

Pignapping! Scoping Out The Clues

Grades: 4th-8th

Duration: 50 Minutes

Program Description

The evidence is indisputable! From Sherlock Holms to CSI everyone loves a mystery! Forensic scientists work at the scene of a crime to solve a mystery. A forensic investigation draws on virtually every area of science and has one primary goal - to establish whether or not there is any scientific evidence to link a person or item to a scene of a crime. The students will examine evidence that was collected at the scene of the crime and flex their powers of observation to solve this horrendous crime. The students will use and learn the different parts of a microscope to examine the evidence to and eliminate the innocent suspects, find the area where the crime was committed, and to find the instrument that was used at the crime scene. The students will in the words of Sherlock Holms, "Eliminate all other factors, and the one which remains must be the truth."

Louisiana GLE:

Grade 4 Science

1. Ask questions about objects and events in the environment (e.g., plants, rocks, storms) (SI-E-A1)
2. Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations (SI-E-A1)
3. Use observations to design and conduct simple investigations or experiments to answer testable questions (SI-E-A2)
6. Use a variety of methods and materials and multiple trials to investigate ideas (observe, measure, accurately record data) (SI-E-A2)
7. Use the five senses to describe observations (SI-E-A3)
9. Select and use developmentally appropriate equipment and tools (e.g., magnifying lenses, microscopes, graduated cylinders) and units of measurement to observe and collect data (SI-E-A4)
10. Express data in a variety of ways by constructing illustrations, graphs, charts, tables, concept maps, and oral and written explanations as appropriate (SI-E-A5) (SI-E-B4)
11. Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction (SI-E-A5)
12. Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios) (SI-E-A6)
17. Recognize that a variety of tools can be used to examine objects at different degrees of magnification (e.g., hand lens, microscope) (SI-E-B3)

22. Explain and give examples of how scientific discoveries have affected society (SI-E-B6)

Grade 4 English Language Arts

34. Adjust pacing to suit purpose, audience, and setting when speaking

35. Interpret, follow, and give multi-step directions

37. Demonstrate active listening strategies, including asking questions, responding to cues, and making eye contact

38. Adjust speaking content according to the needs of the audience

Grade 5–8 Science as Inquiry

1. Generate testable questions about objects, organisms, and events that can be answered through scientific investigation (SI-M-A1)

2. Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)

4. Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2)

6. Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)

7. Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)

11. Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)

12. Use data and information gathered to develop an explanation of experimental results (SI-M-A4)

19. Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)

22. Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)

29. Explain how technology can expand the senses and contribute to the increase and/or modification of scientific knowledge (SI-M-B3)

39. Identify areas in which technology has changed human lives (e.g., transportation, communication, geographic information systems, DNA fingerprinting) (SI-M-B7)

40. Evaluate the impact of research on scientific thought, society, and the environment (SI-M-B7)

Grade 5 English Language Arts

32. Adjust diction and enunciation to suit the purpose for speaking

33. Use complete sentences and standard English grammar, diction, syntax, and pronunciation when speaking

35. Restate or describe oral directions/procedures for tasks

36. Adjust volume and inflection to suit the audience and purpose of presentations

38. Demonstrate active listening strategies

39. Deliver formal and informal presentations for a variety of purposes, including:

41. Participate in group and panel discussions

48. Interpret information from a variety of grade-appropriate sources, including timelines, charts, schedules, tables, diagrams, and maps

Grade 6 Science

4. Differentiate between the physical and chemical properties of selected substances (PS-M-A3)

Key Terms:

Arm: Supports the tube and connects it to the base.

Base: The bottom of the microscope, used for support

Eyepiece Lens: This is the lens at the top that you look through. What is the power of the eyepiece on your microscopes? (5 times)

Illuminator: Is the oversized fiber optic looking structure that reflects the light from an external light source up through the bottom of the stage. It will work much better if you point the thing away and not toward you!

Objective Lenses: There is one objective lens on your microscopes. What is the power of your objective lens? (4 times) What is the total magnification of your microscope? ($4 \times 5 = 20$ times)

Rack Stop: This is the little knob on the tube that determines how close the objective lens can get to the slide. It is set so that teams will not bring the objective lens down into the slide breaking it.

Stage: The flat platform where you place your slides. If you go to a play where does all the action happen? On the stage!

Tube: Connects the eyepiece to the objective lenses.

Connections to Permanent Exhibits:

Schumpert Bodyworks Gallery

Genetic Traits: This exhibit describes nine genetic traits. What form of each of these traits do you have?

Check Your Prints: Examine your fingerprints under a microscope and compare them to common forms.

DNA-The Language of Life: Where is DNA found and what shape does it have?

Gi Gi and Dewey Corley Go Figure Cluster....Trigonometry and Logic

Magic Abacus: Did you arrange the blocks so each line equaled 10? Did you discover a new pattern?

Circular Logic: What was your first step in solving this problem?

Language of Logic Mural: Who was famous for his deductive reasoning? What are some tools of logic?

Crack the Code: Play a game of Crack the Code. What logic did you use to win this game?

Children's Discovery Gallery

Creature Corner: Guinea pigs, hissing cockroaches, hermit crabs, etc. The animals are ambassadors for use by demonstrators to discuss their many characteristics and adaptations.

Web Resources:

Parts of a microscope

<http://www.microscope-microscope.org/basic/microscope-parts.htm>

Practice Naming the parts of a Microscope

<http://www.biologycorner.com/microquiz/index.html#>

Advice About a Career in Science

<http://www.criminology.fsu.edu/faculty/nute/FScareers.html>

Pre-Visit Activity

Exploring Microscopes

The compound microscope is believed to have been invented around 1595 by Zacharias Janssen and his father Hans Janssen. Their primitive device had two lenses that only allowed them to see objects about nine times larger than normal. The invention, however, quickly underwent many changes as other scientists altered the initial design. By 1665 some microscopes were able to magnify up to 250 times, a significant improvement over the capabilities of the early Janssen instrument.

Required Materials

- Science notebook
- Slide
- Glass marking wax pencil
- Dropper
- Small container of water
- Magnifying glass
- Ultrascope
- Source of light (flashlight or good room light)
- Newsprint and comics from the newspaper

Activity Directions

1. Draw a circle in the center of the slide with the glass marking wax pencil. The circle should be a little smaller than the diameter of a dime.
2. Add one drop of water to the circle and observe a lower case "e" in a piece of newspaper by looking through the drop. Draw what you in your science notebook.

Is the "e" upside down or right side up?

Is the "e" larger or smaller than the printed "e"?

3. Add two drops of water to the circle, observe the "e" again and draw what you see.
4. Add three drops of water to the circle, observe the "e" again and draw what you see.
5. Now start over with a one-drop microscope and observe a piece of colored paper from the comics. Explain what you see.
6. Observe the colored paper again using a two drop and a three drop microscope. Draw what you see in your science notebook.
7. Look at the newspaper "e" and the colored picture from the comics with the magnifying lens.

How is the image similar and how is it different from what you saw using the water drop microscope?

8. Now use the magnifying glass to view the newsprint and the colored paper from the comics. If the paper is too thick for light to pass through it from the mirror, then have a partner shine the flashlight down on the slide so that the paper is well lighted.

How is what you see different from what you observed with the

other two types of microscopes?

Is the letter "e" right side up or upside down?

What are the three colors of the dots that make up the comics?

Which of the microscopes produced the largest image?

9. The power of a microscope is described with a number followed by the letter "x." For example, if through a microscope you can see something 25 times larger than actual size, its magnification power is 25x. With most microscopes you can change lenses to increase or decrease magnification power. Click on the link below to see what various things look like through a microscope at different magnifications.

Post-Visit Activity

Measuring Under the Microscope

The following lesson is a wonderful integration of math and science. It is important for students to gain a sense of how large something actually is under the microscope. This lesson will teach the students how to measure under the microscope.

Preparation: Typical Lab set-up as necessary:

- Demo with item in beaker to show bending of light and magnification
- Newsprint available for measuring letters
- Eyedroppers and beakers with water for small groups or individuals
- Transparent rulers for scopes
- Prepared slides (may be manipulated depending on availability)
- Extra pencils are always handy in the classroom
- Plentiful copies of the lab and intro activity...one for each student minimum

Measuring with a Microscope

Author: David Gardner
 Date Created: Summer 2007
 Subject: **Life Science and Biology**
 Level: **Middle School and High School**
 Standards: 1: Analysis, Inquiry and Design
 4: Physical Setting and Living Environment
 Schedule: **80 minutes (double lab period)**

Objectives:

Learn how to measure and/or calculate field of view under various magnifications and thus determine relative sizes of an object and/or organism using a compound light microscope

Students will:

- Observe different tools used for magnification such as a water drop, hand lens or microscope
- Measure field of view in low power of a compound light microscope
- Calculate field of view in high power with a given formula
- View thin sectioned samples found in the classroom or brought from home
- Compare and estimate relative sizes of cells and certain organisms
- Use acquired skills in future lab activities

Vocabulary:

Micrometer
Field of view
Resolution

Magnification
Scale

Materials:

For Each Student:

- Microscope
- prepared slides (to share)
- *paramecium
- *corn stem cross section
- material from home to view
- Worksheet: Size determination in compound light microscopes Intro
- Lab Packet: Measuring with a microscope
- Transparent metric ruler
- Pencil

Safety:

Care in handling and proper use of the microscope and any prepared slide is important. Broken slides and glassware may cut skin easily.

Classroom Procedure:

Engage (Time: 10 minutes)

- Introduce the importance of scale showing some images without scale and try to have students guess what they are, then do the same with some objects that have scale
- Show the "The Universe within" (Powers of Ten) website
 - <http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html>
- Have students measure the width of normal newsprint, then place a drop of water on in and re-measure to determine the magnification power of water

Explore (Time: 50 minutes)

- Students will follow along with and complete the lab activity "Measuring with a microscope"
 - Includes measuring the field of view in scanning power (40X) and low power (100X) with a thin transparent ruler on the stage of the microscope
 - Will calculate the field of view in high power (400X)
 - Will observe prepared specimens and answer included questions

Explain (Time: 5 minutes)

- Have student get together with a partner and come up with an explanation of how to determine an objects size using field of view
- Have students explain why as magnification increases, field of view decreases

Expand (Time: 15minutes...and beyond)

- Students should observe other materials found throughout the room or brought in from home
 - They should provide sketches of these observations including a scale
- Have students come up with 3 other objects/materials/tools that maybe used magnify an object
- Provide students with newspaper or magazines so they may find pictures with and without scale to share with their classmates
- Students can complete an extra credit assignment for a classroom poster representing Field of View for the 3 magnifications present with the compound microscopes. These will be place in the classroom for reference throughout the year as the microscopes will continue to be in use

Assessment: (Evaluation...the 5th E)

The following rubric can be used to assess students during each part of the activity. The term “expectations” here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

1= exceeds expectations

2= meets expectations consistently

3= meets expectations occasionally

4= not meeting expectations

	Engage	Explore	Explain	Expand/Synthesis
1	Student took an interest in the introduction and was able to express real life situations. They were successful with the waterdrop/handmag and helped others with the task	Student is self motivated and follows all directional procedures, completing the lab accurately. Offers assistance to those around them	Worked well with a partner and came up with a logistical reasoning for the question posed	Student looked at 5+ additional items and provided representations with scale and was able to come up with 3+ items used to magnify. Brought in many pictures with and without scale and devised a poster to show Field of View
2	Student was focused during intro and took part in activities	Completes lab on their own successfully	Worked with partner to come up with a generic or broad idea for the question	Student observed about 3 additional items and had 3 items used to magnify. Brought in a few pictures with scale etc, but did not complete a poster
3	Student was off task at times during the intro and made some errors in the activities	Complete lab, but with errors and units missing	Discussed some with partner, but spent time off task talking to other people. Idea was not totally related to the question	Student looked at only 1-2 additional items and could not come up with 3 items for magnification. Found 1 picture with and without scale. No poster completed
4	Does not show interest during the introduction or experiment with the activities.	Does very little to complete assignment on their own. Tries to get all answers from neighbors	Did not participate with a partner or come up with ideas on their own	Student did not look at additional items or come up with items used to magnify.

Extension Activities: Students will be doing additional activities throughout the year with microscopy. Have them bring materials into the class when they find something.

Supplemental Information:

Safety: Care in handling and proper use of the microscope and any prepared slide is important. Broken slides and glassware may cut skin easily.

Acknowledgments: CCMR, Jane Earle, John Grazul, John Hunt, Mick Thomas, and Solvay High School

Activity Sheet 1

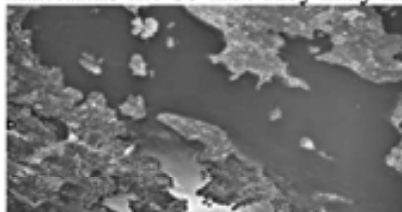
Name _____

Size Determination in Compound Light Microscopes
(Introductory activity to Measuring with a Microscope)

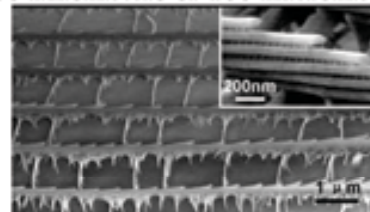
Importance of Scale: What do these pictures represent? Which one is bigger? What's missing?



**Scale is important in order to help assess your material correctly. You need to know how large your materials are so that they may have some relevance. Is it 100 Kilometers or 100 micrometers across? **



Aerial view of Lake Winnepesaukee



Butterfly wing structure

1) As you look at the two pictures below, what is occurring?



2) Are they things you may have observed before?

3) What are some other objects you may have observed that are capable of doing this?

4) Measure the print size (in mm) of the typical lower case letters in a paragraph of newspaper:

Height _____

Width _____

5) Now place a drop of water onto the newspaper and observe what happens and again measure the letters:

Height _____

Width _____

6) What do you think the magnification power of water is?

Name _____

LAB: Measuring with a Microscope

Background: Even though it can be interesting and informative to observe specimens under the microscope, it is often difficult to know the actual size of the object you are looking at. You can not just hold a ruler up to a paramecium or plant cell to determine its size. Therefore, size must be measured indirectly, or compared to the size of something you already know. A convenient standard to use is the *field of view diameter* in a compound light microscope



Two metric units that will be useful for this and all future microscope activities are the *millimeter* (mm) and *micrometer* (μm) (*The micro symbol 'μ' looks like a 'u' with a longer tail in the front)

1 meter (m) = 1000 millimeters (mm)

1 millimeter (mm) = 1000 micrometers (μm)

m = 10 ⁰	or	1m
mm = 10 ⁻³	or	0.001m
μm = 10 ⁻⁶	or	0.000001m

Objectives: in this activity you will:

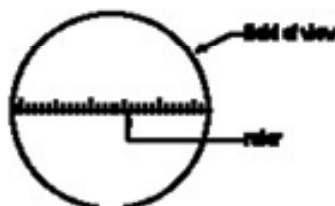
1. Measure the field of view diameter in the scanning and low power fields
2. Calculate the field of view diameter in the high-power field
3. Estimate the sizes of objects viewed under the microscope

Materials:

- Microscope
- Transparent ruler (ONLY USE METRIC...no inches please)
- Prepared slides of paramecium and corn stem cross-section
- Pencil for drawing structures

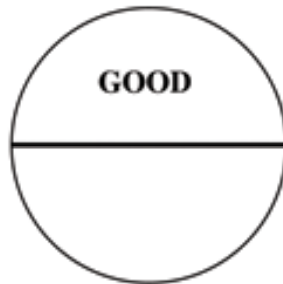
Procedure:

1. Place the ruler on the stage so that it covers half of the stage opening and you can see markings as in the diagram below



2. Prepare your microscope for scanning (40X)

3. Look through the ocular and focus on the ruler using coarse adjustment. You should see numbers and lines.
4. Place the center of a whole number mark (1, 2, 3, etc.) on the left side of the field of view, making sure your ruler edge is exactly across the center of the field to get the most accurate diameter.



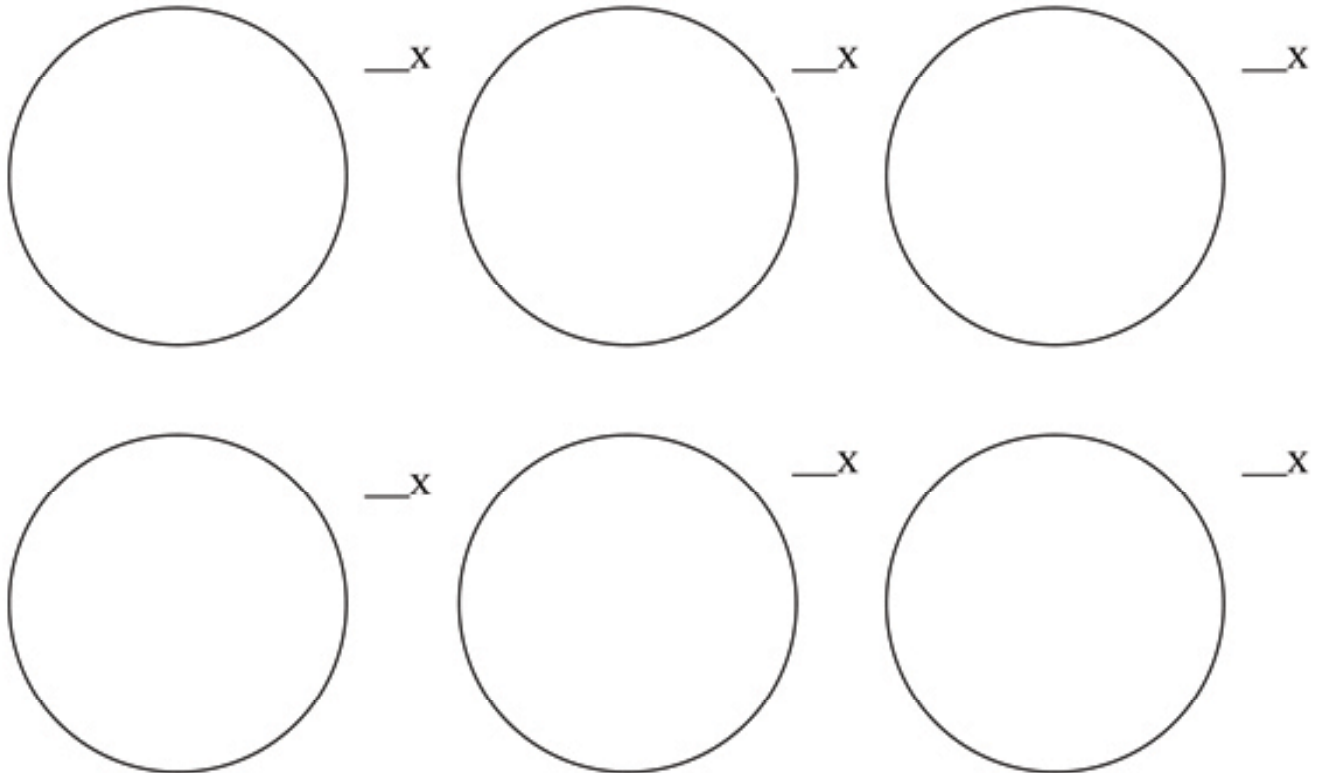
- 4a. What is the field of view in scanning power (40X) to the nearest tenth in millimeters _____
- 4b. Convert this into micrometers by multiplying by 1000 _____
5. Switch to low power (100X) and repeat steps 3-4
 - 5a. What is the field of view in low power (100X) to the nearest tenth in millimeters _____
 - 5b. Convert this into micrometers by multiplying by 1000 _____
6. You will not be able to measure field of view diameter in the high-power field using the same process as you have just completed. Focusing and light problems exist and you may actually hit the ruler with the objective lens. The diameter is less than 1mm and will not easily be seen. You can obtain the diameter indirectly using certain values obtained in earlier procedures with the help of a mathematical formula. The key idea to remember is that *magnification is inversely proportional to field of view*.

$$\frac{\text{high power field of view}}{\text{low power field of view}} = \frac{\text{low power magnification}}{\text{high power magnification}}$$

- 6a. Calculate the high power field of view diameter in micrometers (Show set-up below)
7. In low power, focus on a prepared cross section of corn stem. The center of the stem is filled with large, thin-walled cells called pith cells.
 - a. Observe the pith cells and determine how many fit across the diameter in low power. _____
 - b. Calculate the diameter of a pith cell: Divide the low power field of view diameter (in μm) by the number of cells observed in 7a.

8. Switch to high power and focus with the fine adjustment
 - a. How many pith cells fit across the diameter in high power _____
 - b. Calculate the diameter of the pith cell: Divide the high power field of view diameter (in μm) by the number of cells observed in 8a
 - c. Compare your answers to 7b and 8b
9. Observe a prepared slide of paramecium under low power. Estimate its length by comparing it to your previously determined low power field of view diameter in micrometers _____
10. Switch to high power. Estimate its length by comparing it to your previously calculated high power field of view diameter in micrometers _____
 - a. Compare your answers to 9 and 10

11. Obtain other objects in the classroom for viewing in the microscope. In the spaces below, draw an accurate representation of your findings. Include the magnification and a scale



Analysis and Questions

1. Look at your measurement for the pith cells and paramecium under low power and the calculated measurement under high power. If measurements of the same object are different, what could be the reason?

2. I have a microscope with an ocular of 10X, a low power objective of 10X, a low power field of view diameter of 1600 micrometers and a high power objective of 40X.
 - a. What is the high power field of view diameter? Show all work...Hint, use the formula from within the lab.

 - b. What is the approximate fraction of the low power field area would you see if you were to change to the high-power objective using this microscope?

Inside a Cell-Learn Genetics Genetic Science Learning Center-University of Utah

The next step after learning to use the microscope in life science and biology classrooms is to have a look at cells. This is an awesome cell interactive that could be used to introduce cell organelles. It could be done in a computer lab or teacher directed using an LCD projector and computer.

This cell interactive is found on-line at

<http://learn.genetics.utah.edu/content/begin/cells/insideacell/>