

Paper Circuit: Learning About Light Bulbs and Electricity

Grade Level: 9th - 12th Grade

Unit Objectives: Students will...

1. Learn about the importance of electricity and the way in which electricity is transferred.
2. Students will learn about the components of a simple circuit.
3. Explore a concept used by Lewis Latimer in his laboratory and used by scientists in other laboratories.
4. Work in a small group to share their creations and present in front of a group

Concepts/Skills:

Understanding the basic principles of electricity and circuit, engineering principles, following scientific procedures and fabrication skills.

Paper Circuits

Learn a fundamental skill

Challenge

Create a paper circuit showing an understanding of electricity.

Learning Objective

Build an understanding of electricity and circuits.

Duration

Suggestion time 60 minutes

Lesson Outline

Engage	10 minutes
Explore	15 minutes
Explain	30 minutes
Evaluate	5 minutes

ENGAGE

10 Minutes

Students will be introduced to the idea of electricity as a key principle for innovation and design. We will learn about the components of a circuit. As students think about the various contributions inventor Lewis Howard Latimer has made, they will be encouraged to consider the importance of electricity as a key design component.

One of the best ways to capture and engage students is by starting with familiar ideas, images, and references. Therefore, have students brainstorm what they already know about electricity and circuits. Even their most fundamental knowledge about electrical charge, current, and magnetism will help relate today's activities to their existing knowledge and be able to engage the students in the material.

For example, have students consider how a television remote works. The internal power is supplied by a battery. The remote works based on a circuit inside that translates the inputted signal made from pressing keys into infrared signals that translate on to the television itself. The circuitry of the remote control makes it possible to send signals of watching preferences back to the television.

THINKING PROMPT

Next, have the students consider the way electricity runs in their homes. Guide students to compile a list of steps required to power their home refrigerators. These include the generation of electrical current at their respective generating stations, the use of transformers to provide electricity, and the use of meters to measure energy consumption in homes.

- *Where does electricity come from?*
- *What happens when the power goes out?*
- *What is the purpose of a power source and what are some examples?*

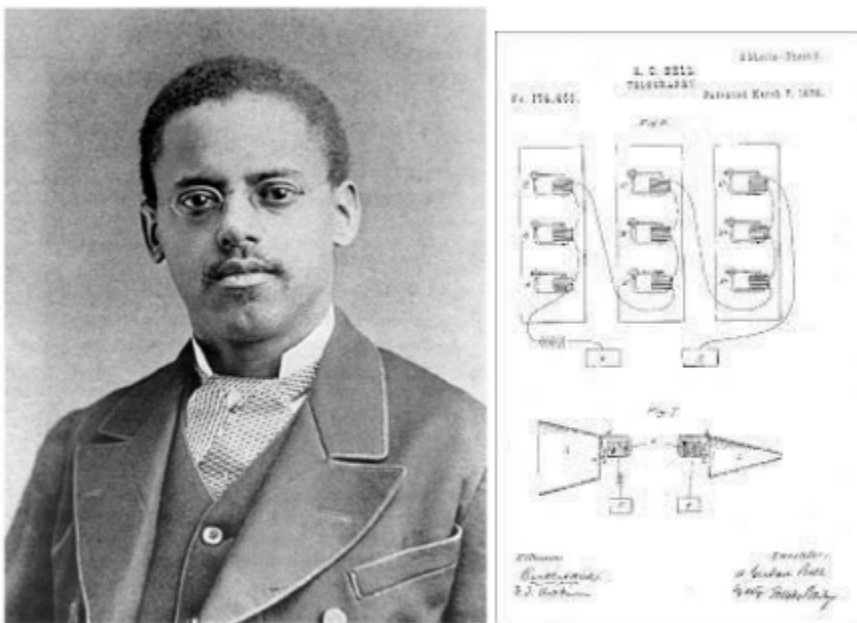
Ask your students to consider the key elements of a lab, and make a class list.

EXPLORE

15 minutes

Watch Video:

[“Lewis Howard Latimer Life Story - Inventor and Innovator”](#)
(6:45 Minutes)



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.

Lewis Howard Latimer's workspace at his home allowed him to create many important innovations. Have students consider some of the objects he must have measured, fundamental dimensions considered in his patent drawings, and the importance of these metrics.

KEY VOCABULARY

Circuit: a set of electrical components in a closed loop

Electricity: the energy formed from a current

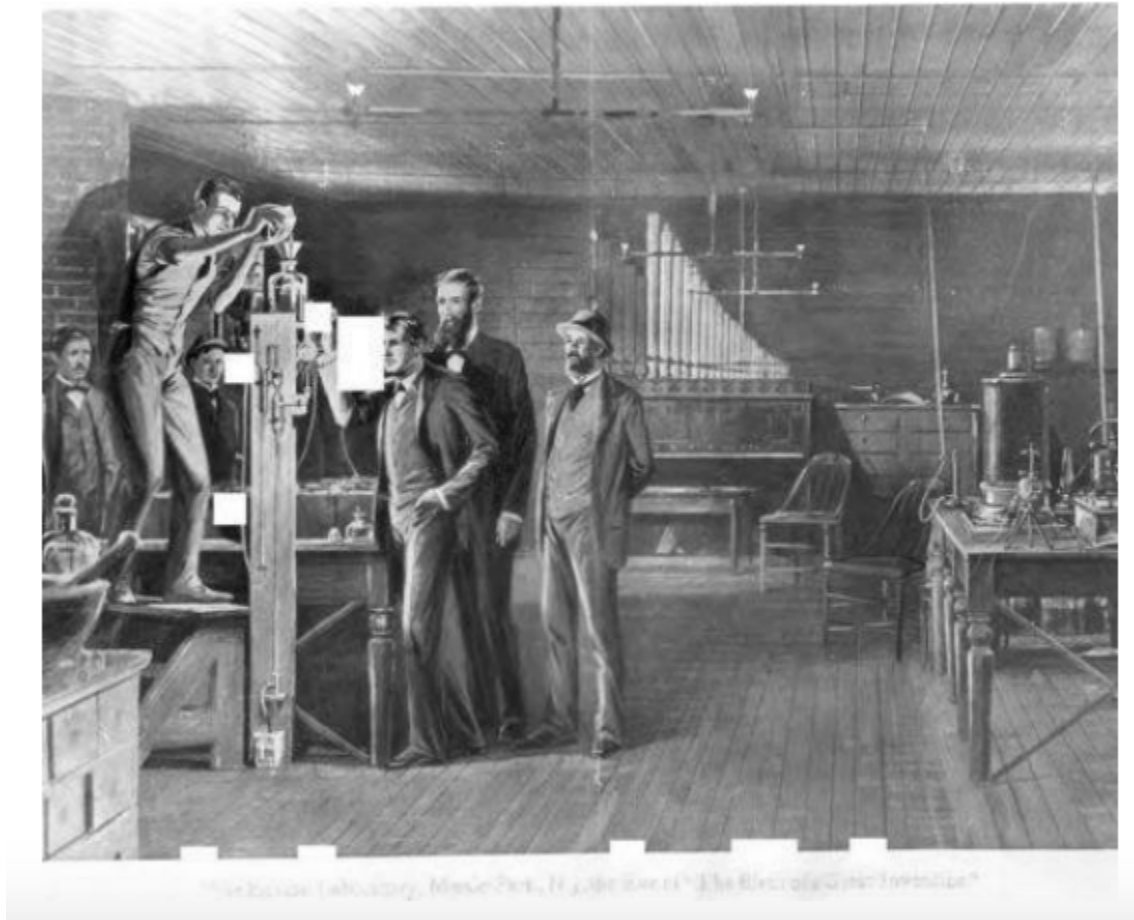
THINKING PROMPT:

Lewis Howard Latimer was an inventor who worked daily to create important inventions for daily use. In doing so, he was gathering information to find answers to questions that had yet to be solved as best as possible while building off of existing knowledge. Therefore, he thought about how to improve inventions current to his time.

- *What are some useful tools that have not yet been invented that would be helpful in your life?*
- *Can you name some problems that do not have good solutions yet? How would you solve them? What could you invent?*

EXPLAIN

30 minutes



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 a machine we have today. Through the context of the next activity, we will learn how important and useful measurement is in the innovation process!

WORKSHEET

NAME
GRADE

DATE
TEACHER

ACTIVITY:

Let's create a paper circuit using your knowledge of electricity and its components!

Materials:

- 5 mm LED(s)
- 3V Coin Cell Battery
- Copper Tape
- Coloring/Drawing Utensils
- Latimer House Paper Circuit Template
- Double Sided Tape

METHOD:

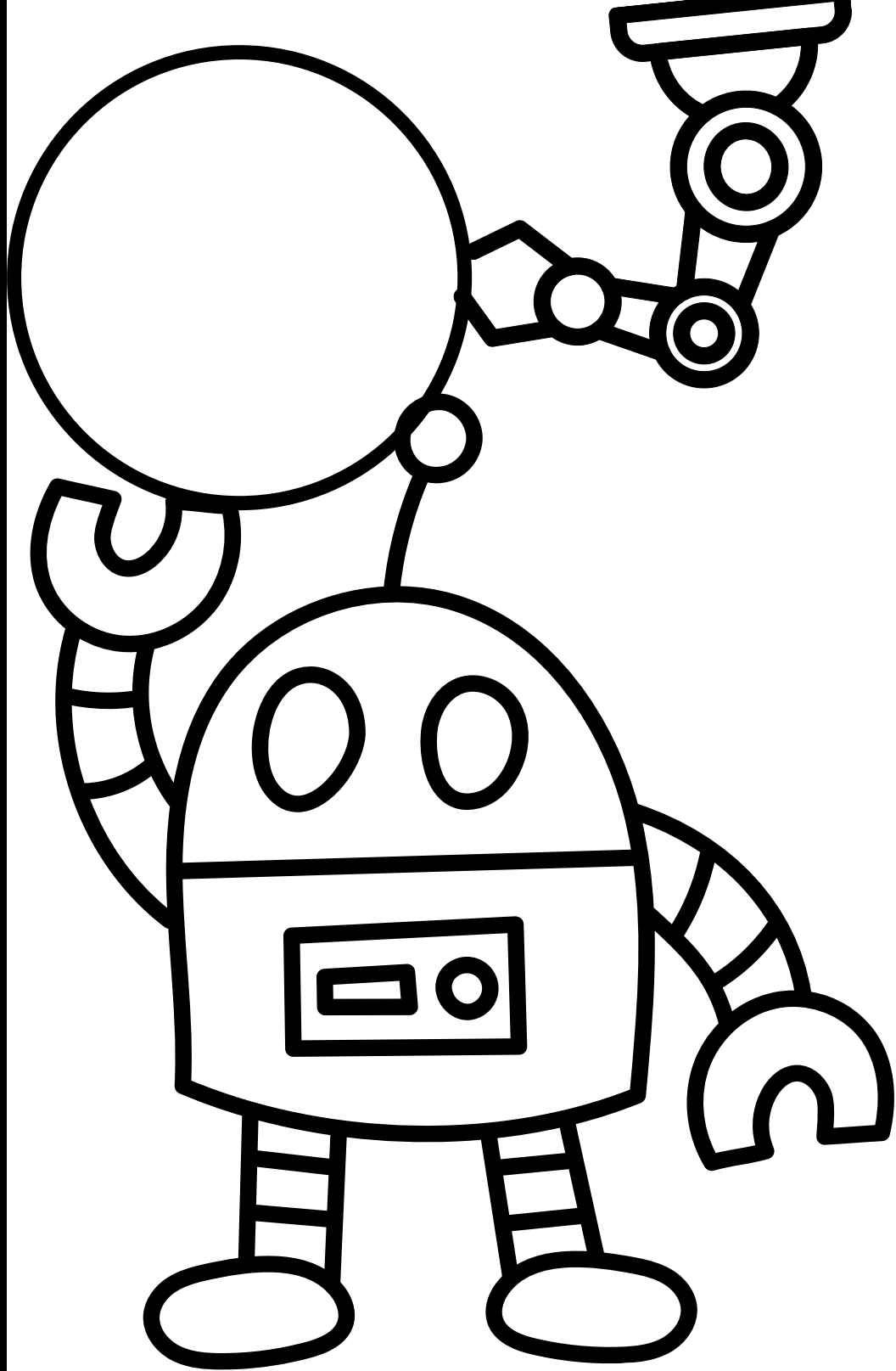
1. Begin by folding the first page of the template (featuring the robot) in half, creating a birthday card-like structure.
2. Take your time coloring the robot image on the front of the card. Leave the antenna uncolored as we'll attach an LED bulb to it later during the paper circuit construction. Add some art to the contraption that the robot is holding.
3. After you've finished your robot drawing, apply double-sided tape to affix the second page inside the folded first page. Ensure precise alignment of both pages, with the paper circuit grid facing you, directly behind the robot. Make sure that the "x" circle on the circuit board aligns perfectly with the circle on the robot's antenna.
4. Now, let's dive into the instructions on the inside of the card, following steps 1 to 4, which involve adding your first layer of copper tape.

5. In step 5, gently fold the card to expose the cover featuring the colored robot. Insert the LED bulb through the circle that represents the antenna. Now, the bulb should be positioned on the outside, alongside the artwork, while the wires should protrude inside the card when you open it.
6. Imagine the wires as legs; bend them flat, creating a 180-degree angle. This will ensure each wire lies flat on top of the initial layer of tape on lines A1 and A2.
7. Continue with steps 6 to 9, adding a second layer of tape to secure the wire beneath it and applying another layer of tape on top of the first layers on lines B1 and B2.
8. Place the battery on the yellow circle and add one more strip of copper tape to line C, making sure the tape passes over the battery. This step should make your bulb light up.

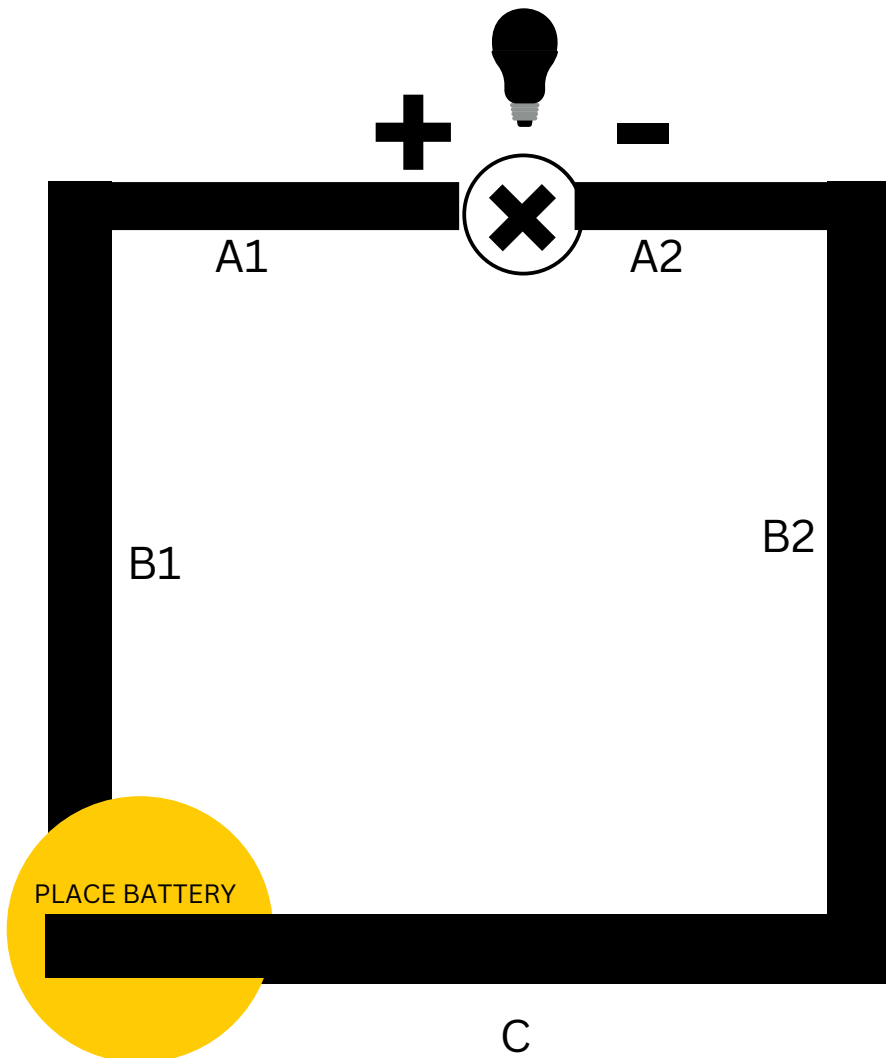
Important Tips:

- Handle copper tape with great care, as it is quite delicate. Be patient and gentle to prevent it from rolling into itself.
- Ensure that the copper tape is flat and without wrinkles. Avoid creating a patchwork of pieces to form a single strip. Stick to just two layers, as adding more layers may obstruct the flow of electricity through the circuit.

Best of luck, and enjoy the creative process!



LEWIS LATIMER
HOUSE MUSEUM



- Add Copper tape to Line A1
- Add Copper tape to Line A2
- Add Copper tape to Line B1
- Add Copper tape to Line B2
- Add Bulb through “x” circle (“+” is the longer wire)
- Add Tape to A1 to secure positive side wire
- Add Tape to A2 to secure negative side wire
- Add another layer of tape to Line B1
- Add another layer of tape to Line B2
- Place Battery on “place battery” circle on negative side
- Add Copper tape to line C over the battery

DISCUSSION QUESTIONS

Were you able to create the simple circuit?

What was the easiest part of creating the circuit?

What was the most difficult part of creating the circuit?

If you were to repeat the steps, what would you do differently?

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 consider the concept of a **circuit**. Although the circuit they generated today was a simple paper circuit, the principles of electricity used by Latimer still translate to their work.

Brainstorm a List of their Knowledge of Electricity:

Working together with students, generate a list of facts about electricity. What have students learned in the last hour that is new information? What were the key concepts that they used when working on their own circuits? After the students have a sizable list, compare the new list with the one from the beginning of the session.

EVALUATE

5 minutes

Assessment Rubric

Use the students' design and written descriptions to evaluate students' ability to determine the layout of their personal historic home museums.

Evaluate their room description for the use of descriptive adjectives, voice, and organization and their illustration based on relative accuracy of size and dimensions.

	Excellent	Good	Satisfactory	Needs Improvement
Student demonstrated understanding of the requirements of a Home Museum.				
Student provided a clear understanding of the function of a Home Museum.				
Student shared their work successfully.				
Student clearly depicted their Home Museum using grade level descriptive language.				
Student shared their work confidently to the class and were able to communicate with others.				

Common Core Standards

Speaking & Listening

SL.6.4

Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

Speaking & Listening

SL.7.4, SL.8.4

Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

Next Generation Science Standards

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.