

PATHWAYS

Unlocking
the Mysteries
of Anesthesia
and the Brain

TEACHING GUIDE

Science and ELA Activities

Investigating Anesthesia and Research Careers

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National Institute of
General Medical Sciences

The Science of Anesthesia: How Scientists Research Mysteries of Pain and Consciousness

Anesthesiology researchers are on the case, working to find answers to questions that have stumped modern medicine for decades! Have your students join in the search for answers.

Objective

Students will develop their literacy in science skills and practice writing for a domain-specific purpose.

NGSS

- **LS1.D** Signal processing in the brain
- **MS-LS1-3** Body subsystems (nervous system)
- **CCC** Science is a Human Endeavor

CCSS Literacy in Science

- **RST.2** Summarize conclusions and central ideas of a text
- **W.4** Produce writing appropriate to task, purpose, and audience

Time

1–2 periods, depending on time allotted to work and peer review

Materials

- ▶ *Pathways* classroom magazine
- ▶ Respond to Anesthesia Research activity sheet
- ▶ Write Like a Medical Detective activity sheet

1 Ask: *If a person were lying here on the floor with their eyes closed (and you could see that they were breathing), what are some of the ways you could test to see whether they were asleep or unconscious?* Prompt for answers like: I could try to wake them (gently shaking or pinching their arm; making a loud noise). I could use observation (are they moving or perfectly still?).

2 Tell students they will be learning more about general anesthesia and how it creates a state of unconsciousness and painlessness in patients who need surgery and other major medical procedures. Contrary to what people may believe, patients who are under anesthesia are not “asleep” and can’t be woken in the conventional way. Although anesthesia is commonly used, there’s a lot we still have to learn about *how* anesthetics produce their effects in the brain. Researchers are at work right now on solving that mystery, so we can use anesthetics in even more effective ways.

3 Explain that anesthesiology researchers are interested in finding out more about the state of unconsciousness, the ways people perceive pain, and the mechanisms in the human body that respond to anesthetics.

4 Distribute the **classroom magazine** and the **Respond to Anesthesia**

Research activity sheet. Have students read the magazine and respond to the questions. Refer to the vocabulary sheet (**scholastic.com/pathways**) as needed.

5 As a class, conduct a brainstorming discussion. If students were researchers in a lab, how might they conduct research to answer questions such as: What is pain? What is unconsciousness? How can pain be measured? Consider possible experiment designs, real and hypothetical tools (e.g., a tool that tracks neurotransmitter activity throughout the brain), and vital signs to measure (e.g., heart rate).

6 Distribute the **Write Like a Medical Detective activity sheet.** Taking on the role of anesthesiology researcher, students will design a research question and a simple study. Encourage them to draw connections to their classroom learning (life sciences, engineering, technology, and applications of science) where possible.

7 Once complete, have students trade proposals and play the role of reviewer. Reviewers should comment on the design of the study and the wider implications of the research. Which questions would they like answered before they grant funding for the project?

Answer Key: Respond to Anesthesia Research activity sheet

1. Surgery was too painful and/or dangerous. General anesthesia makes life-saving procedures possible and contributes to longer, healthier lives.

2. Anesthesiology researchers are seeking to understand pain,

consciousness, and unconsciousness. They want to make anesthesia safer, with fewer side effects, and tailor treatment to individual patients.

Implications for other research: better understanding of central nervous

system, treatment of neurological conditions like epilepsy, alternatives to opioids.

3. EEG, machine learning, neuroengineering [can vary]

4. Varied student responses

Name _____

Respond to Anesthesia Research

Read the *Pathways* classroom magazine, then answer the questions below.

1. Why was surgery considered a “last resort” before the discovery of general anesthesia? Why is the discovery of anesthesia significant?

2. What sorts of things are anesthesiology researchers trying to find out? How might their research have wider implications for other research and health care in general?

3. What kinds of interesting technology, tools, and methods are anesthesiology researchers currently using in their work? List three examples.

4. Choose one of the anesthesiology researchers featured in the magazine. Summarize their research. What are they studying? What are they hoping to achieve? How will their research help people? If you had the chance to interview them about their research to find out more, what questions would you ask?

Write Like a Medical Detective

A *grant*—money given for a particular purpose—often provides the funding needed for scientists to investigate medical mysteries and make discoveries by conducting research. Use the steps below to design and seek funding for your own anesthesiology research project!



1. Choose ONE prompt that interests you most:

- Every day about 60,000 people nationwide have surgery under general anesthesia. Surgery patients range widely in age, genetics, and health, and do not all respond exactly the same to anesthesia.
- After general anesthesia, some patients experience side effects like nausea and confusion.
- After surgery, when anesthesia wears off, some patients feel pain and discomfort.

2. On a separate page, create and fill a planner like the example below about your own research idea.

3. Write a 2–3 paragraph grant proposal, persuading reviewers to fund your research.

My Chosen Prompt	Prompt: "After general anesthesia, some patients experience side effects like nausea and confusion."
Write down the prompt that is most interesting to you. What makes you curious?	I'm curious about: why some patients experience nausea and others do not.
Literature Review	
Research what is already known about your topic.	My research reveals that nausea could be related to dehydration since patients often aren't able to eat and drink in the hours leading up to surgery.
Prior Knowledge	
Make connections to things you already know or are learning about.	I know that leading up to a big race, long distance runners take care to hydrate their bodies well because they can't drink a lot of fluid while running. I know that homeostasis helps to keep fluid levels steady in the human body. I know that thirst and dehydration are related to homeostasis.
Research Question	
What would you like to find out?	Do patients who hydrate well in the days leading up to surgery experience nausea after surgery less frequently than patients who do not?
Study Design	
Explain in simple terms how you plan to test your research question.	My study will compare two groups. Group A will be advised to drink the recommended number of ounces of water per their body weight in the four days leading up to surgery. Group B is the control and will not receive any special instructions. My study will track body fluid homeostasis once a day leading up to surgery, right before surgery, and during emergence from surgery with the help of blood tests. My study will compare reported instances of nausea with body fluid homeostasis data to see if there is a connection.
Tools & Methods	
What will you use?	My study will use a <i>serum osmolality test</i> —which checks levels of sodium and other essential minerals in the blood—as a measure of homeostasis.
Implications	
How could your research help patients or other researchers?	The findings of my research could: <ul style="list-style-type: none"> • provide a simple preventive intervention for postoperative nausea • inspire future researchers to develop easier ways to monitor body fluid homeostasis • help inform research on other patients who experience nausea, such as migraine sufferers and those undergoing cancer treatment