

# Exploring the Science in Our World

Spark your students' curiosity about their world by introducing them to the science of living systems and how its study can improve our health.

## Objective

Students will ask questions and define problems, plan a research project based on focused questions, and demonstrate an understanding of basic science.

## Time

60 minutes

## Materials

- What Is It? video at [scholastic.com/pathways](https://www.scholastic.com/pathways)
- Go on a Science Scavenger Hunt activity sheet
- What Fascinates You? activity sheet
- Vocabulary list at [scholastic.com/pathways/vocablist](https://www.scholastic.com/pathways/vocablist)

**1** Display the following image. Find it in color here: [bit.ly/skinbow](https://bit.ly/skinbow).



After students guess what the image might be, explain that it is a zebrafish scale. Scientists have inserted genes that make cells brightly glow in different colors to highlight different types of cells. Each colored speck is an individual cell.

**2** Play the What Is It? video and have students complete the Go on a Science Scavenger Hunt activity sheet. After students share their thoughts on the video, write one of the following facts on the board.

- People who live in high altitudes have genetic adaptations that allow them to survive in thin air.
- Bacteria on your skin help heal injuries.
- You lose between 30,000–40,000 skin cells every minute.
- If you stretched out the DNA inside one human cell, it would be more than 6 feet long.

**3** Ask students what the fact you displayed makes them wonder about. As a class, compile a list of questions the fact generates. Push students to question the science behind the fact, as well as to consider how the fact could connect to another environment or organism.

**4** Explain that the brainstorm the class just completed is an example of how basic science research begins. Basic science is the practice of figuring out how and why things work (in contrast to applied science, which applies knowledge gained from basic science to make advances in fields like technology or medicine). Science researchers work to uncover the mechanisms and structures that power our world to understand life processes and treat diseases.

**5** Display the other facts from step 2 and distribute the What Fascinates You? activity sheet. Instruct students to develop a basic research plan using one of the facts as a starting place. Allow them to refer to the student magazine for guidance.

**6** Have students share their research plans and challenge their classmates to build on their ideas, generate new questions, or think of alternative applications for their investigations. Acknowledge that there are many different pathways into research questions.

## Using the *Pathways* student magazine

Explain to students that there are many different research

**pathways** within basic science as well as many possible **pathways** to a successful career. As a class, read the researcher profiles in the student magazine. Discuss the researchers' inspiration and interests, and emphasize the importance of students using their own skills and interests to find a career that is the best fit for them. Challenge students to identify quotes from the profiles that align with a growth mind-set (the belief that abilities can be developed through hard work and resilience). Discuss how a growth mind-set can serve students now. Emphasize the fact that the study, teamwork, and critical-thinking skills that students are developing right now can be the basis for a future career in STEM research.

Answers to "Cool Tools in Science" student magazine quiz: Image 1: Gel Electrophoresis, Image 2: Cryo-Electron Microscopy, Image 3: Confocal Microscopy.

# Exploring Research Tools

Have your students design an experiment in their “dream” lab and explore the real-life toolsets of research scientists.

## Objective

Students will define a scientific question that impacts people or the natural environment, identify the research tools needed to plan an experiment, and carry out an investigation.

## Time

60 minutes (plus time to complete experiments)

## Materials

- ▶ Timer
- ▶ Equip Your Science Lab activity sheet
- ▶ Vocabulary list at [scholastic.com/pathways/vocablist](http://scholastic.com/pathways/vocablist)
- ▶ What Is Basic Science? video at [scholastic.com/pathways](http://scholastic.com/pathways)

**1** Set a timer for three minutes. Ask students to complete a quick drawing of a science lab. Have volunteers describe their pictures. What sorts of research tools have your students included in their sketches?

**2** Lead a class brainstorm to build a list of tools and supplies scientists use in their research and experiments. Capture the list on the board. Encourage students to think beyond the typical beakers, test tubes, and microscopes that often come to mind and prompt for ideas such as: pipette, telescope, notebook, graduated cylinder, camera, ruler, goggles, autoclave, burner, thermometer, tongs, vortex mixer, gloves, computer and software, electric field for gel electrophoresis, centrifuge, vacuum, and colorimeter. Hand out the vocabulary list and instruct students to complete the following task.

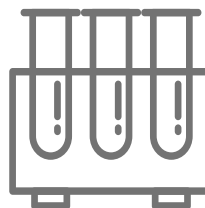
- a. For middle school students: Have students work in small groups to sort or categorize the tools. Suggest categories such as: observation tools, manipulation tools (for mixing, heating, or cooling), measurement tools, recording tools, safety tools (for protection). Invite groups to add more tools to their categories as they work.
- b. For high school students: In small groups, have students generate a list of some advantages and limitations of a few tools. Or, have students consider what substitute tools they could use if they don't have access to expensive, sophisticated tools, and how their experiment results would be similar or different (same but faster? less exact? etc.).

**3** Show the What Is Basic Science? video. Reinforce with students that basic scientists ask a lot of questions and study a range of subjects. Distribute the Equip Your Science Lab activity sheet. Ask students to select one of the scientific research questions (or another of their choosing), design an experiment to find answers, and consider the tools they would use to conduct their experiment. They should use additional sheets of paper as necessary for their work.

**4** Ask students to share their experiment designs and tool lists in small groups. Encourage them to build on each other's ideas and make suggestions for each other's experiment designs. Can groups think of possible practical applications that would arise from their experiments?

## EXTENSION

Conduct an experiment in your class. Have students take notes on the tools they used and questions that evolved during the experiment. Instruct students to write a short description assessing how well the tools functioned, what tools they would use in the future, and what questions and/or next steps that arose from the experiments.



# Small Cells, Big Findings

Bring your students down to the molecular level and uncover cool findings and applications for emerging cellular research.

## Objective

Students will reflect on informational text and conduct inquiry to gain a greater understanding of what can be learned from the cellular subsystems of research organisms.

## Time

60 minutes

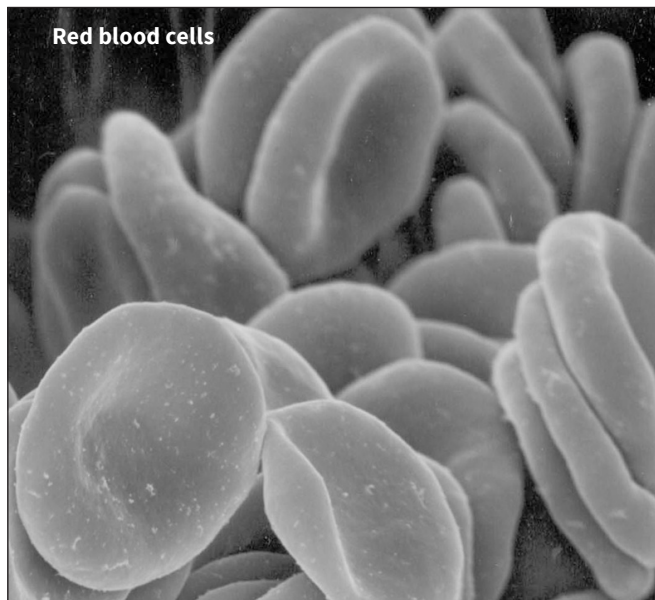
## Materials

- ▶ Uncover the Secrets of Cells activity sheet
- ▶ Vocabulary list at [scholastic.com/pathways/vocablist](https://www.scholastic.com/pathways/vocablist)
- ▶ The Fascinating Cells of Research Organisms video at [scholastic.com/pathways](https://www.scholastic.com/pathways)

**1** Show the video and discuss research organisms. Include the following points:

- a. Much of what we know about biology comes from studying research organisms.
- b. A research organism can be any creature that scientists use to study life, from single-celled organisms, like bacteria, to more complex animals like mice.
- c. The most valuable research organisms have a genetic makeup that is similar to humans or behave in a manner that allows scientists to make important comparisons to the functioning of human cells.
- d. Because of genetic, cellular, or other similarities, researchers can learn more about human function and health by studying research organisms.

**2** Distribute the Uncover the Secrets of Cells activity sheet. Ask students to read the passages and answer the focused reading question: Why do scientists study cells?



**3** Introduce the culminating challenge. Using the information from their activity sheets, students will create an infographic, a quiz, or a set of fun-fact flash cards that could be featured online to help kids learn more about cells, research organisms, and the possible human health applications of scientific research on cells. Generate a list of success criteria together on the board. Prompt for ideas such as: fun to read or use, easy for younger students to read and understand, and/or includes accompanying illustrations.

**4** Have students share their infographics, quizzes, and flash cards with one another in small groups.

### Supporting All Learners

Have older students do additional research to profile research organisms that were not included in the reading passage. Encourage them to explore and expand on ideas such as circadian rhythm, regeneration, CRISPR, DNA chip, and gene sequence.



# Exploring the Research Path

**The field of scientific research is filled with people with varied backgrounds and skill sets. Expand student perspectives on science careers.**

## Objective

Students will conduct a short research project on a science career of their choice and consolidate their findings in writing.

## Time

60 minutes

## Materials

- ▶ Timer
- ▶ Try on a Science Career activity sheet
- ▶ Vocabulary list at [scholastic.com/pathways/vocablist](https://www.scholastic.com/pathways/vocablist)
- ▶ What's the Connection? video at [scholastic.com/pathways](https://www.scholastic.com/pathways)

**1** Set a timer for two minutes. Ask students to quickly sketch a picture of a scientist. Ask volunteers to share and describe their drawings. Facilitate a class discussion to help debunk common stereotypes such as the “mad scientist” (older, perhaps male), that scientists are geniuses, or that they “have a gift.” Other misnomers: Scientists always make “lucky” discoveries during eureka moments, or they always work long hours alone in a lab.

**2** Show the What's the Connection? video and lead a discussion about the different skill sets and careers in basic science research. Be sure to include the fact that in addition to scientists, scientific research requires people who can illustrate, organize, manage, write, and communicate effectively. These creative, logistical, and interpersonal skills are essential to successful research projects.

**3** Distribute the Try on a Science Career activity sheet and invite students to “try on” the roles of molecular animator, lab coordinator, and microbiologist. After they complete the sheet, have them reflect on the experience with a partner: What skills did they use for each job? Did any of the skills or jobs interest them? Why or why not? What kind of skills or jobs might they be interested in?

**4** To wrap up the lesson, have students conduct a short research project to find out more about a science career of their choice (See the Career Bank for ideas). During their research, students

should uncover core job duties, desired skill sets, and education requirements. Students should consolidate their research into the format of a job posting.

**5** Hang completed job postings in the classroom and ask students to explore the postings their classmates have created. Ask students to jot notes as they visit the postings and be prepared to identify the careers they think they would be good at or would enjoy, as well as the careers they want to learn more about.

## Career Bank

Forensic scientist, market research analyst, meteorologist, bacteriologist, technology specialist, science writer, microbiologist, simulations designer, geneticist, science educator, chemist, chronobiologist, science liaison, research scientist, epidemiologist, scientific illustrator, cytologist, lab coordinator, science animator, data analyst/scientist

### Activity Sheet Answer Key

**Lab Coordinator Autoclave pressure chamber:** AM: A, A, A, A, A PM: B, B, D, B, C; **Incubator:** AM: C, C, C, C, D PM: C, C, C, C, B; **Centrifuge:** AM: B, B, B, B, B PM: A, A, D, D, D

**Microbiologist** Irregular/coarse cell shape, multiple nuclei, nucleoli, smaller area of cytoplasm

### Supporting All Learners

During science career research, have older students find college or post-secondary programs related to their chosen career. Encourage them to interview guidance counselors for more information on educational pathways to science careers.



Name \_\_\_\_\_

## Equip Your Science Lab

Design an experiment to answer one of the questions below. Then choose the research tools you'd need to conduct your experiment.

### Research questions

- ▶ Which surfaces in the classroom have the most bacteria?
- ▶ Is there a way to slow the molding and decay of fruit?
- ▶ Is there a correlation between my body temperature and the time of day?



### My question

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**Gather information** What do you already know? What don't you know? Do some research into existing experiments.

**Form a hypothesis** Create an informed prediction. Use an if/then statement. Example: If I increase ambient temperature, then enzymes will work more quickly.

**Design your experiment** What procedure will you follow? How do you plan to measure, observe, and analyze outcomes?

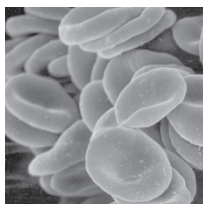
**Tools at school** Which tools would you use if you were asked to conduct research at school? Example: Tools and materials that are readily available with low to no cost. How will each of the tools be used in your experiment?

**Design your dream lab** Which tools would you use if you were asked to conduct research in your "dream" lab? How would each of the tools be used in your experiment?

# Uncover the Secrets of Cells

Read these passages below. Then answer the critical-thinking question at the end.

## Humans have more than 200 types of cells.

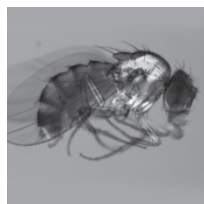


Red blood cells carry oxygen. White blood cells defend against germs. Intestinal cells release molecules that help digest food. Nerve cells send messages that produce

thoughts and movement, and heart cells contract in unison to pump blood. A person's genes help create proteins that carry out specialized tasks for each cell. But sometimes things malfunction. If the genes inside a cell change or "mutate," a cell may have difficulty dividing, making proteins, removing waste, or performing its job properly. These mutations can lead to defects and diseases.

## Fruit flies heal wounds with supersize cells.

If a human falls and scrapes their knee, cells around



the injury divide and grow until a scab forms to cover the injury. Fruit flies on the other hand, heal with the help of polyploid cells, giant cells that grow to cover the entire

site of the injury. Research scientists are interested in the fruit fly's strategy for healing because it may help humans who suffer from non-healing wounds.

## Flatworm cells have superpowers.

Humans have the capacity to repair and regenerate



some parts of their bodies with the help of a few types of cells.

Though we can regenerate blood and skin cells and regrow cells to repair our intestinal lining,

we are not able to replace a limb or regrow an organ that has been severed. The flatworm, however, has dividing cells called neoblasts which allow it to regrow an entire body from a single cell. If a flatworm is cut in half, the tail end can grow a new head and the head end can grow a new tail! Research scientists are interested in the flatworm's regenerative powers to see if something similar might help humans recover from physical damage.

## Lamprey cells take out the trash.

Though human cells turn genes "on" or "off" to



regulate their function, every cell in the human body will maintain its particular genes from birth to death. This is not the case for the lamprey fish, which discards

20 percent of its DNA while still at the embryo stage and continues to undergo programmed genome (the complete set of genetic information in an organism) rearrangement throughout its lifetime. Research scientists are interested in the lamprey's ability to discard DNA from its cells because it may be protecting the animal from disease. Lamprey cell function may hold clues about how to cure human diseases like cancer.

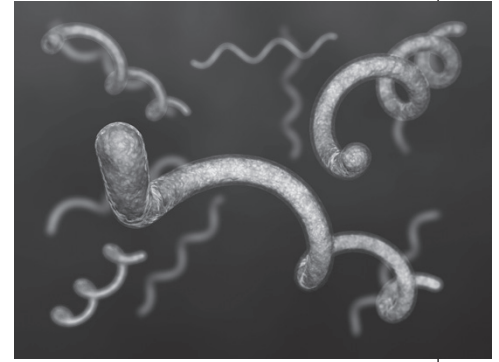
### Think It Through

On a separate piece of paper, give a focused and detailed response to the following question: **Why do scientists study cells?** Your answer should include evidence from the text.

Name \_\_\_\_\_

# Try on a Science Career

Follow the instructions to explore the roles of three careers in science research.



Above: Spirillum bacterium

**1. Molecular Animator (creates animated visualizations of the inner workings of cells)** Using the description below, draw three images in sequence to create a storyboard that shows how you imagine spirillum bacterium looks and moves.

**The spirillum has a long, spiral body. It has tufts of flagellum (thread-like tails) at each end that it often uses to swim in a corkscrew-like fashion.**

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## 2. Lab Coordinator (responsible for coordinating activities in a science lab)

Create a schedule to manage the equipment requirements for this week's experiments.

**Experiment A needs:** centrifuge twice a week in the afternoon; autoclave every morning

**Experiment B needs:** autoclave three times a week in the afternoon; centrifuge every morning; incubator 1/2 day a week

**Experiment C needs:** autoclave 1/2 day Fridays; incubator all day Monday to Thursday

**Experiment D needs:** autoclave 1/2 day Wednesdays; centrifuge Wednesday, Thursday, and Friday afternoons; incubator Friday morning

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Autoclave pressure chamber	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM
Incubator	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM
Centrifuge	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM

## 3. Microbiologist (a scientist who studies microscopic organisms including bacteria, algae, and fungi)

Look at the illustrated sample the microscope is magnifying. Identify the irregular cell or cells. Describe the irregularities.

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