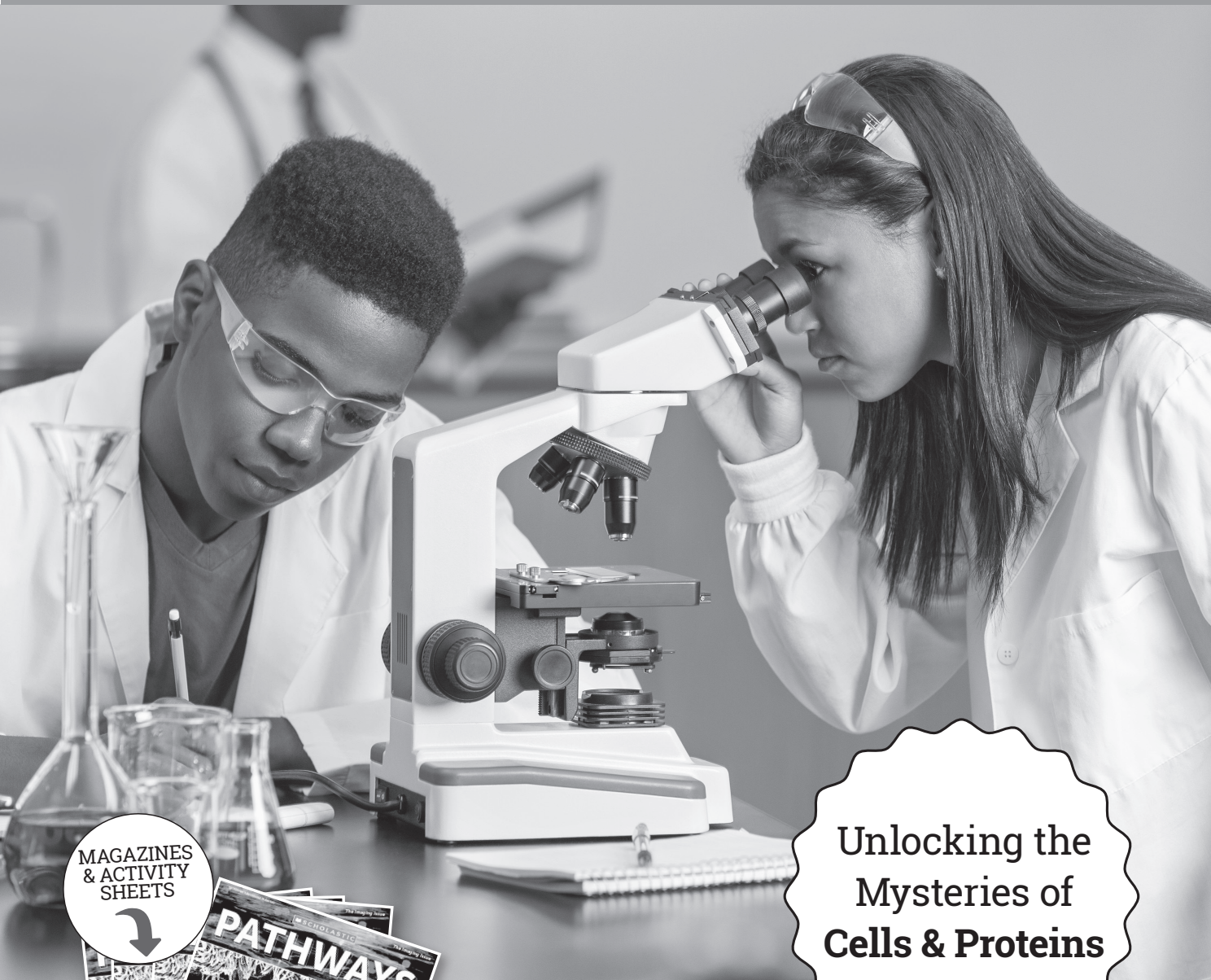


# PATHWAYS



MAGAZINES  
& ACTIVITY  
SHEETS



Unlocking the  
Mysteries of  
Cells & Proteins

## TEACHING GUIDE

About Microscope Technologies,  
Biological Discoveries, and Research Careers

Visit [scholastic.com/pathways](http://scholastic.com/pathways) for  
additional lessons, videos, and more.

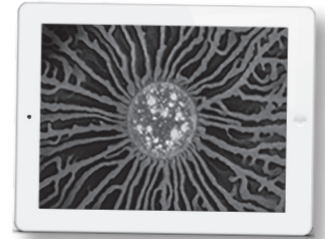
BROUGHT TO YOU BY:



National Institute of  
General Medical Sciences

# A Closer Look at Scientific Imaging

Discover the stunning images created with advancing microscope technologies. Then have your class create a gallery of colorful scientific illustrations of their own.



## Objective

Students will model cell parts and functions, plus learn about technologies used to capture cellular and molecular structures.

## NGSS Standards

### Grades 6–8

**MS-LS1-2.** Model a cell's parts and its function.

### Grades 9–12

**HS-LS1-4.** Model the process of mitosis.

**HS-PS4-5.** Communicate how technological devices use waves to transmit and capture information.

## Time

60 minutes

Allow extra work periods to complete scientific illustrations and imaging research projects.

## Materials

- ▶ Pin (or image of a pin)
- ▶ *Pathways* student magazine
- ▶ Create a Scientific Illustration activity sheet
- ▶ Research Imaging Tech activity sheet
- ▶ Imaging Resource sheet ([bit.ly/imagingresource](http://bit.ly/imagingresource))

## PART A

- 1 Hold** up a pin. Ask students how many cells they think could fit on its head. Reveal that about 10,000 cells can fit on the head of a pin.
- 2 Ask:** What kinds of challenges might researchers and structural biologists encounter when studying cells, proteins, molecular structures, or their atoms? Prompt for ideas like: size (too small to be seen without the help of imaging technology), appearance (can be translucent or require staining to visualize), and movement (a biological process could be moving too fast to capture, or the requirements of the imaging technology could kill the specimen, stopping the biological process).
- 3 Distribute** and have students explore the themes in *Pathways* student magazine.
- 4 Have** students read the main text on pages 2–3. After they read, ask them to quickly sketch one of the imaging processes they read about. In small groups or as a class, have them discuss their sketches and collaborate to deepen their understanding of the processes.
- 5 Direct** students to complete the caption activity on the last page of the magazine. Have them consider advancements like 3D imaging and time-lapse imaging and make connections to ongoing lessons. For example, how might these techniques

## Inside an Imaging Lab

Meet STEM pros who work with exciting imaging technology:  
[scholastic.com/pathways/techlab](http://scholastic.com/pathways/techlab)

compare with static 2D images in helping students better visualize energy production in mitochondria or the process of mitosis?

- 6 Discuss** the career profiles on the bottom half of the last page. Have students imagine they are a structural biologist or molecular animator with access to high-powered microscopes. Ask: *What would you want to study?*
  - 7 Distribute** and have students complete the Create a Scientific Illustration activity sheet, referring to the Imaging Resource sheet if needed. (You may wish to assign Challenge A for middle schoolers and Challenge B for high schoolers.)
  - 8 Hang** or compile completed student diagrams for a physical or digital gallery walk. Have students take in and respond to one another's work.
  - 9 Extend** the learning for high school students. Distribute the Research Imaging Tech activity sheet. Once research projects are complete, have students present or share their work in small groups.
- .....
- ANSWER KEY** Caption Challenge in the student magazine: cell; cell division; cytoskeleton; DNA; neuron



## ◀ Protein Alphabet

Researchers have found a protein in the shape of every letter of the alphabet! Have high schoolers play with the protein alphabet at: [bit.ly/proteinABC](http://bit.ly/proteinABC) or, for middle schoolers, project and play with the alphabet together as a class!

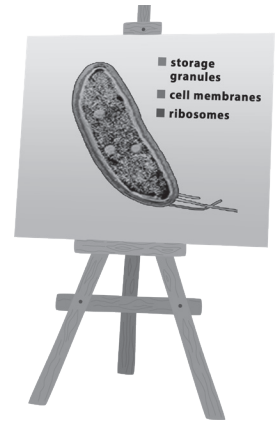
Name \_\_\_\_\_

## Create a Scientific Illustration

**Staining is a technique biologists can use to better visualize cells, their components, and their functions under a microscope.** Researchers can “label” parts of biological specimens with different dyes to add *color* (in microscopes that use light) or *contrast* (in microscopes that use electrons).

A few examples of staining:

- › **Crystal violet** can be used to tint cell walls purple.
- › **Nile blue** can stain a cell’s nucleus blue.
- › **Green fluorescent protein (GFP)** can be used to label organelles and proteins a glowing green.



In addition, when scientists combine photos to create a 3D model of a specimen, they may add color to the illustration (known as colorizing) to help viewers differentiate the parts.

## Colorizing Cells

Give the colorizing concept a try for yourself. On a separate piece of paper, complete challenge A or B.

**Optional:** Access the Imaging Resource at [bit.ly/imagingresource](http://bit.ly/imagingresource) to check out brightly colored examples of staining and colorizing.

### CHALLENGE A

Create an eye-catching visual aid that helps its viewers understand the function of a cell and the ways parts of cells contribute to its function.

- ⇒ **Draw** a diagram of a bacterium or a plant or animal cell.
- ⇒ **“Stain”** each component of the cell structure a different color.
- ⇒ **Create** a key to link your chosen stain color with each cell component.
- ⇒ **Provide** a brief explanation of the function of each cell component.

### CHALLENGE B

Create an eye-catching visual aid that helps its viewers better understand the process of mitosis (cell division).

- ⇒ **Diagram** the stages of mitosis.
- ⇒ **“Stain”** centrioles, chromosomes, centromeres, the nuclear membrane, and the cell membrane different colors.
- ⇒ **Create** a key to link your chosen stain color with each cell component.
- ⇒ **Provide** a brief, written explanation for each stage of the process.

## Think About It

1. What are the advantages of adding color to an image of a microscopic specimen?

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2. What are the limitations of looking at single, static photographs of cells to understanding biological processes?

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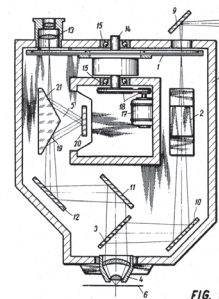


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# Research Imaging Tech

Learn more about the imaging technologies researchers use to make basic science and structural biology breakthroughs. Plus, explore some of the educational and career pathways that have led researchers to their areas of study.



Drawing of the first commercialized confocal microscope: the tandem scanning microscope, developed by Mojmír Peřáň

FIG. 2

## 1 / SELECT the imaging technology of your choice or one from the list below.

- |  |  |   |
|--|--|---|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> Confocal Laser Scanning Microscope</li> <li><input type="checkbox"/> Scanning Electron Microscope</li> <li><input type="checkbox"/> Scanning Tunneling Microscope</li> <li><input type="checkbox"/> Cryo-Electron Microscope</li> <li><input type="checkbox"/> Lattice Sheet Microscope</li> <li><input type="checkbox"/> Fluorescence Microscope</li> </ul> | <p>.....</p> <p>.....</p> <p>.....</p> | <ul style="list-style-type: none"> <li><input type="checkbox"/> X-Ray Crystallography</li> <li><input type="checkbox"/> Raman Spectroscopy</li> <li><input type="checkbox"/> Nuclear Magnetic Resonance (NMR) Spectroscopy</li> <li><input type="checkbox"/> Cryo-Electron Tomography</li> <li><input type="checkbox"/> Digital Scientific Illustration or Animation (3D or 4D Modeling)</li> </ul> |
|--|--|---|

## 2 / CONDUCT research to find out:

- ⇒ How the technology works
- ⇒ Which fields of study it's used in
- ⇒ The imaging result it produces (example: 3D model, molecular-level resolution, etc.)
- ⇒ Examples of specific images it has produced
- ⇒ Major milestones or discoveries associated with the technology or its advancement
- ⇒ How it can be used to learn more about life or human health
- ⇒ Types of careers that use this imaging technology



## 3 / PACKAGE and PRESENT your research findings using the method of your choice:



Create a handy **user manual** or **guide**, with images.



Write a **blog post** or design an informative **webpage**.



**Storyboard** or create a **short video** for presentation to your class.



Write a **journal entry** or **letter** to yourself or a friend.