secs Second Run: \_\_\_\_\_\_\_\_\_\_secs**