

Lesson Plan Exploring Paper Circuits

Grade

Grade 4 Social Studies and Science

Topic

Exploring Paper Circuits - European Exploration and Light



Enduring Understanding

- The rewards that were reaped from the exploration of the New World far outweighed the risks that were involved. Students will understand the motivations for exploration and the cause-and-effect relationships between its risks and rewards.
- Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Primary Standards/Indicators

Social Studies

4-1.4 Summarize the accomplishments of the Vikings and the Portuguese, Spanish, English, and French explorers, including Leif Eriksson, Columbus, Hernando de Soto, Magellan, Henry Hudson, John Cabot, and La Salle.

Science

4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.

Secondary Standards/Indicators

Social Studies

4-1.3 Explain the political, economic, and technological factors that led to the exploration of the new world by Spain, Portugal, France, the Netherlands, and England, including the competition between nations, the expansion of international trade, and the technological advances in shipbuilding and navigation.

ELA

6.1 Summarize multi-paragraph texts using key details to support the central idea

Academic Language

Vocabulary

- Motive
- Route
- Obstacle
- Settler
- Insulator
- Conductor
- Reflection
- Refraction
- Absorption



Language Function and Content Objectives

- Explain the motives and accomplishments of European explorers during the Age of Exploration.
- Identify how visibility is related to light.
- Create a map to illustrate how a specific explorer travelled in order to encounter risks and rewards in the New World.
- Utilize paper circuits in order to add light to the map and chart the course of the explorer.

Assessment Plan

- Pre-Assessment-
 - Students are asked to complete a Padlet in which they write one sentence about something important from the Age of Exploration. This can include people, places and events. Students are encouraged to think through everything they have studied and try not to duplicate their classmates ideas.
 - After students have written their ideas, ask them to volunteer to share about a topic that they did not write about. Make corrections as needed but allow students to show what they know and talk about several different ideas in order to activate knowledge.
 - Anticipation Guide - Students should answer each question on the anticipation guide prior to reading the story book.
- Post-Assessment-
 - Students complete the [handout](#) to demonstrate understanding or identify areas of confusion about circuits.
 - Finally, they should answer the after portion of the anticipation guide.
- Criteria for Mastery -
 - Student is able to explain the motives and accomplishments of one European explorer.
 - Student is able to build a simple circuit and show how light interacts during reflection, refraction and absorption.
 - Student is able to create a model circuit.
 - Student can create a map to show where one European explorer traveled.

Materials

- Padlet or Post-Its
- Anticipation guide
- *Explorers Who Got Lost*
- Paper circuits
 - Copper tape
 - 3V coin cell batteries
 - Surface mount LEDs
 - Binder clips
 - Model circuit paper (so students can “trace” circuits)
- Paper materials to make map (cardstock or construction paper)
 - Each student will need one peice of black cardstock
- Crayons, markers, etc.
- Sample circuits
- Magnifying glasses



Teacher Preparation

For this lesson students should be familiar with the concepts of European exploration, as this can be used as a review of the material and an intro to the concept of light as a form of energy. The paper circuits may seem like an intimidating concept but are fairly easy to use. To help alleviate stress, sample circuits have been included in the kit and students will be provided with outlines of the circuit patterns so they know where to place the copper wiring.

It is helpful to have materials set out prior to lesson. The model papers can be helpful so that students can “trace” where to put copper wiring, battery, light, etc.

Meat of Lesson

● Hook

1. Complete the “Before Reading” section of the anticipation guide.
2. Read aloud - Explorers Who Got Lost (**Step 1 can be completed the day before. Additionally, you will only want to read a section of the book. A recommended sample has been marked.**)
 - a. What were some reasons why explorers went to new places?
 - b. Who sent them?
 - c. What were some of the obstacles, or problems, explorers faced?
 - d. What did they accomplish?
 - e. What technology did the explorers rely on?
3. Explain directions-
 - a. “Today you will be learning about the Age of Exploration. Each person will be in charge of learning about an explorer and creating a map that shows where they travelled using light.”
4. Ask students to predict what will happen when light is observed through a magnifying glass. What about when you observed through a piece of paper? Cardstock?
 - a. Allow students to make predictions. You may want to write these on the board.
 - b. Give each table group a magnifying glass. Allow them to make observations in their groups.
 - c. Bring the class back together. What happened?
 - i. *The light passed through a type of transparent material and changed directions. This is called refraction.*
 - d. Light that went through cardstock did not show. This is absorption. Light through the lined paper could still be seen. This is reflection.
5. *You will create maps to show where your explorers went. Your map should include examples of reflection and absorption.*
6. **NOTE** - During the Age of Exploration, people **did not** have access to electricity like we do today. For our maps, we will be using materials that were not available at this time.

● Brainstorm

- Students will be assigned to work in groups and each group will be given an explorer including Leif Eriksson, Columbus, Hernando de Soto, Magellan, Henry Hudson, John Cabot, and La Salle.
- Students will have time to look at the [sample circuits](#) and select one of the options or make up their own. (Included in kit)
- Next, they will read to learn about their explorer.
- Once they’ve selected their model circuit and come up with their notes, they should sketch out the map.



- Using the anticipation guide, they should draw their sketch on the back of the page.
 - The instructor should encourage them to be creative in how they show reflection and absorption.
- **Prototype**
 - Students will work in groups of 3 to create their circuits and should be encouraged to help each other.
 - Each will receive the model paper, 2-3 lights and copper wiring. They will connect these materials.
 - After they've done this, they will create their maps and add decorations to highlight the route. They may cut, paste, draw, etc.
 - Once they've completed their design, students will attach the battery using the binder clip. Again, they should look at the sample circuits to help them see how to do this.
 - Students that struggle with this should be encouraged to work with students that have successfully completed their circuit.
 - Once students have put all of the pieces together, they should test their map. Does the object work? Do the light(s) go on? Is absorption and reflection present? How can it be improved?
 - Instructor should be asking these questions of groups. If anyone finishes early, ask them how they can improve their message.
- **Share**
 - Students show off their maps. Ask them to talk about the explorer's motives, obstacles and accomplishments. They will need to discuss how light interacted with different materials.
 - Each group should be given time to share.
 - Instructor asks for feedback- What went well? What made this challenging?
- **Synthesize**
 - At this time students should be brought back together in a whole group. The instructor will lead a discussion of what was needed for the light to go on. *See discussion guide.*
 - Students should complete the post assessment and after reading on the anticipation guide.

Supports for Student Learning

Accommodations

- **ELs**- Provide labels and written directions for each of the steps. The instructor can also use props to further help students understand major concepts and instructions. Due to the visual and hands-on nature of this lesson, there is little written work but students may use images instead of complete sentences when creating their maps.
- **Grade Level adaptation**- Stencils are provided and groups can be teacher selected to scaffold for those that need more support. Definitions can be introduced and practiced ahead of time. Those that need help writing or explaining their note can substitute words for images and can be paired with other students to develop a script.
- **Advanced students**- Those students who are able to grasp these concepts quickly will be asked to incorporate more intricate circuits in their maps, including adding switches. They will use these to examine how to better control the circuit and make their message more interactive through the use of one or multiple switches.



- **Additional supports-** As needed.

Discussion Guide

Synthesis

- Ask students, “What went well and what was difficult about making the lighted maps?” Allow them to share their answers and see if any talk about how they adapted their messages.
- Your light would not go on until you added the battery. This was held in place with the binder clip. What job does the battery do? (*Provides power to the circuit.*) Do you think you could use something other than the binder clip? (*Yes, this is just a way to hold the battery in place.*)
- Why did we use copper tape in our message? Do you think string or ribbon would have worked just as well? (*No, ribbon or string would not work as well. These are examples of **insulators**. Copper foil is made of copper metal, which is a great material to **conduct** electricity.*)
 - If time, you can test this with the students.
- Did the circuit work when the foil wasn’t touching other foil or the LED light? Can you predict why? (*Think back to what happened when we weren’t holding hands with the energy stick! If the pieces do not all touch, the electricity cannot flow all the way through and the circuit is broken.*)
- What happened if you did not leave a gap for the LED light and ran the copper foil through it? Can anyone predict why? (*The light did not shine. If there is no break, the electricity will “skip” the light and continue to run through the foil. This is known as a short circuit.*)
- What do you think the plus (+) and minus (-) signs mean? Why do you think they need to match in order to make your circuit work? (*These show positive and negative charges. If they do not match, the circuit will not work.*)

More to Explore (Resources)

<https://tinkering.exploratorium.edu/paper-circuits>

https://www.teachengineering.org/lessons/view/cub_energy2_lesson01

<https://learning-in-action.williams.edu/opportunities/elementary-outreach/science-lessons/4th-grade-energy-unit/>

