

# Get the Scoop on the Scope

6<sup>th</sup>- 12<sup>th</sup> Grade

Lesson Plan by DeAnna Lee-Rivers, MA Ed.

## DURATION

Pre-Visit: 30-50 minutes

Visit: 20 minutes

Post-Visit: optional

## LOCATION

Scanning Electron Microscope (SEM) Lab  
in the Gem & Mineral Hall

## SUPPLIES

- [Pre-Visit & Post-Visit Slides](#)
- Worksheets ([English](#) & [Spanish](#))
- Writing utensil
- Clipboard (optional)

## STANDARDS

### NGSS

HS-PS4-5

### S+E Practices

1, 5, 6, 8

### Crosscutting Concepts

Influence of Science, Engineering,  
and Technology on Society and the  
Natural World (MS-ETS1-1, HS-ESS3-3)

### CCSS ELA

WHST.9-12.2

## VOCABULARY

- SEM
- Electron
- Resolution

## Overview

Museum researchers use the Scanning Electron Microscope (SEM) to zoom in on tiny specimens and learn about worlds they otherwise wouldn't be able to see. Now you too can view these worlds in the SEM Lab! Follow along with the worksheets (available in [English](#) and [Spanish](#)) to discover how the technology works, learn how a specimen is prepared for viewing, and meet some of the scientists using the SEM to advance their fields of research.

## Concepts

- Scanning Electron Microscopes are powerful tools that work by directing a focused beam of electrons over the surface of a sample to create an image.
- Magnification allows us to see an enlarged image of a specimen and increases the resolution: our ability to see details of a specimen or sample.
- The SEM helps us to see objects at magnifications as low as 40x to as high as 100,000x! Light microscopes have a maximum magnification of only around 1,000x.
- The Natural History Museum of LA County is unique in that it is an active research site—a place where scientists work to expand their understanding of the world.

## Objectives

- Students will be able to explain how the SEM works.
- Students will understand the scale of SEM magnification.
- Students will be able to imagine what types of applications SEM technology has for the future.

## Outline

1. Facilitate a discussion with your class on the SEM and its applications by presenting the [Pre-Visit Slides](#).
2. During a trip to the Museum, explore the SEM lab and complete the worksheets (available in [English](#) and [Spanish](#)).
3. You may expand your learning with activities and conversation starters from the [Post-Visit Slides](#) and Post-Visit content at the end of this lesson plan.

## Pre-Visit

A **Scanning Electron Microscope** (SEM) is a powerful instrument that uses electrons to create a detailed image of incredibly small specimens. Present the [Pre-Visit Slides](#) to your class to provide students with a foundation for their trip to NHM and exploration of the SEM Lab.

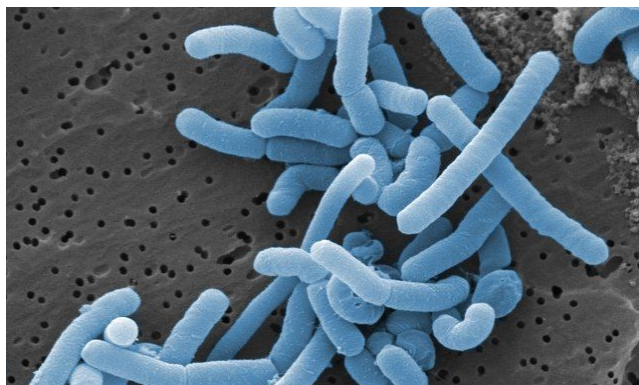
## Visit

During a field trip to NHM, take some time to investigate the SEM Lab. You may split your class into small groups or have students work individually to complete the Get the Scoop on the Scope Worksheets (available in [English](#) and [Spanish](#)). Note that there are two versions—A & B—which will allow your class to occupy the space efficiently.

## Post-Visit

SEM technology has changed the way we look at the world and helped solve problems that we weren't able to before. The best part is that we are able to imagine new possibilities for the future! Go through the [Post-Visit Slides](#) and consider the ideas below in your discussion on this question: **How could SEM technology be useful for your community?**

- Here are some ideas:
  - Particulate matter and air quality - What size are the particles floating in our air? These particles (dust, soot, fibers, etc.) are considered pollutants and can get trapped in our lung tissue.
  - Disease diagnosis at cellular level - How could we use the SEM to investigate and diagnose disease such as cancer?
  - Distinguishing between the good and bad bacteria in your body - Some bacteria can invade our cells and make us sick. How does microscope technology help us tell them apart? Consider the following two images of bacteria; Which of the two types of bacteria would move faster through our system?

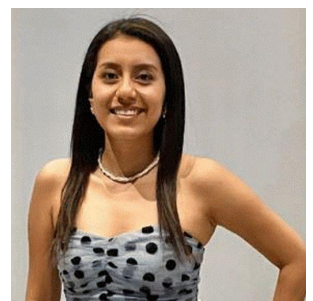


Left: Lactic acid bacteria which keeps our immune system strong; Right: *E. coli* which makes us sick.  
**Please note:** Images have been colorized after SEM imaging. SEM microscopes produce images in grayscale.

## Variation & Extension Ideas

In order to continue engaging with the exhibit and exchanging ideas, you will find additional resources below. Feel free to pick and choose which of these resources you would like to use.

- **Draw a picture** of an organism or item that you would like to see under an SEM. Perhaps consider organisms living in or on our own bodies such as gut bacteria and face mites on skin.
- **Create-A-Creature:** Choose an SEM image of an organism that looks especially interesting to you. Create a life story for that organism. Get as creative as you possibly can and use these questions to get started:
  - What type of organism is it?
  - What does it eat?
  - Where does it live and how does it interact with other organisms?
- **Opportunities for Research:** Further investigate a topic related to SEM that you find interesting. Prepare your findings in an essay or report. Here are some example topics:
  - Why are samples coated in a thin layer of gold? Describe the process. Why not use another metal?
  - Explore discoveries or research that used different types of microscopes as tools. Why might one be used over the other? Explain.
  - Which scientific advancement or discovery made with the SEM is most interesting to you? Why?
- **Diversity in the field of SEM research:** There are scientists from many different backgrounds who have contributed to SEM advancements and who use the technology currently. You can read about two of them below. Research another scientist using microscopes in their field of study and present their biography to the class in the form of a poster.
  - **Helio da Silva, Ph.D.** (Universidade Federal Rural do Rio de Janeiro, Brazil) works on frog morphology, or structure, and their place on the tree of life. Part of his research involves investigating the structural characters overlooked over the years. He and his students use SEM to unravel details of tadpole "tooth" shape and development, sexual characteristics on the hands of frogs and toads, and warts on the skin of toads.
  - **Itzahi Silva Morales, Ph.D. candidate** (Departamento de Sistemática y Ecología Acuática, El Colegio de la Frontera Sur, Chetumal, Quintana Roo, Mexico) is one of the few biologists who conducts research on a group of marine animals known as peanut worms or sipunculans. She studies them with the use of SEM and has discovered, details in their morphology that have often been overlooked. Her research will greatly enhance knowledge of the diversity and evolutionary relationships of this group of worms.
- **Community Connections:**
  - How can YOUR community benefit from this technology?
    - What would your community consider to be a benefit?
    - Might one community benefit from something different than another?
  - Based on what you learned from the SEM Lab and classroom discussions, how will you get your community members/leaders excited about this technology?



## SEM Lab FAQs

1. Will my students be able to use the Scanning Electron Microscope during their visit?
  - a. No, the SEM is a powerful research tool used only by Museum staff who have specialized training and expertise. The SEM is always visible to Museum visitors through the window in the SEM Lab.
2. Will a scientist be demonstrating how the Scanning Electron Microscope works during our visit?
  - a. There may be a Museum scientist working with the SEM during your visit, but there is no scheduled programming. You will be able to look at the SEM from behind glass and learn how the SEM works through exhibit pictures and text.

# Get the Scoop on the Scope 6<sup>th</sup>- 12<sup>th</sup> Grade

Worksheet Version A *By DeAnna Lee-Rivers, MA Ed.*

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

Instructions: Fill in this worksheet as you explore the SEM Lab during your Museum visit.

1. Take a peek through the first window into our Mineral Sciences Lab, which is used every day by our research staff. As an active research site, how many new minerals have been described by NHM in the last 10 years?

-----

2. This exhibit features some of the scientists at NHM who use the SEM in their work! What does Dr. Jann Vendetti, Associate Curator of Malacology, look at under the SEM?



3. The SEM's technology is much different from that of a light microscope.

- a. What part of the atom does the SEM use to make images? \_\_\_\_\_
- b. What do you know about this part of the atom?

4. Fill in the blanks: The SEM at the Museum has a resolution of \_\_\_\_\_ nanometers. That's like standing in \_\_\_\_\_ and being able to spot a quarter on the sidewalk in \_\_\_\_\_!

5. Take a look at the display in front of the SEM Lab. Fill in the blanks with new vocabulary:

**WORD:** Sonicator

**DEFINITION:**

**WORD:** \_\_\_\_\_

**DEFINITION:** An instrument that covers specimens in a thin layer of gold.

6. How would you describe how the SEM works (in language you would use for a young learner)?

# Get the Scoop on the Scope 6<sup>th</sup>- 12<sup>th</sup> Grade

## Worksheet Version A: Answer Key *By DeAnna Lee-Rivers, MA Ed.*

Instructions: Fill in this worksheet as you explore the SEM Lab during your Museum visit.

1. Take a peek through the first window into our Mineral Sciences Lab, which is used every day by our research staff. As an active research site, how many new minerals have been described by NHM in the last 10 years?

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2. This exhibit features some of the scientists at NHM who use the SEM in their work! What does Dr. Jann Vendetti, Associate Curator of Malacology, look at under the SEM?

***Dr. Vendetti looks at snails and slugs and is able to see their teeth.***



3. The SEM's technology is much different from that of a light microscope.
  - a. What part of the atom does the SEM use to make images? **Electrons**
  - b. What do you know about this part of the atom?

***Electrons are negatively charged particles that orbit around an atom's nucleus.***

4. Fill in the blanks: The SEM at the Museum has a resolution of **3** nanometers. That's like standing in **Los Angeles** and being able to spot a quarter on the sidewalk in **New York City!**
5. Take a look at the display in front of the SEM Lab. Fill in the blanks with new vocabulary:

**WORD:** Sonicator

**DEFINITION:** ***An instrument that uses sound waves to clean debris off of specimens.***

**WORD:** Sputter Coater

**DEFINITION:** An instrument that covers specimens in a thin layer of gold.

6. How would you describe how the SEM works (in language you would use for a young learner)?

***The SEM shoots a beam of tiny particles (electrons) at a specimen. This releases other particles which are detected and converted into an image. Magnetic lenses allow the specimen to be viewed.***

# Get the Scoop on the Scope 6<sup>th</sup>- 12<sup>th</sup> Grade

Worksheet Version B *By DeAnna Lee-Rivers, MA Ed.*

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

Instructions: Fill in this worksheet as you explore the SEM Lab during your Museum visit.

1. Take a look at the display in front of the SEM Lab. Fill in the blanks with new vocabulary:

**WORD:** Sonicator

**DEFINITION:**

**WORD:** \_\_\_\_\_

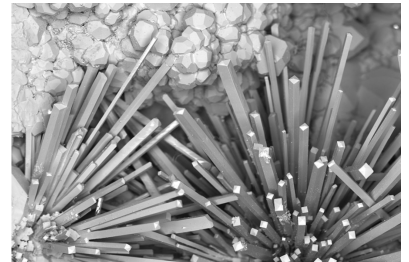
**DEFINITION:** An instrument that covers specimens in a thin layer of gold.

2. Find the Mineral Sciences mural.

- a. What is the name of the crystals pictured here? \_\_\_\_\_

- b. Fill in the blank:

At their real size, both spiky balls would fit inside a \_\_\_\_\_.



3. How would you describe how the SEM works (in language you would use for a young learner)?

4. There are several steps to preparing a sample to be viewed under the SEM. List them in the correct order.

- a. Keep samples dry
  - b. Clean off debris
  - c. Coat sample in gold
  - d. View sample under stereo microscope
1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  4. \_\_\_\_\_

5. Why are SEM images black and white? Fill in the blanks.

Instead of light, SEMs use \_\_\_\_\_ to make images. Without visible light, there are no colors and all SEM images are shades of \_\_\_\_\_.

# Get the Scoop on the Scope 6<sup>th</sup>- 12<sup>th</sup> Grade

## Worksheet Version B: Answer Key *By DeAnna Lee-Rivers, MA Ed.*

Instructions: Fill in this worksheet as you explore the SEM Lab during your Museum visit.

1. Take a look at the display in front of the SEM Lab. Fill in the blanks with new vocabulary:

**WORD:** Sonicator

**DEFINITION:** *An instrument that uses sound waves to clean debris off of specimens.*

**WORD:** *Sputter Coater*

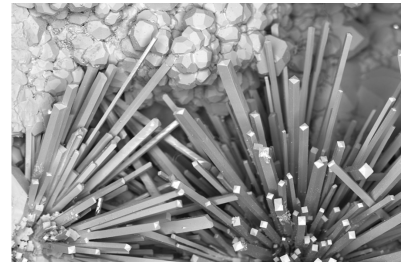
**DEFINITION:** An instrument that covers specimens in a thin layer of gold.

2. Find the Mineral Sciences mural.

- a. What is the name of the crystals pictured here? **natrolite**

- b. Fill in the blank:

At their real size, both spiky balls would fit inside a **pea**.



3. How would you describe how the SEM works (in language you would use for a young learner)?

***The SEM shoots a beam of tiny particles (electrons) at a specimen. This releases other particles which are detected and converted into an image. Magnetic lenses allow the specimen to be viewed.***

4. There are several steps to preparing a sample to be viewed under the SEM. List them in the correct order.

- |  |  |
|--|--|
| a. Keep sample dry                     |  |
| b. Clean off debris                    | 1. <b><i>View sample under stereo microscope</i></b> |
| c. Coat sample in gold                 | 2. <b><i>Clean off debris</i></b>                    |
| d. View sample under stereo microscope | 3. <b><i>Keep sample dry</i></b>                     |
|  | 4. <b><i>Coat sample in gold</i></b>                 |

5. Why are SEM images black and white? Fill in the blanks.

Instead of light, SEMs use **electrons** to make images. Without visible light, there are no colors and all SEM images are shades of **gray**.



# Get the Scoop on the Scope

Grados 6<sup>o</sup> a 12<sup>o</sup>

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

## Hoja de Trabajo Versión A *Por DeAnna Lee-Rivers, MA Ed.*

Instrucciones: Completa esta hoja de trabajo mientras exploras el SEM LAB (Laboratorio SEM) durante tu visita al Museo.

1. Echa un vistazo a la primera ventana del Mineral Sciences Lab (Laboratorio de Ciencias Minerales), que nuestro personal de investigación utiliza todos los días. Como centro de investigación activo, ¿cuántos minerales nuevos ha descrito el NHM en los últimos 10 años?

\_\_\_\_\_

2. ¡Esta exposición presenta a algunos de los científicos del NHM que utilizan el SEM en su trabajo! ¿Qué está observando la Dra. Jann Vendetti, curadora asociada de malacología, bajo el microscopio?



3. La tecnología del SEM es muy diferente a la de un microscopio óptico.

- a. ¿Qué parte del átomo usa el SEM para formar imágenes? \_\_\_\_\_
- b. ¿Qué sabes sobre esta parte del átomo?

4. Completa los espacios en blanco: El SEM del Museo tiene una resolución de \_\_\_ nanómetros. Eso es como estar parado en \_\_\_\_\_ ¡y poder ver una moneda de veinticinco centavos en la banqueta en \_\_\_\_\_!

5. Mira la pantalla al frente en el SEM Lab. Completa los espacios en blanco con el vocabulario nuevo:

**PALABRA:** *Sonicator* (Sonicador)

**DEFINICIÓN:** \_\_\_\_\_

**PALABRA:** \_\_\_\_\_

**DEFINICIÓN:** Instrumento que cubre las muestras con una capa delgada de oro.

6. ¿Cómo describirías cómo funciona el SEM (scanning electron microscope / microscopio electrónico de barrido)? (Con palabras que utilizarías para un estudiante joven)

# Get the Scoop on the Scope

Grados 6<sup>o</sup> a 12<sup>o</sup>

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

## Hoja de Trabajo Versión A. Respuestas *Por DeAnna Lee-Rivers, MA Ed.*

Instrucciones: Completa esta hoja de trabajo mientras exploras el SEM LAB (Laboratorio SEM) durante tu visita al Museo.

1. Echa un vistazo a la primera ventana del Mineral Sciences Lab (Laboratorio de Ciencias Minerales), que nuestro personal de investigación utiliza todos los días. Como centro de investigación activo, ¿cuántos minerales nuevos ha descrito el NHM en los últimos 10 años?

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2. ¡Esta exposición presenta a algunos de los científicos del NHM que utilizan el SEM en su trabajo! ¿Qué está observando la Dra. Jann Vendetti, curadora asociada de malacología, bajo el microscopio?

***La Dra. Vendetti observa caracoles y babosas y es capaz de ver sus dientes.***



3. La tecnología del SEM es muy diferente a la de un microscopio óptico.

- a. ¿Qué parte del átomo usa el SEM para formar imágenes? **Electrones**
- b. ¿Qué sabes sobre esta parte del átomo?

***Los electrones son partículas con carga negativa que giran alrededor del núcleo del átomo.***

4. Completa los espacios en blanco: El SEM del Museo tiene una resolución de **3** nanómetros. Eso es como estar parado en **Los Ángeles** ¡y poder ver una moneda de veinticinco centavos en la banqueta en **Nueva York!**

5. Mira la pantalla al frente en el SEM Lab. Completa los espacios en blanco con el vocabulario nuevo:

**PALABRA:** *Sonicator* (Sonicador)

**DEFINICIÓN:** *Instrumento que utiliza ondas sonoras para limpiar los residuos en las muestras.*

**PALABRA:** *Sputter Coater (Recubrimiento de pulverización catódica)*

**DEFINICIÓN:** Instrumento que cubre las muestras con una capa delgada de oro.

6. ¿Cómo describirías cómo funciona el SEM (scanning electron microscope / microscopio electrónico de barrido)? (Con palabras que utilizarías para un estudiante joven)

***El SEM dispara un rayo de partículas diminutas (electrones) a una muestra. Esto libera otras partículas que se detectan y se convierten en una imagen. Las lentes magnéticas permiten ver la muestra.***

# Get the Scoop on the Scope

Grados 6° a 12°

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

## Hoja de Trabajo Versión B *Por DeAnna Lee-Rivers, MA Ed.*

Instrucciones: Completa esta hoja de trabajo mientras exploras el SEM LAB (Laboratorio SEM) durante tu visita al Museo.

1. Mira la pantalla al frente del SEM Lab. Completa los espacios en blanco con el vocabulario nuevo:

**PALABRA:** *Sonicator* (Sonicador)

**DEFINICIÓN:** \_\_\_\_\_

**PALABRA:** \_\_\_\_\_

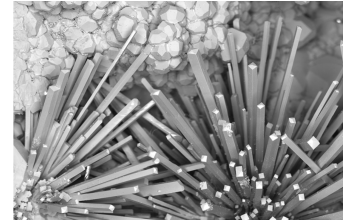
**DEFINICIÓN:** Instrumento que cubre las muestras con una capa delgada de oro.

2. Encuentra el mural de Ciencias Minerales.

a. ¿Cómo se llaman los cristales que se muestran aquí? \_\_\_\_\_

b. Completa el espacio en blanco:

En su tamaño real, ambas bolas puntiagudas cabrían dentro de un \_\_\_\_\_.



3. ¿Cómo describirías cómo funciona el SEM (scanning electron microscope / microscopio electrónico de barrido)? (Con palabras que utilizarías para un estudiante joven)

4. Existen varios pasos para preparar una muestra para ser observada bajo el SEM. Enuméralas en el orden correcto:

- |  |          |
|--|----------|
| a. Mantener las muestras secas                       | 1. _____ |
| b. Limpiar los residuos                              | 2. _____ |
| c. Recubrir la muestra con oro                       | 3. _____ |
| d. Ver la muestra bajo el microscopio estereoscópico | 4. _____ |

5. ¿Por qué las imágenes SEM son en blanco y negro? Completa los espacios en blanco.

En lugar de luz, los SEM utilizan \_\_\_\_\_ para formar imágenes. Sin luz visible, no hay colores y todas las imágenes SEM son en tonos de \_\_\_\_\_.

# Get the Scoop on the Scope

Grados 6° a 12°

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY

## Hoja de Trabajo Versión B. Respuestas Por DeAnna Lee-Rivers, MA Ed.

Instrucciones: Completa esta hoja de trabajo mientras exploras el SEM LAB (Laboratorio SEM) durante tu visita al Museo.

1. Mira la pantalla al frente del laboratorio SEM. Completa los espacios en blanco con el vocabulario nuevo:

**PALABRA:** *Sonicator* (Sonicador)

**DEFINICIÓN:** *Instrumento que utiliza ondas sonoras para limpiar los residuos en las muestras.*

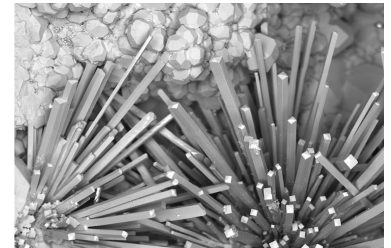
**PALABRA:** *Sputter Coater* (Recubrimiento de pulverización catódica)

**DEFINICIÓN:** Instrumento que cubre las muestras con una capa delgada de oro.

2. Encuentra el mural de Ciencias Minerales.

- a. ¿Cómo se llaman los cristales que se muestran aquí? **Natrolita**
- b. Completa el espacio en blanco:

En su tamaño real, ambas bolas puntiagudas cabrían dentro de un **chícharo**



3. ¿Cómo describirías cómo funciona el SEM (scanning electron microscope / microscopio electrónico de barrido)? (Con palabras que utilizarías para un estudiante joven)

***El SEM dispara un rayo de partículas diminutas (electrones) a una muestra. Esto libera otras partículas que se detectan y se convierten en una imagen. Las lentes magnéticas permiten ver la muestra.***

4. Existen varios pasos para preparar una muestra para ser observada bajo el SEM. Enuméralas en el orden correcto:

- |   |   |
|---|---|
| a. Mantener las muestras secas                            | 1. <b><i>Observar la muestra bajo el microscopio estereoscópico</i></b> |
| b. Limpiar los residuos                                   | 2. <b><i>Limpiar los residuos</i></b>                                   |
| c. Recubrir la muestra con oro                            | 3. <b><i>Mantener las muestras secas</i></b>                            |
| d. Observar la muestra bajo el microscopio estereoscópico | 4. <b><i>Recubrir la muestra con oro</i></b>                            |

5. ¿Por qué las imágenes SEM son en blanco y negro? Completa los espacios en blanco.

En lugar de luz, los SEM utilizan **electrones** para formar imágenes. Sin luz visible, no hay colores y todas las imágenes SEM son en tonos de **gris**.