Design A Laboratory Unit

Grade levels: 3 - 5

Unit Objectives: Students will...

1. Learn about the life and scientific contribution of inventor Lewis Howard Latimer, through a virtual tour of the Lewis Latimer museum.

2. Compare Latimer’s inventor workspace with other scientific laboratories and the modern-day makerspace.

3. Build an understanding of the tools found in both Latimer’s inventor’s workshop at home and other scientific workspaces throughout history, while learning the importance of safety precautions, supplies, and equipment during the process of invention.

4. Develop a criterion to test the efficiency of a lab layout design, while studying its proportions and geometric measurements.

5. Work in a small group to create a paper prototype of (choose one):
   a. An Industrial laboratory in the past and present.
   b. An inventor’s workshop in the past and present (makerspace).

Concepts/Skills:

Prototyping, engineering design, 3D to 2D spatial translation and reasoning, and practice using measurement tools.
The Inventor’s Workshop
Learn about the places where inventors work

Challenge
Imagine your own inventor’s workshop

Learning Objective
Build an understanding of the physical spaces where scientists, engineers, and inventors work.

Duration
Suggested time 60 minutes

Lesson Outline

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<td>Explore</td>
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<tr>
<td>Explain</td>
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<td>Elaborate</td>
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ENGAGE
10 minutes

Students will be introduced to an inventor’s workshop and design their own. Through an exploration of Lewis Howard Latimer’s home inventor’s workshop, students will understand the thought process behind designing a functioning workspace. We will also compare the differences between working in a professional lab, and inventing at home.

One of the best ways to capture and engage students is by starting with familiar ideas, concepts, and images for reference. We suggest starting the lesson with examples of inventors we know from pop culture and media (T.V. Shows, Movies, Comics) for a better understanding of where people invent.

However, integrating pop culture into your lesson does not mean that your entire discussion should focus on said reference. Instead, you can incorporate this knowledge to ultimately bridge the gap between what they know, and what they will learn from the virtual tour of Lewis Latimer House Museum.

Thinking Prompt:

Think about the various spaces where scientists and inventors do their work. We call those spaces laboratories (or labs for short), workshops or makerspaces.

Let’s talk about some laboratories that you may have seen in a popular cartoon or in a movie.

Some examples of science labs or inventor workshops are in our television and media. Some popular culture examples include: Phineas and Ferb, Harry Potter and the Sorcerer’s Stone, Despicable Me, and A Wrinkle in Time.

● Have you seen a lab in a movie or television show?

● Have you ever visited a lab in real life?

● Have you seen an advertisement in a book or magazine, or on the internet that takes place in a lab?
Ask your students to consider the key elements of a lab, and make a class list.

**Inquiry Questions:**

- **What do these laboratory spaces have in common?**
  
  *Example responses:*
  
  *Big tables, special lights, a place to put supplies....*

- **How are these laboratory spaces different?**
  
  *Example responses:*
  
  *Smaller tools, windows, comfortable feeling and furniture...*
Lewis Howard Latimer (1848-1928), was an African-American inventor, electrical pioneer, and a son of fugitive slaves. With no access to formal education, Latimer taught himself mechanical drawing while in the Union Navy, and eventually became a chief draftsman, patent expert, and inventor.

Latimer’s at-home workspace was quite different than the laboratories he used when working with Thomas Edison in 1884. After watching the following videos, spend time discussing the similarities and differences with your students.
VOCABULARY

**Science Laboratory (lab):** A scientific space used to test important theories, measure properties, document findings, and explore useful experiments.

**Inventor’s Workshop:** Home Based labs that provides flexibility for inventors to work when inspired.

**Makerspace:** A collaborative space where inventors share ideas about technology, equipment, and brainstorm on future innovations.

PLACES FOR INVENTING & MAKING

For some students, the concept of a laboratory that is not a scientific laboratory is difficult to understand. Guiding students to the realization that invention can happen in a variety of ways and settings is an important concept to explore.

**What is a science laboratory?**

A *science laboratory (lab)* is a place or setting used to test scientific information. In this room, experiments are performed. Observations and investigations either agree or disagree with a beginning hypothesis.
What is an Inventor’s Workshop?

In the times of Lewis Latimer, many inventor workshops were based in homes. This provided flexibility for inventors, designers and engineers to work when they were inspired - whether it be early in the morning, or in the middle of the night.
What are some historic and modern inventor’s workspaces?

Thomas Edison was the founder of the Edison Company (now known as General Electric). In 1884, Latimer was employed by Edison alongside a team of other scientists - men and women with a variety of skills and educational backgrounds - to invent electrical advancements meant to societally improve the quality of life.

Modern labs are found in colleges, universities, and companies helping to reimagine everyday inventions - from pharmaceuticals creating a new toothpaste flavor, to the motor industry designing self-driving electric cars. Scientists are working in laboratories all over the world, discovering new and exciting ways to fix today’s biggest problems.
What is a Makerspace?

A *makerspace* is a place in which people with shared interests and scientific perspectives gather to share ideas, brainstorm new projects, and collaborate. Through an extensive process of trial-and-error, these makerspace projects may or may not bring important scientific advancements.
Thinking Prompt

Lewis Howard Latimer was an inventor who worked with other scientists including Thomas Alva Edison to create a better light bulb. That laboratory was called the Edison Lab (General Electric). There, Latimer worked extremely hard to improve Edison’s invention, making it more suitable for people’s needs.

Sometimes, Latimer had ideas that he wanted to work on in the middle of the night. This is when he became inspired to work on new ideas for new inventions of his own.

- Did Mr. Latimer work in an institutional laboratory all the time? Why or why not?

  “He liked to work at home because he had ideas that were different from those of his scientific peers. He wanted to think about his ideas and solve problems in his own space.”

- What are the good opportunities when working from home?

  “No travel, take a rest, work early or late.....”

- What are some challenges about working from home?

  “Interruptions, responsibilities, missing important time with family, not having the proper tools, danger/fire/explosion.....”
ACTIVITY
Mr. Lewis Howard Latimer’s home inventor’s workshop was a great place for discovery. It was a special place that he designed for a wide range of activities, with tools, and materials. Consider the laboratories we discussed from popular culture, pick one and explain how they are similar or different from Mr. Latimer’s workshop.
DISCUSSION QUESTIONS:

What do all of these spaces have in common?

What kinds of equipment are required?

What supplies and materials does every laboratory need?

(This is an opportunity to show real objects from a classroom laboratory).

In what ways are laboratories specially designed? Why?

(High ceilings, long tables, chairs or stools, safety equipment, etc.)

Does the layout of the laboratory matter?

How much space is needed for these places? Why?
Lewis Latimer was an inventor who lived and worked in the late 1800’s. His ideas brought new and improved inventions to people in the United States and around the world. He had many ideas, and some of those inventions are the foundation of technologies we have today, for example:

Here are a few resources to help:

**WIKIPEDIA**
[https://en.wikipedia.org/wiki/Lewis_Howard_Latimer](https://en.wikipedia.org/wiki/Lewis_Howard_Latimer)

**LEMELSON CENTER**
“Edison’s light bulb used a carbonized bamboo filament, which unfortunately burnt out rather quickly. Latimer created a way to make the carbon filament more durable by encasing it in cardboard.”
[here](https://en.wikipedia.org/wiki/Lewis_Howard_Latimer)

He also formed the ideas behind the air conditioner and other everyday objects.

Many inventors also worked at home in inventor workshops. Smaller spaces that were specifically designed by the inventor.
BRAINSTORM

Explain to your students that inventions come from ideas, and that the best inventions are developed in teams that work together. Ask your students to also consider the differences of working in a large industrial science laboratory, a home-based inventor’s workshop, and the new workspaces that are being developed today in communities throughout the world called makerspaces.

Inventing Something New: 3 minutes discussion

Take notes on a board or Padlet. Exploring Lewis Latimer’s workspace will support students as they gain an understanding that there were many inventions that changed the world. Where would we be without Latimer? What are other cool inventions that have changed our lives?

Examples: Perhaps a car that could fly? Or maybe small pods for living under the water?

Workspace for Inventing: 3 minutes discussion

Students also can discuss the design elements related to the real people who worked in real spaces for invention in the late 1800’s -- industrial laboratories may have been dirty, unsafe, crowded, contained dangerous equipment, and information and ideas were shared there.

Examples: Using wider doorways for entering and exiting.
ELABORATE

After learning about Lewis Latimer’s home inventor’s workshop, we will ask students to complete a short design challenge to consider the idea that Latimer was very successful as an inventor by working in his at-home workspaces, and improving on already-existing inventions.

Work with students to complete a simple design of a space they would work in to fix a problem and design a new solution.

What would you invent in your workshop? Is there any new technology or machine that you would like to improve?

Remember students should consider:
1. Inventing something new or rethinking something old
2. What is a useful and safe workspace for inventing

Examples: a robotic arm, a chemical/bacteria that kills a new virus, a new cell phone with features that do not yet exist.

The sky’s the limit for this activity. Encourage students to think big. Many students will not know the names of the tools they need, that is not important for this assignment. The focus is demonstrating an understanding that there are different workspaces and they are better suited for different types of invention.
ACTIVITY
Your challenge is to imagine inventing something new, and design the workspace for invention. What would you invent? What would your workspace look like?

*Circle which space you chose to design below:*

- Science Laboratory
- Inventor’s Workshop
- Makerspace

*My New Invention/My Improved Invention*
## Evaluate

### Rubric

**Assessment**

Use the students' design and written descriptions to evaluate students' ability to determine the difference between spaces and concerns about safety, supplies and space for work.

Evaluate their room description for the use of descriptive adjectives, voice, and organization.

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<th>Excellent</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Needs Improvement</th>
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</thead>
<tbody>
<tr>
<td>Student demonstrated understanding of the differences between scientific laboratories and a home-based inventors workshop.</td>
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<tr>
<td>Student provided a clear understanding of the work conducted in a laboratory.</td>
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<td>Student shared their work successfully.</td>
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<tr>
<td>Student clearly depicted their laboratory using grade level descriptive language.</td>
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<tr>
<td>Student shared their work confidently to the class and were able to communicate with others.</td>
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### Common Core Standards

**Geometry**

**3.G.A.1**
Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

**Measurement and Data**

**3.MD.D.8**
Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

### Next Generation Science Standards

**3-5 ETS1-1**
Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

**3-5 ETS1-3**
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

**MS ETS1-1**
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**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.

**MS ETS1-4**
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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