

## NMIH Tour Post-Visit Lesson Plan

### GOAL

Students will be better able to bridge the past and present through stories of people, ideas, and inventions.

### OBJECTIVE

After participating in this post-lesson:

- students will think critically about contemporary advancements in science, technology, engineering, and the arts
- students will recognize how America –and much of the world—has changed since the Industrial Revolution
- students will cultivate a desire to look for and invent solutions to common problems

### THEME

Innovation

### S.T.E.A.M. INITIATIVE

At NMIH we strive to use an interdisciplinary approach to educate our visitors—the general public and school groups alike—about our city’s unique history, the region’s industrial heritage, and the far-reaching impact of the local innovations, entrepreneurs, and workers.

The following RESOURCES, MATERIAL LIST, ENRICHMENT SECTION, and DISCUSSION GUIDE can be used in any combination to meet the needs of the students and subject being taught in the classroom. It is not necessary to use the post lesson following your school visit to the National Museum of Industrial History, however, we find that students who participate in a post lesson are better able to synthesize the information they learned in the pre-lesson and through the interactive experiences they had during their visit to arrive at logical and well-informed conclusions about scientific principles and social history. Additionally, students who complete both a pre and post lesson have a deeper understanding of the content taught and are more likely to be able to apply the concepts they learned to future experiences.

Additional lesson plans and discussion guides for use in the classroom are available upon request.

### AUDIENCE

Bethlehem Area School District 5<sup>th</sup> graders (2016-2017)

## **APPLICABLE CORE CONTENT STANDARDS FOR THE LESSONS WITHIN THIS UNIT**

### **ARTS AND HUMANITIES**

Standard - 9.1.5.B

Recognize, know, use and demonstrate a variety of appropriate arts elements and principles to produce, review and revise original works in the arts.

Standard - 9.1.5.J

Apply traditional and contemporary technologies for producing, performing and exhibiting works in the arts or the works of others.

- Experiment with traditional technologies (e.g., ceramic/wooden tools, earthen clays, masks, instruments, folk shoes, etching tools, folk looms).
- Experiment with contemporary technologies (e.g., color fills on computers, texture methods on computers, fonts/point systems, animation techniques, video conferencing, multimedia techniques, internet access, library computer card catalogues).

Standard - 9.1.5.K

Apply traditional and contemporary technology in furthering knowledge and understanding in the humanities.

Standard - 9.2.5.F

Know and apply appropriate vocabulary used between social studies and the arts and humanities.

### **BUSINESS, COMPUTER, AND INFORMATION TECHNOLOGY**

Standard - 15.2.5.B

Discuss career pathways and describe businesspeople in those pathways within the community.

Standard - 15.2.5.C

Identify and compare occupations within the global marketplace.

Standard - 15.2.5.D

Discuss traditional and virtual work environments.

Standard - 15.2.5.O

Explain the importance of accepting diverse populations.

Standard - 15.2.5.Q

Identify recent occupations emerging in the workplace. Reference Career Education and Work 13.3.5.F

## **COMMUNICATION**

Standard - 15.3.5.A

Create work product with a variety of formats including note taking, outlines, essays, correspondence, journals and presentations. Reference English Language Arts CC.1.4.2.T, CC.1.4.5.F, CC.1.4.5.L, CC.1.4.5.R

Standard - 15.3.5.C

Apply strategies to understand directions. Reference English Language Arts CC.1.1.2.E, CC.1.2.5.C

Standard - 15.3.5.D

Explain and use vocabulary terms related to business and commerce. Reference English Language Arts CC.1.1.5.D

Standard - 15.3.5.E

Distinguish between age appropriate and inappropriate print and electronic resources used for introductory research. Reference English Language Arts CC.1.4.5.U

Standard - 15.3.5.G

Prepare appropriate information for impromptu and planned presentations. Reference English Language Arts CC.1.5.2.D

Standard - 15.3.5.H

Present information as an individual or in a small group. Reference English Language Arts CC.1.5.5.A, CC.1.5.5.C, CC.1.5.5.D, CC.1.5.5.E

Standard - 15.3.5.K

Model appropriate verbal and non-verbal behaviors in various contexts.

Standard - 15.3.5.M

Apply proper etiquette when using technology.

## **ENTREPRENEURSHIP**

Standard - 15.5.5.A

Define the qualities of an entrepreneur.

Standard - 15.5.5.F

Identify global businesses in the local or state economy

Standard - 15.5.5.I

Identify the functions of a business operation.

## **GLOBAL BUSINESS**

Standard - 15.7.5.A

Identify global and domestic business and products.

Standard - 15.7.5.B

Identify businesses in the community that trade products and/or services internationally.

Standard - 15.7.5.K

Explain how the responsible use of natural resources benefits the individual; the family; and local, national, and global communities.

Standard - 15.7.5.L

Explain why business organizations should be constantly aware of external changes.

Standard - 15.7.5.M

Identify countries that produce or specialize in a particular product or industry.

## **TECHNOLOGY AND ENGINEERING EDUCATION**

Standard - 3.4.5.C1

Explain how the **design** process is a purposeful method of planning practical solutions to problems.

Standard - 3.4.5.C2

Describe how design, as a dynamic process of steps, can be performed in different sequences and repeated.

Standard - 3.4.5.C3

Identify how **invention** and **innovation** are creative ways to turn ideas into real things.

Standard - 3.4.5.D1

Identify ways to improve a design solution.

Standard - 3.4.5.D2

Use information provided in manuals, protocols, or by experienced people to see and understand how things work.

Standard - 3.4.5.D3

Determine if the human use of a product or system creates positive or negative results.

## RESOURCES

This resources list is divided by S.T.E.A.M. subjects and includes sources for educators to consider while preparing a post-lesson following a visit to NMIH.

### Science

<http://www.biographyonline.net/scientists.html>

<http://www.biographyonline.net/scientists/famous-inventions.html>

<http://www.history.com/topics/inventions>

### Technology

<http://www.kidsdiscover.com/infographics/infopacket-7-amazing-teen-inventors/>

<http://www.history.com/topics/inventions/alexander-graham-bell/videos/the-telegraph-and-telephone>

### Engineering

<http://www.kidsdiscover.com/quick-reads/arkansas-teen-builds-nuclear-reactor-garage/>

<https://www.tinkeringlabs.com/>

<http://www.lancemakes.com/>

<http://www.aas-world.org/YIP/>

## **Art(s)**

<https://sites.google.com/a/alpinedistrict.org/rube-goldberg/home/example-of-the-original>

[https://en.wikipedia.org/wiki/Science\\_and\\_inventions\\_of\\_Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Science_and_inventions_of_Leonardo_da_Vinci)

## **Mathematics**

<http://www.biography.com/people/ada-lovelace-20825323#synopsis>

## **MATERIALS LIST**

The materials list is a quick reference of the suggested items and/or images educators will need prior to facilitating a post-lesson.

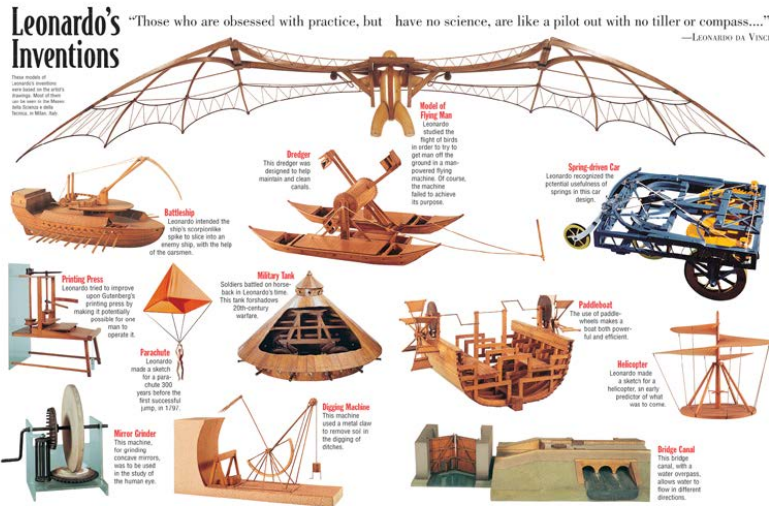
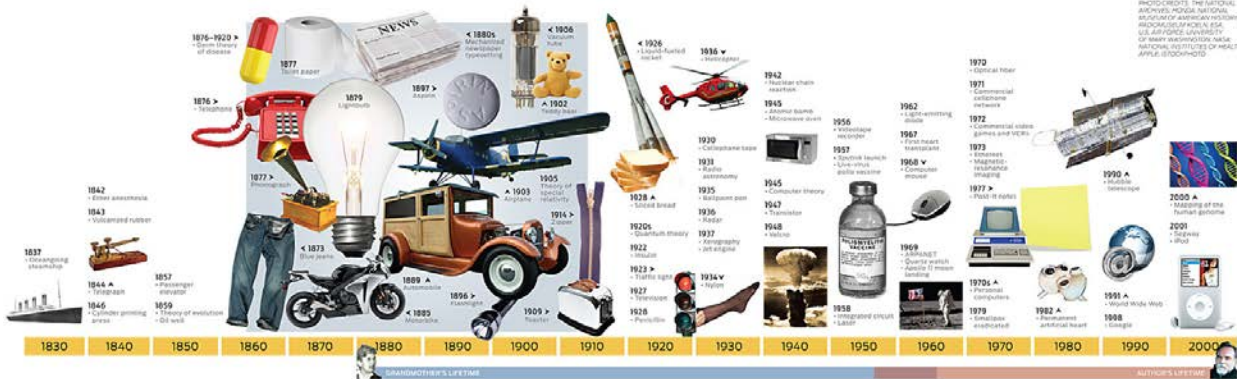
- Lined notebook paper
- Card stock
- Markers, crayons, colored pencils
- 11x17 paper
- A list of great inventors throughout history
  - Create a timeline/infographic with visuals of the individual and the list of their inventions
    - Include inventors from history as well as the modern age
    - Include youth inventors
- Illustrations of Rube Goldberg's whimsical inventions
- Image of Jacquard loom punch card
- Image of IBM computer programming punch card
- Examples of a timeline and infographic
  - Directions for timeline/infographic assignment
- Image of an exhibition layout
  - Directions for STEAM Exhibit assignment

## ENRICHMENT SECTION

The images and information in the enrichment section correspond to the suggested items from the materials list.

The purpose of the enrichment section is to provide in depth information on resources from the materials list. These items can be used to facilitate an in-class lesson, supplement a curriculum based project, or can be assigned as homework. Activities in this section should ideally relate back to the concepts taught in the pre-lesson and experiences gained during the visit to NMIH.

- **Timeline/Infographic**

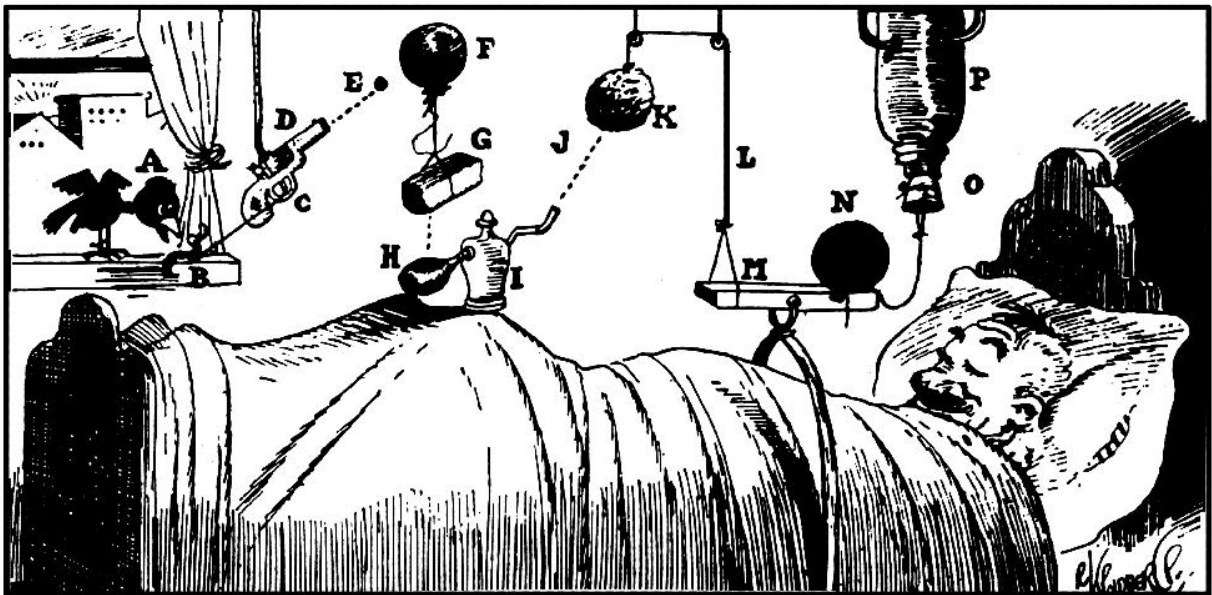


- **Activity:**

- This activity can be done by students in groups or as individuals
- Have the students create a timeline/infographic illustrating the major events of an inventor's life, including steps in the development of an invention, successes, failures, or other inventions created. The following is a list of examples:
  - Thomas Edison
  - Alexander Graham Bell
  - Guglielmo Marconi
  - Louis Pasteur

- Marie Curie
- Alan Turing
- Have students create a timeline/infographic for a specific technological or scientific advancement that has impacted their lives. The following is a list of examples:
  - The Development of Communication
  - The History of Transportation
  - The History of Photography
- Identify a Problem, Create a Solution (Rube Goldberg style)

## Simple Alarm Clock



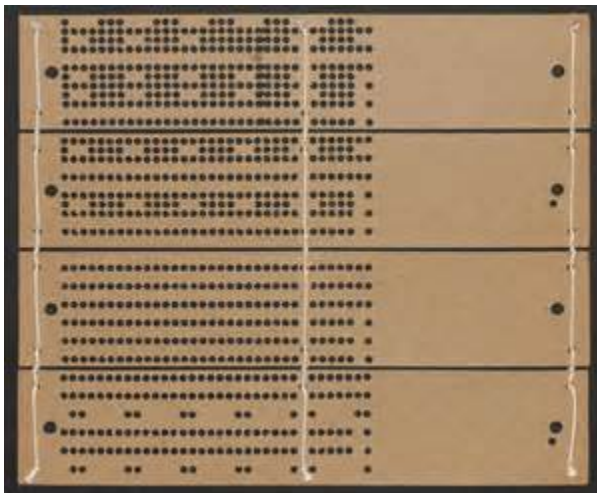
The early bird (A) arrives and catches worm (B), pulling string (C) and shooting off pistol (D). Bullet (E) busts balloon (F), dropping brick (G) on bulb (H) of atomizer (I) and shooting perfume (J) on sponge (K)—As sponge gains in weight, it lowers itself and pulls string (L), raising end of board

(M)—Cannon ball (N) drops on nose of sleeping gentleman—String tied to cannon ball releases cork (O) of vacuum bottle (P) and ice water falls on sleeper's face to assist the cannon ball in its good work.

- Reuben (Rube) Goldberg was born July 4, 1883 in San Francisco, CA
- He was an American cartoonist, sculptor, author, engineer, and inventor
- He is best known for his cartoons depicting complicated inventions that perform simple tasks
- The expression, *Rube Goldberg Machine*, refers to a contraption, invention, or device that is deliberately over complicated and uses a series of chain reactions to accomplish a simple task. The use of the expression generally means any confusing or complicated system.



- Activity:
  - Have students review what is an invention and who is an inventor, as per the NMIH visit
    - What were some inventions at NMIH that impressed you?
    - Do you remember the names of any of the inventors that you learned about at NMIH?
  - Introduce Rube Goldberg
    - Inventing a solution to a process is a creative activity
    - Have students work collaboratively to identify a list of common problems
    - Have the students select one problem they would like to solve
    - Allow the students to work on inventing solutions
      - They must create a visual representation of their invention
      - They must label the parts of their invention
      - They must write a description of how their invention works and what problem it solves
  - If time permits, have the student groups present their work to the rest of the class
  
- **Adapting old technology**



- The power loom invented by Joseph Marie Jacquard made the manufacturing of complex patterned textiles easier
- The pattern the loom created was controlled by a series of punch cards that were sewn together
- Each card represents one row of the finished fabric design
- The Jacquard Loom, attachments, and process of weaving patterns are probably one of the most important inventions
- Jacquard based his invention on earlier inventions by other men in the textile industry
- Just as Jacquard refined previous inventions and applied them to greater advantage, early twentieth century programmers used the concept of Jacquard's loom punched cards to input data into computers
- Information could be written and stored on punched cards
- IBM (International Business Machine Corporation) used a paper tape punched with holes to program some early computers (such as the 1944 IBM Harvard Mark I)
- Punched cards remained in use in computing up until the mid-1980s

- **Activity:**
  - Thinking back to their visit to NMIH, have the students identify some of the early machines, materials, or processes that have modern day applications
    - The Frick Steam Engine (external combustion)- Modern Car Engine (internal combustion)
    - The Linde-Wolfe Ammonia Compressor- Refrigerator
    - Iron- Steel
    - Peddle/Treadle powered woodworking tools- Electric tools
    - Punched Cards- Computer programming
  - Have students take the activity a step further by having them consider what the next development might be for some of these inventions

- **Today's Inventors (Youth Connection)**



- Brooke Martin, the 13-year-old from Spokane who invented an Internet-enabled device that allows dog owners to video chat with their pups and automatically deliver a dog treat from afar.

<http://www.geekwire.com/2013/teen-invented-internet-enabled-dog-treat-dispenser-wins-2nd-national-science-competition/>

- Ann Makosinski created a flashlight that could run off of the warmth of one's hands. She called it "Hollow Flashlight" and won a 2013 Google Science Fair award for the creation.



<http://www.nbcnews.com/nightly-news/teen-inventors-bright-idea-may-light-world-n103601>

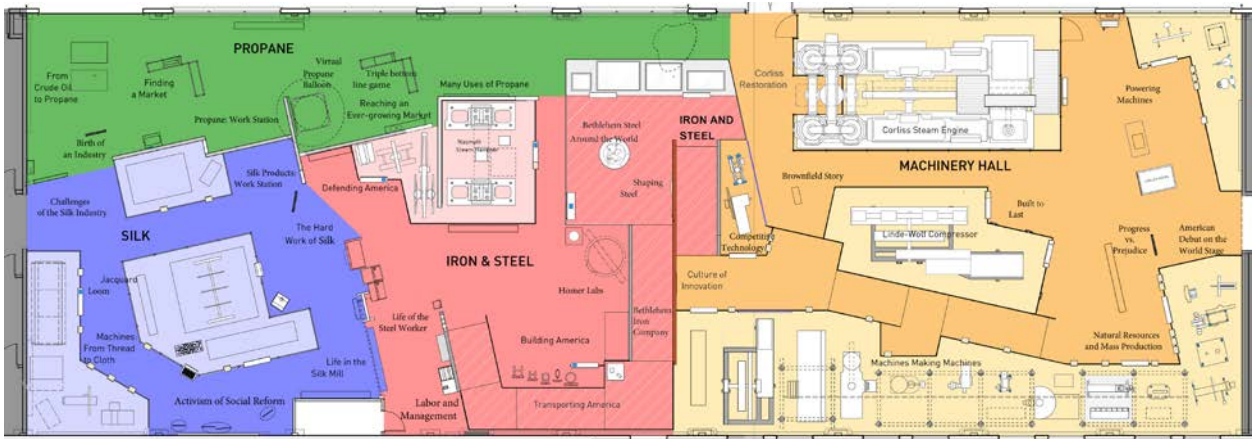


- Ryan Patterson, a high school student, invented a glove that converts American sign language into text on a portable screen has won a top award for young scientists.

<https://www.wired.com/2002/01/a-glove-that-speaks-volumes/>

- Activity:
  - Learn about a young inventor (three links to articles are provided, however, the students can find other articles about young inventors)
    - What did they invent?
    - Why did they invent it?
    - What problem did their invention solve?
    - Were they successful the first time? How many attempts were made to create a working invention?
  - Write a report about what you learned.
  - Consider some of the problems you have—or someone you know has—on a daily basis. Think about real solutions to those problems.
    - What problems do you notice in the world around you?
    - Do you have an idea for how to solve these problems?
  - Write a report about what you discovered and what your solution would be.

• **Create your own STEAM Exhibit**



- An exhibit is an organized presentation or display of selected works of art or items
- Exhibits are organized by a communicated theme

- Exhibitions usually occur in museums, galleries, or a defined space
- The purpose of an exhibition is to give people the ability to appreciate and study unique objects
- Activity:
  - Have the students review what they learned about the 1876 Centennial Exposition
  - Remind the students that the Centennial Exposition was a very large exhibit featuring the creative and practical inventions of America individuals and businesses
  - Have the students make a list of the inventions they recognize/use/appreciate in their personal lives
    - It may be necessary to facilitate a brainstorming session to create a list of the many inventions we use, but take for granted, on a daily basis (i.e. toothbrushes, toaster oven, blender, buttons, shoelaces, etc.)
  - If they were able to design an exhibit of modern inventions what would they include?
  - Allow the students to create an exhibition
    - Floor plan- like the image included, have the students create an exhibition where they feature multiple galleries with inventions grouped by theme
    - Scene- students can also create a single perspective view of inventions on display

## **DISCUSSION GUIDE**

The following is a list of prompts to be used in class or as a homework assignment in an effort to engage the students to consider the impact of inventions/inventors on individuals, a society, and the nation.

In your opinion, what invention (which inventor) made the biggest impact on your life? For your country? In the world?

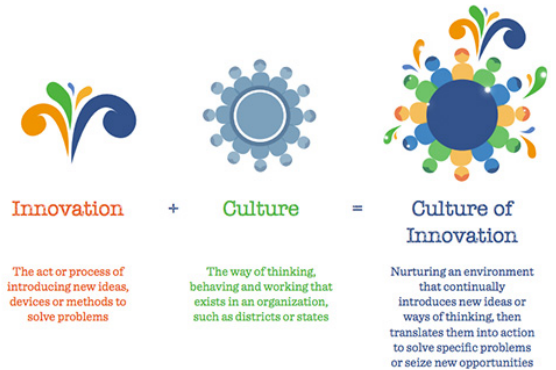
There is no wrong answer. Explain your choice.

What invention can you not live without? Now imagine life without this invention. What is life like without this invention? What did people use before this invention existed?

Do you think everything that could be invented already has been invented? What would you like to see invented? What problem does it solve? How would this invention change the way we live? Does it have any negative consequences?

Discuss the following concept: *Culture of Innovation*

A culture of innovation is one in which businesses recognize creativity, imagination, and original thinking as valuable resources.



Historical context: Look at this picture.



This is John Fritz. He was an American pioneer of iron and steel technology who has been referred to as the "Father of the U.S. Steel Industry". He was the General Superintendent and Chief Engineer of the Bethlehem Iron Works (which became the Bethlehem Steel) until he was 70 years old.

This photograph is from John Fritz's 80<sup>th</sup> Birthday Party. In attendance were some of the great inventors, entrepreneurs, and business men of the time. Some of his biggest competitors were also invited. A culture of innovation is one in which great minds seek out the ideas and advice of other great minds to find solutions to common problems. When great minds work together, they can often create solutions that they would not have discovered on their own. John Fritz and Andrew Carnegie were competitors in the Steel Industry, but they shared "recipes" for making better steel and America benefitted.

## **GLOSSARY**

**Adapt-** Make something suitable for a new use or purpose; to modify; to adjust

**Culture of Innovation-** A culture of innovation is one in which businesses recognize creativity, imagination, and original thinking as valuable resources.

**Engine-** A Machine with moving parts that converts power into motion

**Entrepreneur-** A person who organizes and operates a business, taking on greater than normal financial risks in order to do so

**Exhibit-**A display a work of art or an item of interest in a gallery or museum; an object or collection of objects on public display

**External Combustion-** An engine that derives its heat from fuel consumed outside the engine

**Industry-** Economic activity concerned with the processing of raw materials and manufacture of goods in factories

**Innovative-** (of a product or idea) featuring a new method; advanced and original

**Internal Combustion-** an engine that generates power by burning fuel with air inside the engine, the hot gases produced are used to drive a piston or do other work as they expand

**Invention-** The action of inventing something, typically a process or device; something created

**Inventor-** A person who invented a particular process or device or who invents things as an occupation

**Machine-** An apparatus using or applying mechanical power and having several parts, each with a definite function and together performing a particular task

**Manufacture-** the making of articles on a larger scale using machinery