

TEACHER GUIDE

A Look inside the Lab: Microscopes

OVERVIEW

The VMP Next Step Science resources provide mini lessons, videos, and other materials related to the practice of science. These resources are meant to enhance the exploration of a particular topic or offer insights into the profession of scientific research.

The Next Step Science “A Look inside the Lab” series is comprised of reading passages and videos designed to introduce students to pieces of laboratory equipment and the scientists who use them. The series can be used to enhance an existing lesson or as a starting point for introducing a concept.

Each mini lesson will include:

- Short video featuring scientists from the Children’s Hospital of Philadelphia Research Institute discussing their work and how they utilize the lab equipment on a day-to-day basis
- Related reading passage
- Teacher guide
- Student worksheet

Additional VMP “A Look inside the Lab” videos and materials can be found at vaccinemakers.org/next-step-science.

OBJECTIVES

“A Look inside the Lab” series activities are designed to:

- Introduce students to equipment commonly used in medical research laboratory settings and explore how the technology impacts and serves society
- Introduce students to scientists, science careers, and the types of investigations that scientists conduct on a day-to-day basis
- Provide an opportunity for students to read informational text about scientific topics, enhance their understanding of how science is done, and consider how scientists develop possible solutions to problems

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LESSON RESOURCES

- Magnified images for “engage” section matching game:
 - Magnified images student game sheet:
https://vaccinemakers.org/sites/default/files/resources/Look_Lab_Microscopes_magnified_images_student_game_sheet_FINAL.pdf
 - Student game sheet without images:
https://vaccinemakers.org/sites/default/files/Look_in_Lab_Microscopes_magnified_game_sheet_without_images_FINAL.pdf
 - Game images in Power Point slideshow format:
https://vaccinemakers.org/sites/default/files/Look_in_Lab_Microscopes_magnified_images_slideshow_FINAL.pptx
 - Game images slideshow in PDF format:
https://vaccinemakers.org/sites/default/files/Look_in_Lab_Microscopes_magnified_images_slideshow_PDF_FINAL.pdf
- Lesson video, *A Look inside the Lab: Microscopes*, <https://vimeo.com/527278642>
- Video transcript PDF:
https://vaccinemakers.org/sites/default/files/resources/Look_Lab_Microscopes_video_transcript_FINAL.pdf
- Reading passage, *How the Microscope Advanced Understanding of Sickle Cell Disease*,
https://vaccinemakers.org/sites/default/files/resources/Look_Lab_Microscopes_reading_passage_FINAL.pdf
- Student worksheet:
https://vaccinemakers.org/sites/default/files/resources/Look_Lab_Microscope_worksheet_FINAL.pdf
- Student activity sheet, Microscope Diagram Review (Activity 1), for “evaluate” section:
https://vaccinemakers.org/sites/default/files/resources/Look_Lab_Microscopes_Activity1_FINAL.pdf

LESSON

The lesson progression outlined below can be completed in one 90-minute class or be split over two class periods.

Engage

Time: 10-15 minutes

Have students:

- Look at the magnified images on the game sheet and match each one with its name from the image list. This can be done as a class, individually, or in small groups. You

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may wish to have teams of students compete to see which group can identify the most images correctly.

Explore

Time: 10-15 minutes

Have students

- Watch the short video, *A Look inside the Lab: Microscopes*.
- Read the passage, “*How the Microscope Advanced Understanding of Sickle Cell Disease*.”

Explain

Time: 15-20 minutes

Have students:

- Complete the student worksheet, which includes “think about it” questions.

Elaborate

Time: 20-30 minutes

Have students:

- Conduct research to learn more about how a specific type of microscope works.
- Draw a diagram that they could use to explain how the microscope functions to a younger child, parent, or grandparent.
- This part of the lesson could also be completed outside of class.

Evaluate

Time: 15-20 minutes

Have students:

- Work in pairs or groups to share their diagrams and review each other’s effort for accuracy, ease of explanation, neatness, and following directions using the rubric in the Microscope Diagram Review sheet (Activity 1).
- Have students share and discuss their feedback with each other.

Extension (Optional)

Time: 20-30 minutes

Have students:

- Conduct research about how scientific understanding about sickle cell disease (SCD) has continued to evolve over time. (Teacher note: Instead of having all students research SCD, you may wish to assign an assortment of diseases to the class, or let students choose a disease to research.)
- Draft a short paragraph discussing advancements related to the diagnosis and treatment of the disease they researched.

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Answer key list for correctly matched lettered name to image number.

Following the list, we have provided a key in grid form, which also contains each image source URL from the [CDC's Public Health Image Library \(PHIL\)](#).

- A.** Coronavirus particles 7
(human coronavirus 229E)
- B.** African eye worm 14
- C.** *Bacillus anthracis* bacteria 9
- D.** Mosquito egg mass 10
- E.** Red blood cells 13
- F.** Tick 16
- G.** *Enterococcus faecalis* bacteria 3
- H.** Ebola virus 5
- I.** White blood cells (leukocytes) 15
- J.** Flea 2
- K.** Influenza virus particles 1
- L.** Tapeworm 11
- M.** *Mycobacterium tuberculosis* bacteria 4
- N.** T cell infected with HIV 6
- O.** Mite 8
- P.** MERS-CoV virus particle 12
(Middle East respiratory syndrome)

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<p>1 - K Influenza virus particles https://phil.cdc.gov/Details.aspx?pid=11702</p>	<p>2 - J Flea https://phil.cdc.gov/Details.aspx?pid=23286</p>	<p>3 - G <i>Enterococcus faecalis</i> bacteria https://phil.cdc.gov/Details.aspx?pid=12803</p>	<p>4 - M <i>Mycobacterium tuberculosis</i> bacteria https://phil.cdc.gov/Details.aspx?pid=18139</p>
<p>5 - H Ebola virus https://phil.cdc.gov/Details.aspx?pid=23186</p>	<p>6 - N T cell infected with HIV https://phil.cdc.gov/Details.aspx?pid=18143</p>	<p>7 - A Coronavirus particles https://phil.cdc.gov/Details.aspx?pid=15523</p>	<p>8 - O Mite https://phil.cdc.gov/Details.aspx?pid=5447</p>
<p>9 - C <i>Bacillus anthracis</i> bacteria https://phil.cdc.gov/Details.aspx?pid=1819</p>	<p>10 - D Mosquito egg mass https://phil.cdc.gov/Details.aspx?pid=21846</p>	<p>11 - L Tapeworm https://phil.cdc.gov/Details.aspx?pid=22124</p>	<p>12 - P MERS-CoV virus particle https://phil.cdc.gov/Details.aspx?pid=18108</p>
<p>13 - E Red blood cells https://phil.cdc.gov/Details.aspx?pid=2713</p>	<p>14 - B African eye worm https://phil.cdc.gov/Details.aspx?pid=21308</p>	<p>15 - I White blood cells (leukocytes) https://phil.cdc.gov/Details.aspx?pid=10614</p>	<p>16 - F Tick https://phil.cdc.gov/Details.aspx?pid=14477</p>

RUBRIC: STUDENT WORKSHEET

1. List at least one fact about each microscope type listed in the table.

Student answers may vary, but might include the following:

Simple	Uses light for illumination, uses single lens for magnification, has eyepiece
Compound	Uses light for illumination, uses multiple lenses for magnification, has eyepiece, has light source on bottom and lenses on top
Inverted	Uses light for illumination, uses multiple lenses for magnification, has eyepiece, has light source on top and lenses on bottom, has larger space for samples (e.g. can fit a specimen flask)
Digital	Uses light for illumination, uses a computer and screen, may have additional functionality such as being able to record images or count the number of cells in a sample
Confocal	Uses lasers for illumination
Electron	Uses electrons for illumination, can magnify extremely small objects

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2. List two ways you think microscopes can be of use in a laboratory.

Answers may vary. Sample responses may include:

- Monitor cell health/growth when growing cells in a lab for study
- Inspect samples from people or animals (blood, stool) for pathogens or other indication of disease (like sickle-shaped blood cells)
- Inspect water samples to determine which microorganisms are present

3. Give one example of how microscopes have helped people better understand the world (other than sickle cell disease).

Answers may vary. Students should be able to articulate that magnifying items allows scientists and healthcare providers to see molecular structures and allows for observation of organisms that are otherwise invisible to the naked eye.

4. Other than the medical field, describe how you think microscopes could be important in another field of biology (e.g., botany, geology, paleontology, archeology, forensic science, etc.)

Answers may vary. Sample responses may include:

- Botany – look at the structure of plants on a cellular level, inspect soil/water samples to assess the health of the ecosystem where a plant is located
- Geology – determine what minerals/elements a rock fragment is composed of
- Paleontology – examine bone fragments for indicators about a dinosaur’s environment, diet, age
- Archeology – determine what materials were used to make tools or other artifacts
- Forensic science – examine evidence (such as hair, soil, carpet threads) that could connect a person/vehicle to a crime

5. Answer one of these questions about Herrick and Irons:

- a. Why do you think Herrick chose not to give Irons credit on the scientific paper he published? Do you think his choice was justified? Why or why not?
- b. If you were Herrick, how would you have handled Irons’ discovery?
- c. If you were Irons, how would you have felt when you found out about Herrick’s paper? What would you have done?

Answers may vary. Students should articulate why they think a certain aspect of the situation would or would not be warranted.