Activity: Efficiency is Key

Grades: 2-8 **Concepts:** Industrial Engineering, Assembly Line, Efficiency
Length: 45 minutes **Materials**: Items to build a model of the student's choosing, pencil, paper

Background Information:

What is an Assembly Line?
An assembly line is an arrangement of machines, tools, and operators in order to put together a product, or you may call it assembled. This is done by having each area perform a specific, in order operation on an incomplete unit as it passes by each station. Generally, in a large manufacturing plant, there are multiple assembly lines working on multiple products all at the same time. Assembly lines require a really thought through plan to get all the moving parts through a **system**. Lots of study on the time it takes to complete each part of the process and how many workers are needed at each station, and an organized, individualized way to produce the number of **assemblies** are needed for each order. Some, but not all, of the items made on an assembly lines are vehicles, hats, baseballs, pinball machines, airplane wings, sewing machines, children's toys, and even peanut butter. This list is an illustration of just how broad and necessary these systems are.

Below are photos of operators working on assembly lines.

Here is a photo of operators working on their workstation.

This section of the assembly line primarily utilizes robotics and machines to get the job done.

What is an Industrial Engineer and why are they important for assembly lines?
Industrial Engineers find ways to eliminate **waste** in production processes throughout a work environment. They design and create efficient systems that integrate workers, machines, materials, information, and energy to make a product or provide a service. Industrial engineers apply science, math, and engineering techniques to make the workplace more productive, cost effective, and safe. Because the systems they work on are so large and so broad, industrial engineers have to be knowledgeable and have skills in a wide variety of areas, like the ability to work well with people, and a broad view to be ready with a number of tools to do their best work. The role of an industrial engineer, who is studying an assembly line, is to watch closely for areas in the system that could use improvement. These improvements could be related to a poor workstation resulting in an operator getting injured due to bad postures, a ton of excess materials in their inventory that is costing the plant lots of money and time, developing studies on the times that each process takes in order to eliminate time wasted, or determining ways to improve employee and customer satisfaction throughout the whole system. Some jobs that an industrial engineer can have include process engineer, manufacturing engineer, data analysis, and so many more.

Learn more about what industrial engineering: https://youtu.be/Ww9hDlwjeF4

Think about what systems or processes do you complete in your daily life? Like the video mentioned, is it your morning routine, putting together a LEGO® creation, or the way your family shops at a grocery store? How can you make any of the processes more efficient, cost less, or be safer? We will get to these topics in the activity!

Activity: Efficiency is Key
Start by reading through the *Background Information*.

What's the Problem: Today you will create a prototype (or model), detail each step in the process, and work to make the process better!

Explore the Constraints: Just like engineers and scientists, you are limited to a select amount of time and materials. You can build your prototype out of LEGO® bricks, use a building toy you have, construction paper, blocks, or anything that you can find around your house.

Design your Solution: Brainstorm, plan, and draw your prototype. You can make anything! Do you want to make a car, a robot, a cat?

Create: Now that you have planned an amazing design, build it! While you are building, document each step in the process, making the details as precise as possible so that if someone else were to build your model, they could do so easily.

Try it Out: After you have built your model and detailed the steps you took, deconstruct your model. Utilizing a sibling, family member, or just doing it by yourself again, rebuild the model. With the person you are with, try to figure out a way to make the process of building your model more efficient. Should you place the pieces in order that you assemble them (line an assembly line)? Use some sort of holder to make sure you can use both of your hands? How can you make the system quicker, use less parts but still making sure the model has the same function, use fewer steps?

Make it Better: All designs can be made better. How can we redesign the model again and again to make the system more efficient? What happens when you change small parts of the process to better the whole thing? Take these ideas and continue to engineer your model.

Expand Upon your Design. If you can, keep thinking of ways to **innovate** your solution and re-test. Try it out with another model! Talk about your improvements with each new iteration (that means each try or design)!

Definitions
- **Efficiency:** Capability of producing desired results with little to no waste (such as time and materials)
- **System:** A group of parts combined to form a whole that works or moves as a unit. Example: ropes and pulleys carrying baskets of stones up the ramp; a body that functions as a whole; an assembly line from start to finish.
- **Assembly:** The final product or model made by all the processes in an assembly line.
- **Process:** One segment or operation in the assembly line.
- **Waste:** An unwanted by-product of a manufacturing process (excess time, inventory, materials)
- **Operator:** A worker operating at a workstation.

Reading and Resources

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<u>Books and Articles</u>
- *If I Built a Car* by Chris Van Dusen
- *A Woman Who Made Work Easier*
  http://teachers.egfi-k12.org/lillian-gilbreth/?utm_source=Teachers+Newsletter+March+2014&utm_campaign=egfi+teachers+March+2014&utm_medium=archive

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<u>Videos</u>
- What is Industrial Engineering?
  https://www.youtube.com/watch?v=gb4nTNG63mQ
- My Cool Job: Industrial Engineer
  https://www.youtube.com/watch?v=9Y5Auwf0nXE

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Check out more great resources at www.isek.iastate.edu!