Lesson Plan:

Utilizing Material Culture to Teach S.T.E.A.M. Concepts

Content Area: History, Visual Art, Physical Science, S.T.E.A.M. (Science–Technology–Engineering–Art–Math)

Grade: 4th-7th

Tech Needs: Whiteboard or Projector, laptop

Estimated Time: 50 min.

Objectives:

(1) To learn about the inventions that have led to modern-day technology
(2) To use archaeology to understand mechanics and engineering
(3) To understand how science and history can be taught together to enhance comprehension
(4) To learn about the role new technology played in nineteenth-century life

Materials:

- Google Slides
- This Kiddle page
- How Does This Work slideshow
- manually made bottles video
- machine-made bottles video
- play-dough
- straws
- cellophane
- Styrofoam board or soap

Learning Context:

The nineteenth century was a period of significant technological advancements that revolutionized the manufacturing industry. One of the most significant changes was in the production of glass bottles. Before this era, glass bottles were handmade, and their production was laborious and time-consuming. However, with new technologies, glass bottle production has become faster, more efficient, and less expensive.

One of the most significant technological advancements that changed how glass bottles were made in the nineteenth century was the invention of automatic bottle-making machines. These machines used compressed air to blow molten glass into molds, which resulted in uniform shapes and sizes. This innovation eliminated the need for skilled artisans to create each bottle by hand, reducing labor costs and increasing production rates.

Another significant development during this period was using gas-fired furnaces to melt glass instead of wood-fired ones. Gas-fired furnaces were more efficient and produced higher temperatures than their predecessors. This allowed faster melting times and increased productivity in glass factories.

New methods for cutting and polishing glass were also developed during this era. Diamond-tipped tools replaced traditional methods, such as grinding with sandstone wheels or acid etching. These new techniques allowed greater precision in shaping bottles while also reducing waste.

The introduction of mass-produced soda water also changed how glass bottles were made during this period. Soda water manufacturers required large quantities of uniform-sized bottles to package their products efficiently—the demand for these types of bottles led to further innovations in machine-made bottle production.

The Owens Bottle Machine is a significant invention in the history of glass manufacturing. It was invented by Michael J. Owens in 1903 and revolutionized how glass bottles were produced. The machine automated this process, allowing faster production and lower costs. It could produce up to 2,500 bottles per hour, compared to the 244 bottles produced by hand.

The Owens Bottle Machine also introduced the concept of mass production to the glass industry. This allowed for standardized bottle sizes and shapes, making it easier for bottlers to package their products. This impacted soft drink manufacturers, breweries, and pharmaceutical companies. It allowed them to increase their production capacity while reducing costs.

Its impact can still be seen today in modern-day factories, where machines have replaced manual labor in many industries.

Lesson Sequence:

1. Review contextual information.
2. Watch these modern videos of how glass bottles are made:
    1. manually made bottles

    2. machine-made bottles
3. Go over the following definitions (source: Merriam-Webster)
    1. pontil mark: the mark left over on a bottle's base from where a metal rod was used for gathering molten glass
    2. annealing: to heat and then cool (a material, such as steel or glass), usually for softening and making less brittle
    3. molten: fused or liquefied by heat
    4. compressed air: air under pressure more significant than that of the atmosphere
    5. thermal shock: a significant and rapid change of temperature considered especially concerning its effects upon living organisms or structural parts
    6. soda ash: commercial anhydrous (free from water) sodium carbonate
    7. limestone: a rock that is formed chiefly by accumulation of organic remains (such as shells or coral), consists mainly of calcium carbonate, is extensively used in building, and yields lime when burned
    8. raw materials: crude or processed material that can be converted by manufacture, processing, or combination into a new and useful product
4. Google Slides
5. Students will view and discuss the How Does This Work slideshow.
6. Discuss the images and come up with guesses as to how the technology worked.
7. Give correct answers and determine if anyone's guesses were accurate
8. Go back and look at the same How Does This Work slideshow, this time having groups explain how the machines worked
9. Now create hands-on models: Make a mold out of play-dough, and use a straw and cellophane to see if you can get the plastic to take the shape of the mold.
    1. Project instructions:
        1. Make a mold of a bottle out of play-dough. If you want an extra challenge, carve a mold from Styrofoam or soap.
        2. Make sure you have made two halves of the mold because they must fit together at the end.
        3. Use a pencil and create a maker's mark imprint inside one of the halves for fun.
        4. Use cellophane and a straw to create the effect of a blown bottle. Tips: *Stretch the cellophane as thin as possible without ripping it before you start. *Put a small dot of Elmer's glue on each side of the mold. *The thinner the straw, the better.

10. Final wrap-up discussion

Extensions/Adaptations:

Create a timeline on a poster board of the technology used to make glass bottles

References Cited

Bourhis, Eric Le. “Glass: Mechanics and Technology, 2nd Edition.” Wiley.com, July 8, 2014. https://www.wiley.com/en-us/Glass%3A+Mechanics+and+Technology%2C+2nd+Edition-p-9783527679447.

“Linda Hall Library - Our Collections.” The Linda Hall Library, August 16, 2022. https://www.lindahall.org/research/collections.

Merriam-Webster.com Dictionary, s.v. “pontil,” accessed June 13, 2023, https://www.merriam-webster.com/dictionary/pontil.

NPRHA.org. Accessed June 13, 2023. http://www.nprha.org/.

“Owens-Illinois Home.” OI, September 22, 2022. https://www.o-i.com/.

“Richard Trevithick.” Encyclopedia Britannica, April 18, 2023. https://www.britannica.com/biography/Richard-Trevithick.