Cornell Institute for Biology Teachers

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Title: **Microscopes**

Authors: Nancy V. Ridenour, Ithaca High School, Ithaca, New York

Betty House, Northeast Elementary School, Ithaca, NY

Appropriate Level: Grades 3-5

Abstract: Students will identify the parts of a microscope. Students will observe, manipulate, write and memorize. Students will also compute total magnification of the objective lenses.

Special Equipment needed: Compound and dissection microscopes.

Time Requirement: 3-5 classes, 45 minutes each

NYS Learning Standards **1-Analysis, Inquiry, Design**: S1- Purpose of Scientific Inquiry: 1.2; S3 – Testing Proposed Explanations: 3.2a,b; **4-The Living Environment**: 1-Living and Nonliving: 1.1 **4-The Physical Environment**: 3- Characteristics of Matter: 3.1c,e

Additional Teacher Information

Objectives

- Students will learn the structure and function of the microscope.
- Students will learn how to use the microscopes appropriately so they can observe organisms under the microscope.
- Students will observe organisms related to their ecology unit.
- Through the activities, they will also:
    1. Read, comprehend and respond.
    2. Appreciate and create poetry.
    3. Develop vocabulary.
    4. Manipulate scientific materials.
    5. Discover and problem-solve.

Information with which Students must be Familiar

Students should spend time learning the parts of the microscope and how to handle the microscope. They also need instruction on careful preparation of microscope wet mounts and observation of them using the microscope. They need instruction about the total magnification of a microscope; the total magnification is obtained by magnifying the power of the eyepiece with the power of the objective lens. For example, most eyepieces magnify ten times. One of the objective lenses also magnifies ten times. The total magnification with that combination of optics is 100 times.

Time Required

Before class: At least 45 minutes to set up the microscopes and collect samples.

Materials

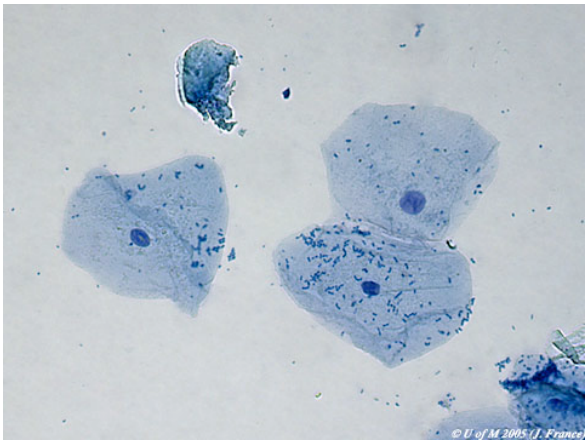
- Microscopes
- Coverslips
- Pipettes
- Jars or cups
- Microscope slides
- Lens paper
- Source of organisms

Tips for the Teacher

- Hay infusions are an excellent source for microscopic organisms. They are inexpensive and really easy to prepare. Place either hay or grass cuttings (free from pesticides or herbicides) inside a clean glass jar. Fill it with pond or any natural water, and let is sit, uncovered for a few days. Within two days you should start seeing protozoans swimming around. If you use tap water, let it sit, uncovered, overnight, so the all the chlorine evaporates. If you don't have access to a body of water, check in your backyard: any water from containers with deposited rain water will work as well. Some teachers sprinkle baking yeast or add drops of milk to the water, sources of food for the bacteria that will grow in the infusion. There is a risk, however, that these eventually will cause the water to smell.

  The protozoans lived in the grass. When the grass dried up, the protozoans did not die. They can enclose themselves in tiny cysts that keep them from drying up. They can remain dormant for long periods of time until more favorable conditions develop.

- A fun, easy and inexpensive way to show their own cells to the students, is to observe cells from their cheeks. To do this, have students gently scratch their cheek with the non sharp end of a toothpick. Cells in our cheeks are replaced just about every 20 minutes, the fastest in the human body. The lining of the mouth is quite delicate, and so they don't need to scratch or draw blood to collect cells. Place the swabbed end of the tooth pick onto the middle of a microscope slide; you will be able to see some residue on the slide. Add one small drop of clean water on top of the sample and then one small drop of methylene blue stain. Place a cover slip on top of the cell/water/stain solution and gently push the slip down. You might need to clean off any excess water or stain before observing under the microsope. CIBT's kit includes a small vial of methylene blue and plastic slides and cover slips. The cells will look somewhat like these in the picture. The prominent structure towards the midle of the cell is the cell's nucleus. The Material Safety Data Sheet for methylene blue is included at the end of the teacher section.



- American Science Surplus (http://www.sciplus.com/) is an inexpesive source of science related materials, including supplies and accessories for microscope labs.

- Some interesting items to look at under the stereoscope (also called 'dissection scope') include insects, entire flowers and other plant parts, seeds, feathers, creepy crawlers (worms, caterpillars, snails, spiders, slugs, etc). Make sure that you are using the top light to observe these, as the thick nature of the specimen would block the bottom light, allowing students to see only the contour.

- There are many elementary-level books about microscopes that should be available to students before doing the lab. The first part of the lab will be a total class activity. The teacher and students should discuss the student section before doing the lab.

- If you are able to get a high school student or an adult volunteer to help at the microscope table, the lesson will go more smoothly. Three to four high school students worked well during field testing.

- The second half of the lab will be completed in small groups during independent work sessions.

- There are ten microscopes in our kit. It is suggested that all ten microscopes be placed on a table along with other materials and specimens needed to complete the lab. A group of students will be invited to the table to use the microscopes. This procedure depends upon the individual classroom, number of students, number of "helpers," and the interest of the students.

- Clean the lenses of the microscopes and the eyepiece with lens paper and rubbing alcohol. The lenses quickly become dirty with student use.

- The remainder of the students will be in groups of four to six completing the "History of Microscopes" and "Poetry and Science" activities at their own pace. Students are expected to help one another.

- There are three reference books in the kit for additional activities and information about microscopes and magnification. They are the following and can be obtained from bookstores or webshopping.

  Levine, Shar and Leslie Johnstone. The Microscope Book. NY: Sterling Publishing Co., Inc. 1996. ISBN 0-8069-4899-X

  Oxlade, Chris and Corinne Stockley. The World of the Microscope. Usborne Publishing Company. 1989. ISBN 0-7460 0289 0

  VanCleave, Janice. Microscopes and Magnifying Lenses. New York: John Wiley and sons, Inc. 1993. ISBN 0-471-58956-X

Methylene Blue MSDS Sheet, Material Safety Data Sheet

1. Product Identification

Synonyms: Basic Blue 9,trihydrate; Methelyne blue trihydrate; 3,7-Bis(dimethylamino)phenazathionium chloride trihydrate
CAS No.: 61-73-4 (Anhydrous); 7220-79-3 (Trihydrate)
Molecular Weight: 373.91
Chemical Formula: C16H18ClN3S-3H2O

2. Composition/Information on Ingredients

Ingredient: Methylene Blue
CAS No.: 61-73-4
Percent: 100%

3. Hazards Identification

Emergency Overview
Methylene Blue is relatively non-hazardous in routine industrial situations.
Potential Health Effects
Inhalation: No adverse health effects expected from inhalation. May cause a short period of rapid or difficult breathing.
Ingestion: A burning sensation of the mouth may be noted following ingestion of methylene blue. May cause nausea, vomiting, diarrhea, and gastritis. Large doses may cause abdominal and chest pain, headache, profuse sweating, mental confusion, painful micturation, and methemoglobinemia.
Skin Contact: Not expected to be a health hazard from skin exposure. Methylene blue may color the skin a bluish color. May cause photosensitization.
Eye Contact: No adverse effects expected. May cause mechanical irritation.
Chronic Exposure: No information found.
Aggravation of Pre-existing Conditions: No information found.

4. First Aid Measures

Inhalation: Remove to fresh air. Give oxygen if breathing is difficult; give artificial respiration if breathing has stopped. Keep person warm and quiet; get medical attention.
Ingestion: Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.
Skin Contact: Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire: Methylene blue is considered to be a fire hazard.
Explosion: Not considered to be an explosion hazard.
Fire Extinguishing Media: Use any means suitable for extinguishing surrounding fire.
Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face piece.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment. Pick up spills and place in a suitable container for reclamation or disposal, using a method that does not generate dust.

7. Handling and Storage

Keep Methylene Blue in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Avoid dust formation and control ignition sources. Isolate from incompatible substances. Containers of Methylene Blue may be hazardous when empty.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits: None established.
Ventilation System: In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved): Not expected to require personal respirator usage. For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerin, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator.
Skin Protection: Wear protective gloves and clean body-covering clothing.
Eye Protection: Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance: Methylene Blue is dark green crystals with bronze luster or crystalline powder.
Odor: Odorless.
Solubility: Soluble in water.
Specific Gravity: No information found.
pH: No information found.
% Volatiles by volume @ 21C (70F): 0
Boiling Point: Decomposes.
Melting Point: 100 - 110C (212 - 230F)
Vapor Density (Air=1): 13
Vapor Pressure (mm Hg): Not applicable.
Evaporation Rate (BuAc=1): No information found.

10. Stability and Reactivity

Stability: Methylene Blue is stable under ordinary conditions of use and storage.
Hazardous Decomposition Products: May produce oxides of nitrogen, sulfur and carbon when heated to decomposition.
Hazardous Polymerization: Will not occur.
Incompatibilities: Strong oxidizing agents, alkali, dichromates, alkali iodides, reducing agents.
Conditions to Avoid: Heat, flame, ignition sources, dusting and incompatibles.

11. Toxicological Information

Methylene Blue: 1180 mg/kg LD50 oral rat. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------			
----------	NTP Carcinogen---		
Ingredient ----------	Known --	Anticipated --	IARC Category
----------	-----	----------	----------
Methylene Blue(61-73-4) --	No --	No ---------	None

12. Ecological Information

Environmental Fate: When released into the soil, this material is not expected to evaporate significantly. When released into water, this material is not expected to evaporate significantly. This material has an estimated bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.
Environmental Toxicity: No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. Dispose of container and unused Methylene Blue in accordance with legal requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

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--------\Chemical Inventory Status - Part 1\-----------
Ingredient -------------  TSCA  EC   Japan -- Australia
------------------------  ----  ---  ----- -- ---------
Methylene Blue (61-73-4)  Yes   Yes  Yes      Yes
------\Chemical Inventory Status - Part 2\-- Canada ---
Ingredient -------------  Korea -- DSL -- NDSL -- Phil.
------------------------  -----    ---    ----    -----
Methylene Blue (61-73-4)  Yes      Yes    No      Yes
USA Federal, State & International Regulations - Part 1\
------------------------  -SARA 302-   ------SARA 313------
Ingredient -------------  RQ     TPQ   List  Chemical Catg.
------------------------  ---    ---   ----  --------------
Methylene Blue (61-73-4)  No   No   No    No
USA Federal, State & International Regulations - Part 2\
--------------------------------  -RCRA-  -TSCA
Ingredient -------------  CERCLA  261.33  8(d)
------------------------  ------  ------  ------
Methylene Blue (61-73-4)  No      No       No
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Chemical Weapons Convention: No; TSCA 12(b): No; CDTA: No
SARA 311/312: Acute: Yes; Chronic: No; Fire: No; Pressure: No; Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.

EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.
WHMIS (Canada): Not controlled under WHMIS (Canada).
DSCL (EEC): R36/38- Irritating to eyes and skin.
HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 1
Reactivity: 0
Personal Protection: E
National Fire Protection Association (U.S.A.):
Health: 2
Flammability: 1
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

16. Other Information

Disclaimer:
****
Our company provides this **Methylene Blue MSDS information sheet** contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This Methylene Blue MSDS sheet is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose.
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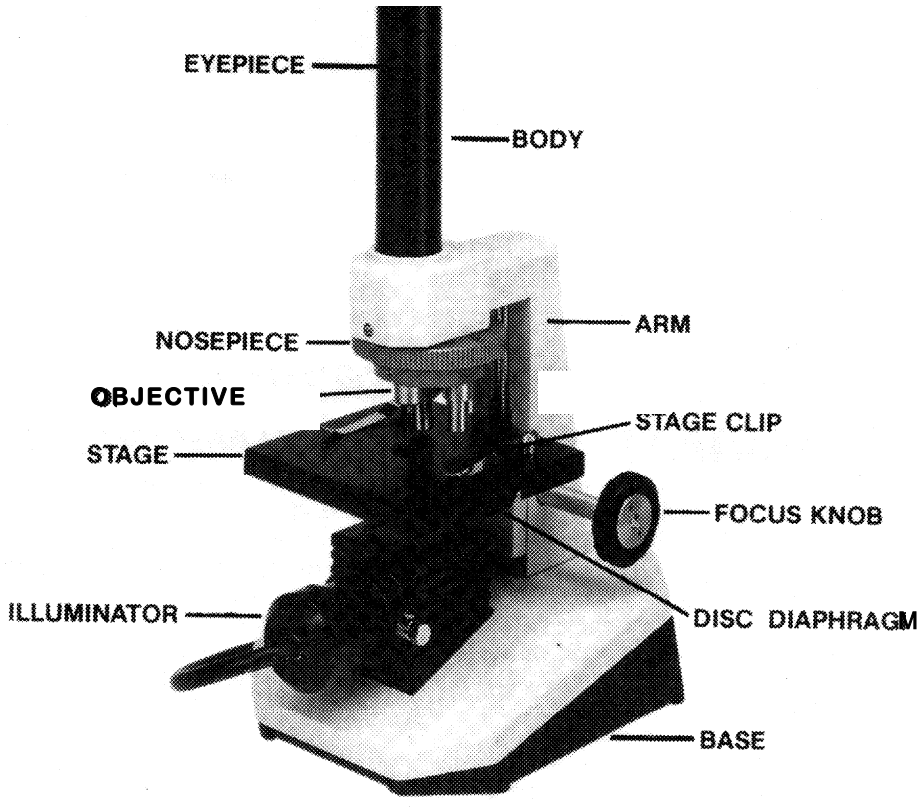
Microscopes!

CIBT
Student Laboratory Exercise

Name_____ Date_____

Introduction

The microscope was invented in the 1500's and has been a major tool of biology ever since. By means of lenses, the microscope can magnify things too small to be seen by the naked eye. One type of microscope we have in the lab is a compound microscope. You are to learn the structures and functions of the parts of this microscope. See the diagram and descriptions below.



Parts of a Microscope

- **Eyepiece** magnifies the image ten times (10x). Do NOT remove it from the microscope because it will allow dirt into the body tube or you could drop and break it.

- **Body** tube keeps the eyepiece and objective lenses at standard distances.

- Low power **objectives** magnify the specimen 4x and 10x. ALWAYS START YOUR FOCUSING ON LOW POWER. Start with the 4x objective to scan the slide and then switch to the 10x objective. High power **objective** magnifies the object 20x on your microscopes. THE MICROSCOPE SHOULD ALWAYS BE LEFT ON LOW POWER WHEN PUTTING IT AWAY.

- **Stage** is the structure on which you place the slide. There are stage clips to hold the slide in place. The stage should be dry so you can easily move the slide to find whatever you are looking for.

- **Focus knob** is used to focus the specimen.

- **Diaphragm** is below the stage, is round and has holes. Some have more complicated structures. It allows you to adjust the amount of light coming up from the mirror. It works like the iris of your eye that controls the amount of light entering the pupil.

- **Illuminators** are built into these microscopes. The light is found under the stage to shine the light up through the specimen you are looking at.

Learn These Terms for Homework

1. **Magnification** is the ability to enlarge an image (what you see looking through the eyepiece). The total magnification for the microscope is obtained by multiplying the magnification of the eyepiece times the magnification of the objective lens. The eyepiece on the microscope is 10x and the three objective lenses are 4x, 10x and 20x.

   What is the total magnification using each of the objective lenses?

   4x=_____ 10x=_____ 20x=_____

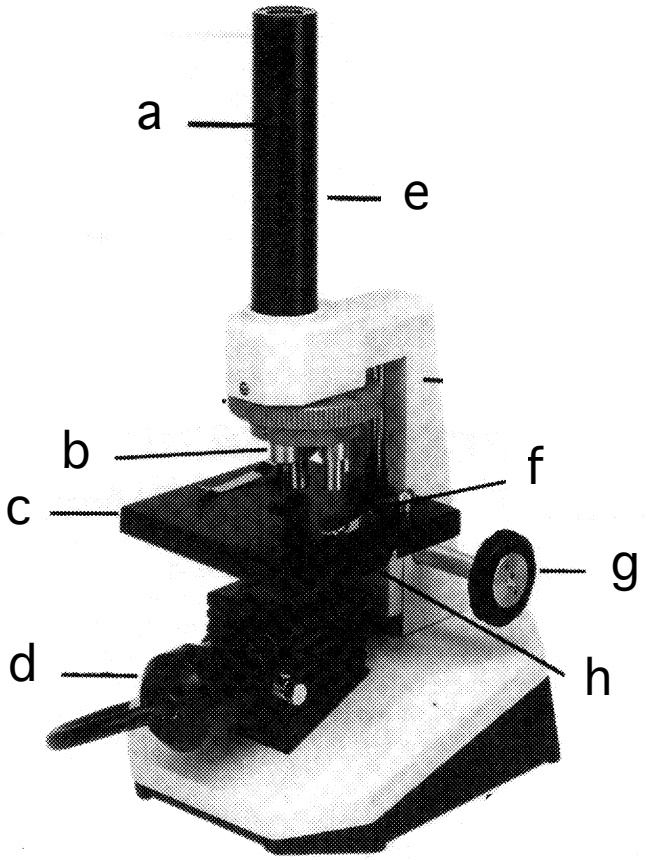
2. **The Field of view** is what is observed looking through the microscope. It is circular. The field of view on low power is larger than the field of view on high power.

3. **Transmitted light** is what goes through a thin specimen and is used in the compound microscope. Your specimen, therefore, has to be thin enough to allow light to go through it.

4. **Reflected light** is used in the stereo microscopes to observe large specimens. Light reflects off the surface so you can see the surface of the object, such as a flower.

Study sheet

Identify each of the parts of the microscope and describe their functions.



Microscope part	Function
a.	
b.	
c.	
d.	
e.	
f.	
g.	
h.	

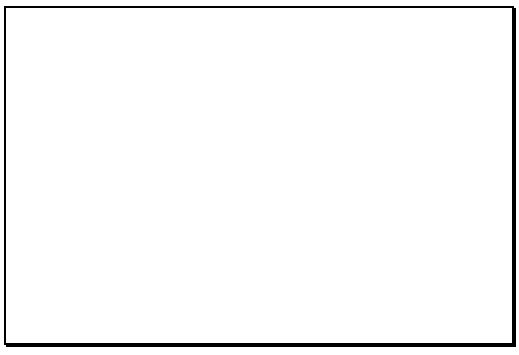
Materials

- Slides
- Eyedroppers
- Compound microscopes
- Plastic coverslips
- Tweezers
- letters from newsprint paper
-
- Books about microscopes. An excellent book is the following: Kumin, Maxine. *The Microscope*. ISBN# 0-06-023524-1. Harper Collins Publisher. This book is out of print but can be obtained through Amazon.com. There are many other books available through Amazon.com that are at the elementary level.

Procedure

Part I. Compound Microscope:

1. Go to the table or desk where your teacher has placed the microscopes. The microscope should have been left with the low power lens in use.
2. Obtain a clean slide and coverslip. If the slide is not clean, use a paper towel and water to clean it.
3. Place a piece of newspaper under the objective lens and find a letter "e" in a word. You do not need to use a slide for this. Do not use the capital "E." Make sure the "e" is in a normal position to your naked eye.
4. With a pencil, sketch the letter as you see it while looking through the microscope.



5. Compare how the "e" looks under the microscope to how it looks with the naked eye.

_____

6. Switch to high power.

7. Now how does the "e" look?

_____

8. Get a piece of colored paper. Put it on the stage without a slide and look through the microscope. Describe what you see under the microscope compared to what you see with your naked eye:

_____

_____

_____

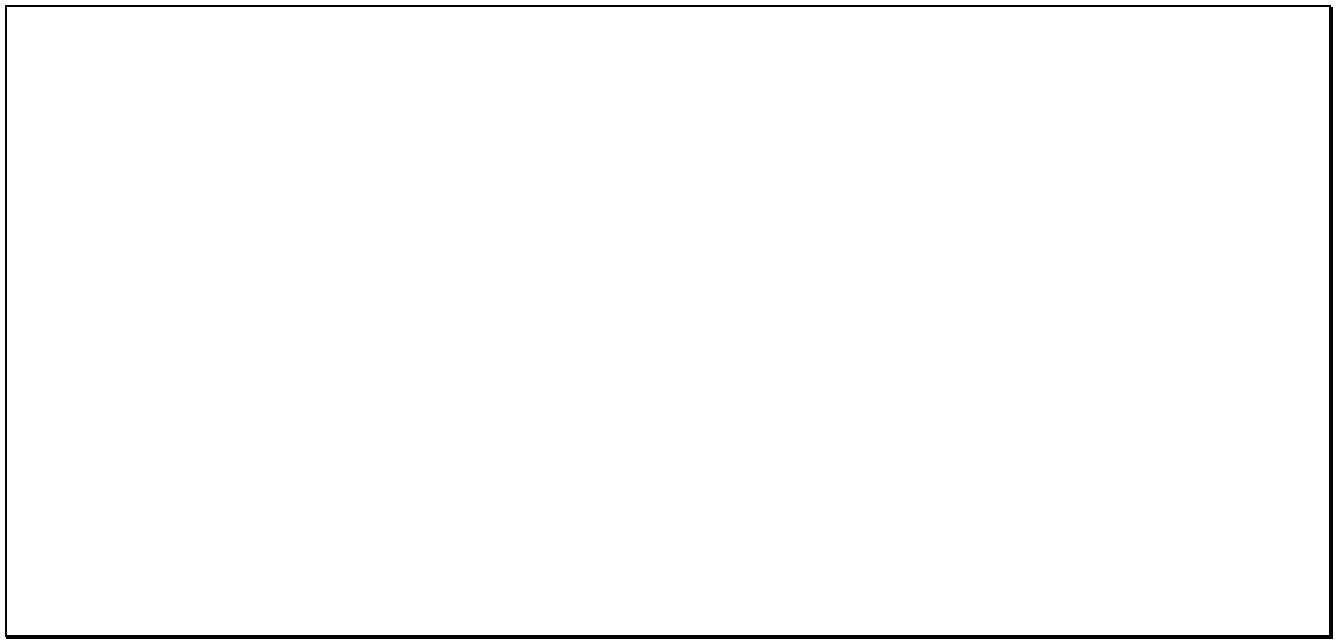
_____

Observe a couple of strands of pond algae, or a drop from a hay infusion.

- Take the algae from the container with a tweezers and place the strands on the slide. TAKE ONLY A COUPLE OF STRANDS or t. will look like a pile of junk under the microscope.
- Add a drop of pond water and a coverslip. You might also need to use Protoslo, if you are using hay infusion, to slow down the creatures in the drop.
- Wipe any water from under the slide with a piece of paper towel.
- Place the slide on the stage and observe under LOW POWER (4x and then 10x)
- Sketch what you see in the box below.

Algae strand or drop of water under low power

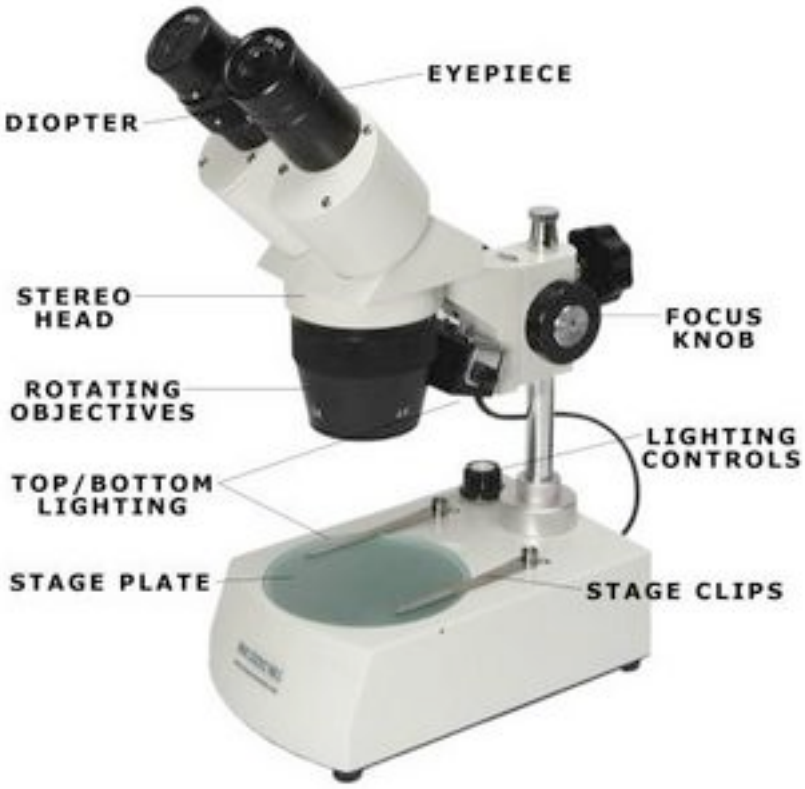
9. Switch the microscope to HIGH POWER (20X) and observe the algae very carefully. Make another sketch in the box below.



Algae strand or drop of water under high power

Part II. Stereo Microscope:

1. Examine the stereo microscope. Working with a partner find as many differences between a compound microscope and a stereo microscope and list them here:



2. Fill in what these parts do:

Microscope part	Function
a. Eye piece	
b. Rotating objects	
c. Stage plate	
d. Focus knob	
e. Lighting controls	

3. Choose an object or an organism to explore under the stereo microscope on the lab desk.

3. Sketch the organisms seen under the stereo microscope. Follow the rules of scientific drawing:

   a. Draw only what you see! Do not include what you think you should see.

   b. All drawings must be done in pencil ONLY.

   c. Drawings must be large and clear so that features can be easily distinguished.

   d. Always use distinctive drawings, do not sketch.

   e. Give your drawing a title, write the magnification and label important features.

Part III. Activity: History of Microscopes

Go to the following web site and write a paper on the history of microscopes:

http://www.hometrainingtools.com/history-of-the-microscope/a/1356/

Or read the History of the Microsope in the *The World of the Microscope Book,* before writing your paper.

Part IV. ELA Activity: Poetry and Science

1. If available, read the book *Microscope* by Maxine Kumin. If this book is not available, substitute another book that is relevant to this exercise.

2. Write a ten-line poem containing some of the words, concepts or activities pertaining to microscopes and things you learned while using materials in this kit.

1._____

2._____

3._____

4._____

5._____

6._____

7._____

8._____

9._____

10._____

Elementary Microscopes

New York State Learning Standards

Standard 1: Analysis, Inquiry, and Design

Scientific Inquiry

Key Idea 1: The purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.

1.2 Question the explanations they hear from others and read about, seeking clarification and comparing them with their own observations and understandings.

Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.

3.2 – Interpret organized observations and measurements, recognizing simple patterns, sequences and relationships.

Standard 4: The Living Environment

Key Idea 1: Living thing are both similar to and different from each other and non-living things.

1.1- Describe characteristics of and variations between living and nonliving things.

Standard 4: The Physical Setting

Key Idea 3: Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

3.1- Observe and describe properties of materials, using appropriate tools.