

Paper Circuits



SOCIAL-EMOTIONAL CONNECTION: Interdependence **GRADES:** 5th **TIME:** 90 Minutes

INSTRUCTOR EXPERIENCE: Intermediate

OBJECTIVES: How can you reach difficult goals? Students use a diagram to create their own card that will light up.

ESSENTIAL QUESTION: How might we use energy transfer in simple circuits to design and construct a card that lights up?


MATERIALS:

- Book- I Can Do Hard Things
- Paper Circuit Goal Card
- Computer
- Projector
- Cardstock or thick paper for the greeting card
- Copper tape (with conductive adhesive)
- Coin cell battery (e.g., CR2032)
- LED lights (choose your desired color)
- Binder clip or paper clip
- Scissors, tape, and pencil

STANDARDS: [VA STEM](#)
[5.1a-f;5.4b](#)

SCIENTIFIC AND ENGINEERING PRACTICES:

 5.4b: create a model of a simple circuit and explain how it works

 5.4b: create a functioning simple circuit and explain how the circuit works, using appropriate scientific terms

Lesson delivery note: This lesson is designed to take approximately 90 minutes. Adapt the lesson to fit the amount of available time.

INSTRUCTIONS

1. Ask (5 minutes)

Have you ever wanted to give someone a greeting card of some kind, and wanted to *really* impress them? Are you feeling limited with making the same old drawings with a pencil, pen, or marker? Did you know it is possible to create greeting cards that light up?

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How do engineers think creatively to solve difficult problems?

In this activity, you will get to design, customize, and create your own light-up card that is powered with a mini battery, an LED (or multiple LEDs), and a circuit made of copper tape.

2. Research (15 minutes)

Read the book titled, "I Can Do Hard Things."

Hold up the book and ask students to join you for a whole group read aloud.

- Preview the book by showing the cover and a few images.
- Ask students what are some hard things they have done?
- Tell students that they will learn about what people can make in a day—from small to large—and after reading, they will make things just like the characters in the book.
- Ask: How do the people around you impact your attitude, thoughts, and behavior?
- Ask: How can you connect with other people to help achieve your goals?
- Once the story is finished, revisit the question, "How can we reach our goals?"
 - Identify some problems the characters in the book solve or try to solve.
 - Ask students to share examples of how characters in the book solved these problems.

3. Connect to Careers (10 minutes)

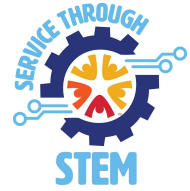
The concept of a "paper circuit design challenge" typically involves creating functional electronic circuits using conductive materials on paper, often paired with LEDs, sensors, or other basic components. This experiment with electronics can be linked to several careers:

- **Electronics Engineer:** Understanding circuit design is fundamental for anyone hoping to enter the field of electronics engineering. Engineers in this field design, develop, and test electronic equipment and systems.
- **[Paper Engineer:](#)** This may sound unusual, but there's a niche for designing intricate paper-based creations, sometimes incorporating electronic components. Such engineers might design elaborate greeting cards, pop-up books, or interactive paper-based products. Check out this video.

4. [Tinker to Discover](#) (10 minutes)

- Distribute circuit goal cards.
 - Discuss SMART goals - how do you write SMART goals?
 - Here is an article about SMART goals: [LINK](#)
 - Add your goals to the goal card

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5. [Build a Prototype](#) (15 minutes)

1. Plan Your Circuit:

- Design the path of the circuit on the back of your card-this will serve as the model for the simple circuit.

2. Apply Copper Tape:

- Place the copper tape over the path. Ensure there are no breaks in the tape. If you need to turn the tape at a corner, fold it at a 90-degree angle to keep it continuous.

3. Position the LED:

- Punch a small hole where there is a mark for the LED position. Push the LED legs through to the front side of the card. Ensure the longer leg (positive) is aligned with the path that will connect to the positive side of the battery and the shorter leg (negative) with the path for the negative side.
- Tape down the legs onto the copper tape path using the copper tape.

4. Insert Battery:

- Place the coin cell battery in the position where it completes the circuit, with the positive side facing up. The LED should light up. If not, check your connections and ensure the copper tape paths are continuous and well-connected to the LED legs.
- To keep the battery in place, you can create a small paper flap or pocket. This flap should press the battery down onto the copper tape to maintain a good connection.

5. Secure the Circuit:

- Use a binder clip or paper clip to press the flap against the battery when you want the LED to light up and remove it to turn the LED off.

6. Finalize Your Card:

- Finish decorating your card as desired. You can add more designs, stickers, or write a special message.

9. [Test & Improve](#) (25 minutes)

● Test Your Card:

- Before giving your card away, test it a few times to ensure the LED lights up consistently and that a functioning simple circuit was created
- Make adjustments to the circuit if needed

Remember, this is a basic design of a circuit, and you can get more complex by adding switches, multiple LEDs, or even sensors if you're feeling ambitious. The key is to ensure that the circuit is continuous and that the positive and negative connections are correctly aligned.

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6. Discuss and Reflect (10 minutes)

After the students test their card facilitate a class discussion by talking about the following questions:

- What did you find most enjoyable or satisfying about this project? Why?
- Was there anything about the paper circuit that surprised you? Explain.
- How do you think advances in flexible or paper-like electronics might impact the future of technology?
- What are some ways that you will make connections between your actions, habits, or friends to reach your goals?
- Have students complete the exit slip

EXTENSION ACTIVITIES

- Distribute the binary puzzle for students to complete
- Organize a showcase where students present their paper circuit and goals, and explain their decisions behind the goal and barriers they faced in making the light work.
- Teach students the difference between parallel and series circuits watching this [video](#).