FOCUS ON SCOPES

TEACHERS NOTES

Recommended year levels: 5-9

OBJECTIVES

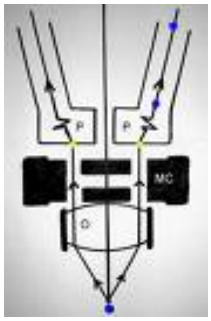
1. To determine the focal length of a hand lens.
2. To correctly use microscopes to make observations
3. To observe the microscopic features of organisms

BACKGROUND INFORMATION

Microscopes are instruments used for viewing objects not visible to the naked eye.

Hand Lens

A hand lens uses a single convex lens to magnify an object. The distance between the lens and the object must be shorter than the focal length of the lens; otherwise the image will appear smaller and inverted. The typical focal length of a hand lens is about 25cm.



Stereo or dissecting microscope

In a stereo microscope, light is reflected from the object being studied. The light travels through two different paths involving different objective lenses and eyepieces; each path leads to a different eye. When the brain processes the two images – one from each eye – a three dimensional visualization of the image is formed.

Compound microscope

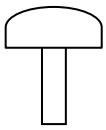
A compound microscope uses a lens placed near the object and another lens in the eyepiece. Light is transmitted through the object.

Scientific Drawing

Human memory is prone to error and forgetfulness so it is important to keep records of observations. Drawings and written notations are recorded in a scientist's journal, which may record years of work.

There are two types of drawings used by scientists: realistic drawings and outline (oval, box and line) drawings.

- Realistic drawings – what the object really looks like. These are usually done made by professional illustrators
- Outline drawings – use ovals, boxes and lines to record quantitative information such as the number of segments in a specimen. Parts of the specimen may also be labeled. Shading and colouring is not normally used.



Information such as the date, time, location and any special conditions such as weather at the time of observation are recorded in writing. Information such as colour or smell may also be noted.

The Magnification must also be recorded. The power of the eyepiece can be located on the eyepiece and will be a number followed by an "X" e.g. 10X. The power of the objective lens is also marked on the objective. Not all simple microscopes will have both the eyepiece and objective lens powers marked; some may just have one position where the magnification power is inscribed on the microscope. If the microscope has both the eyepiece and objective lens magnifications marked then the overall magnification is calculated as follows:

Magnification = eyepiece power x objective lens power.

WHAT YOU NEED

- Hand lens (magnifying glass)
- Stereo microscope
- Compound microscope
- Microscope slides (some with wells if possible)
- Plastic cover slips
- Small jar
- ruler
- Sticky tape
- Newspaper
- Hay or dried grass
- Sterile water (cooled, boiled water)
- Paper towel

Prepare the "E" slide

WHAT TO DO

1. Cut out the letter "e" from a sheet of newspaper.
2. Use a piece of sticky tape to attaché the letter "e" to a flat glass microscope slide. (Alternatively place the letter "e" between two pieces of sticky tape.)

Making a Hay Infusion

The protozoa in the infusion come from the surfaces of the leaves, grasses and hay. They encase themselves in a shell called a cyst until rain falls or they end up in a pool of water like a puddle or pond. Once they are in contact with water they become active.

You may wish to set this up with your students and have them monitor the progress.

WHAT TO DO

1. Wash the jar with hot tap water and allow to cool.
2. Place a handful or crumpled hay or grass in the bottom of the jar.
3. Fill the jar with sterile water and cover with paper toweling.
4. Leave the jar for a few days until the grass begins to sink or the water becomes cloudy.
5. Place a drop of water from the jar onto a microscope slide and cover with a cover slip.

Note: Eventually toxic waste products in the infusion will begin to kill the organisms living in it. A new infusion can be started by transferring a dropper full of the infusion to a new jar containing sterile water and hay/dried grass.

QUESTIONS

1. How has the water in the jar changed over time? *It has become murky and smelly.*
2. What do you think might be happening in the pond water to have caused these changes? *Algae or other small micro-organisms are growing in the water and decomposing the grass.*

Using the Microscope

WHAT TO DO

1. Observe the slide using a hand lens. Complete an outline drawing of what you see. Label your diagram and record all the important information.
2. Adjust the Stereo microscope to low power.
3. Place the slide on the microscope stage. Focus the microscope and draw and label what you see.
4. Adjust the compound light microscope to low power.
5. Put your slide on the microscope stage with the sample over the hole in the stage. Draw and label what you see.
6. Adjust the compound microscope to high power and draw and label what you see.

QUESTIONS

1. Which gave the clearest image, the hand lens, the stereo microscope or the compound microscope? Why? *The hand lens is the least powerful so you see the least details. The two microscopes give different types of views – the stereo is sort of 3D and the compound gives a translucent image.*

2. How does the field of view change as you go from low to high power? *The field of view is broader at low power.*
3. What did you observe in the pond water? *Many single-celled and some multi-cellular micro-organisms.*
4. Were there any similarities between the water from the pond and from the haywater infusion? *This will vary but you will probably see paramecium in both.*

REAL WORLD APPLICATIONS OF MICROSCOPES

Hospitals - In the pathology lab, microscopists take tissue removed during surgery and prepare it for light or electron microscopy. The tissue is studied to aid in diagnosis; the patient's treatment is often based partly on these findings, so the microscopist's role is literally one of life or death.
The Police - Microscopists in the forensic science lab can often help by identifying small pieces of hair, fabric or other materials found at the scene of a serious crime. A person's guilt or innocence is often decided partly on the results of such findings.
Universities and Colleges - Microscopy plays a part in almost every area of study. In biology, materials science, microelectronic design and fabrication, ecology and conservation, medical research, and not least in training the next generation of microscopists.
Museums - Pollen analysis, tree ring dating and other methods help archaeologists date their finds. Microscopy also helps curators understand the structure and state of their exhibits and so plan how to stabilize and preserve fragile objects for display.
Industry - Quality control, analysis of structural failure, product design and development all depend partly on the application of microscopical methods. Many large companies like IBM, Shell and ICI retain large teams of microscopists in well-equipped labs similar to those in universities.

Source: Jefferies, C. (1995). Accessed 18 June 2009. *Making a Living from Microscopy - The Professional Scene*. http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/articles/profess.html

CURRICULUM CONCEPTS ADDRESSED

Essential Learnings:

Ways of working

By the end of Year 5:

- collect and organise data, information and evidence
- select and use tools, technologies and materials suited to the activities and investigations

By the end of Year 7:

- collect and analyse first- and second-hand data, information and evidence
- select and use scientific tools and technologies suited to the investigation
- communicate scientific ideas, data and evidence, using scientific terminology suited to the context and purpose

By the end of Year 9:

Select and use scientific equipment and technologies to enhance the reliability and accuracy of data collected in investigations

Life and Living

By the end of year 5: Living things have relationships with other living things and their environment

By the end of year 7:

- Survival of organisms is dependent on their adaptation to their environment
- Different feeding relationships exist within an ecosystem

By the end of Year 9: In ecosystems, organisms interact with each other and their surroundings

RESOURCES USED TO DEVELOP THIS ACTIVITY

1. Wood, M. (1995). *Magnificent Microworld Adventures*. USA: AIMS Education Foundation.
2. Jefferies, C. (1995). Accessed 18 June 2009. *Making a Living from Microscopy - The Professional Scene* http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/articles/profess.html