Field Studies Council

Invertebrates Under the Microscope

Field Studies Guidance Note

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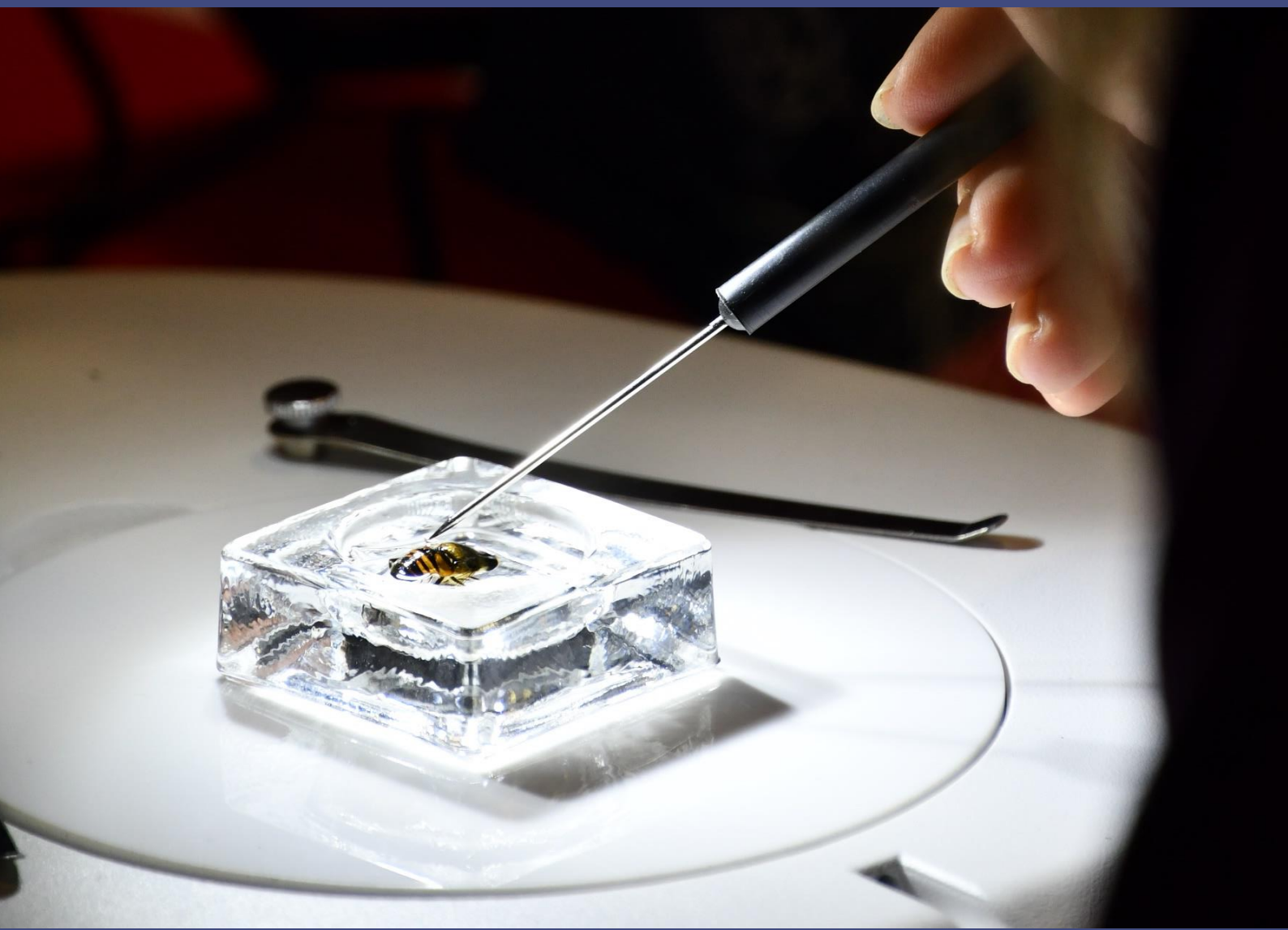

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Observing Invertebrates

Many invertebrates are too small to identify with the naked eye. Therefore, identification will require the use of a hand lens and/or a microscope.

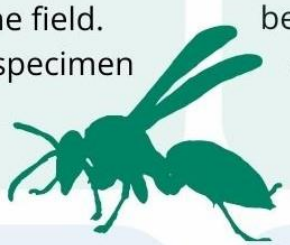
Some of the larger invertebrates can be seen and identified with the naked eye.

Taking photographs of larger invertebrates can aid identification. When doing so, it is a good idea to take several from varying angles, ensuring that the key identification features are in view.

For dragonflies and butterflies, identification can be determined by the patterns, colours and features that are all visible to the human eye.
Close focus binoculars can be used to get a closer look in the field.

Although many invertebrate species are visible to the human eye, their key identification features may not be.

A hand lens can be useful for getting a closer look at a specimen and its identification features in the field. The most common models will magnify the specimen by 10x or 20x.



Social wasps are visible to the human eye, as are their colours and patterns — however, to get an accurate identification, smaller features need to be observed. Social wasps can be trapped in a sample pot, and a hand lens can be used to enhance key features.

If identification features are too small to see clearly with the aid of a hand lens, then a microscope will be required.

Stereo microscopes are commonly used for looking at invertebrates in 3D. However, compound microscopes are used to view tiny invertebrates or mounted features from dissected specimens.

Ants are a good example of a group that requires microscopes to aid identification. They often have tiny features that need to be viewed clearly under a microscope — such as the shape and size of ridges on the clypeus.

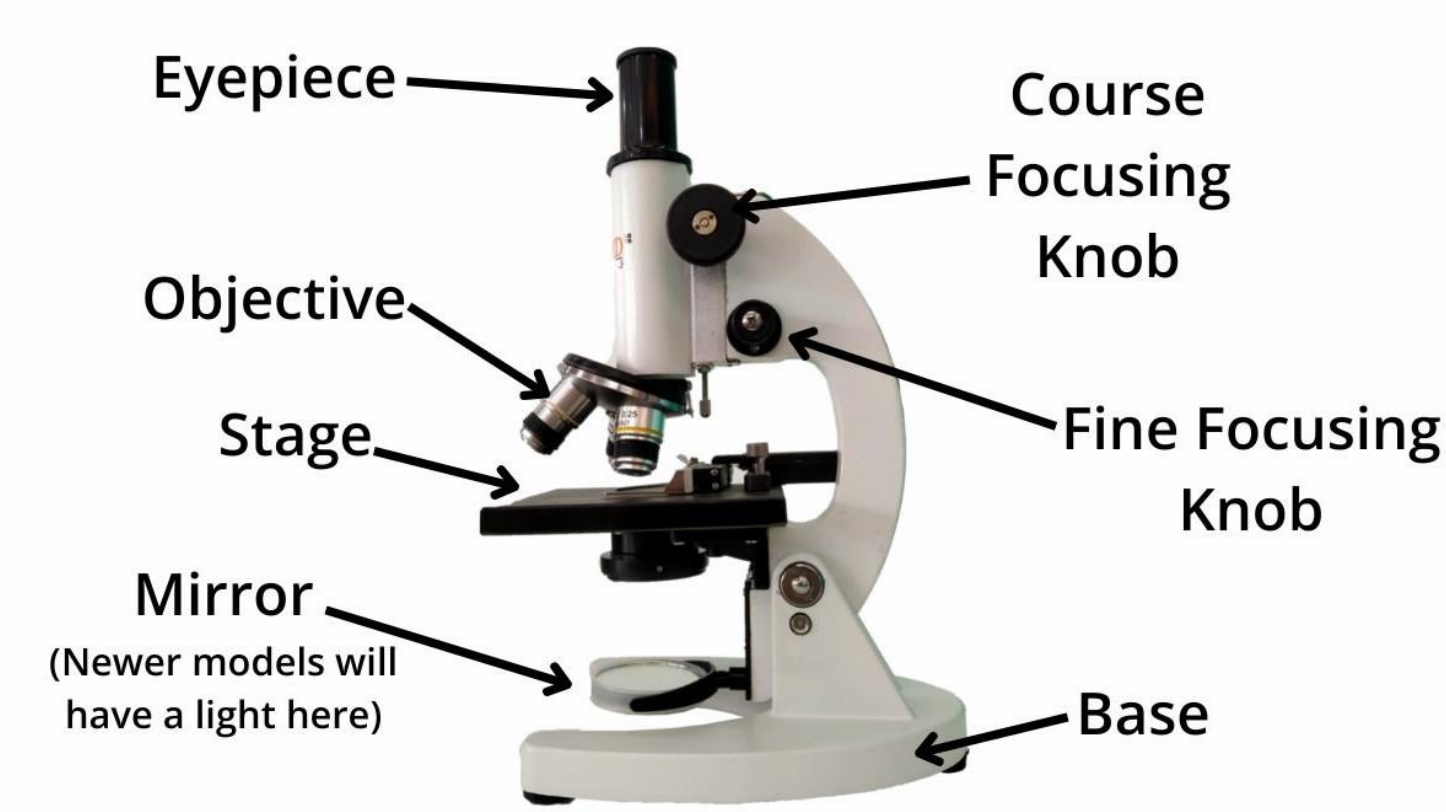
Compound Microscopes

Compound microscopes, also known as biological microscopes, have a higher range of magnification but do not produce a 3D image as all samples need to be mounted onto a prepared slide.

They are used to view features and organisms that are too small to see with a stereo microscope. For invertebrates, sometimes internal features need to be viewed for identification purposes, which will involve the dissection of the specimen and preparing the sample onto a glass slide. These microscopes are also used in other areas of study for looking at things such as blood samples, fungal spores, and bacteria.

They typically have a higher range in magnification, from 40x to 100x and 400x. Some models can go up to 1000x, however, this magnification will come with a larger cost.

These microscopes generally come with a built-in light source, as slides will need to be illuminated for the sample to be seen. The light sits below the slide and projects onto it — generally, the brightness can be altered which will help with the clarity of the image. Some older models may have a mirror on the bottom instead of a light, designed for use under natural light i.e. sat next to a large window. However, the light projected onto the slide may be uneven and investing in an external light source may be required.



Stereo Microscopes

Stereo microscopes, also known as dissecting microscopes or low-power microscopes, create a 3D image that can be seen through two eyepieces.

These are usually used to look at the surface features of larger, more robust specimens that don't require slide preparation (and are commonly used both in entomological and botanical identification). They are also used to dissect mosses, fungi etc., to prepare slides for examination under compound microscopes.

They typically have a magnification of between 10x and 40x. The combination of lower magnification (than a compound microscope) and the 3D image that is created, allows specimens to be manipulated and moved whilst being observed.

Stereo microscopes may come with or without a built-in light source, and light sources may illuminate the specimen from above or below (when using a transparent stage plate).

The stage plates are interchangeable and can be black, white, or transparent.

Light Sources

- **In-built lights** — Some microscopes come with lights incorporated into the microscope stand that illuminate the specimen from above.
- **Goose/Swan Neck Lamps** — The flexible necks of these lamps allow you to move the light and illuminate the specimen from different and multiple angles. You can purchase budget versions of these from homeware stores.
- **Ring Lights** — These produce images that appear flatter due to a reduction in shadows and can be useful for mounted specimens, though they can cause glare when looking at specimens within a liquid.

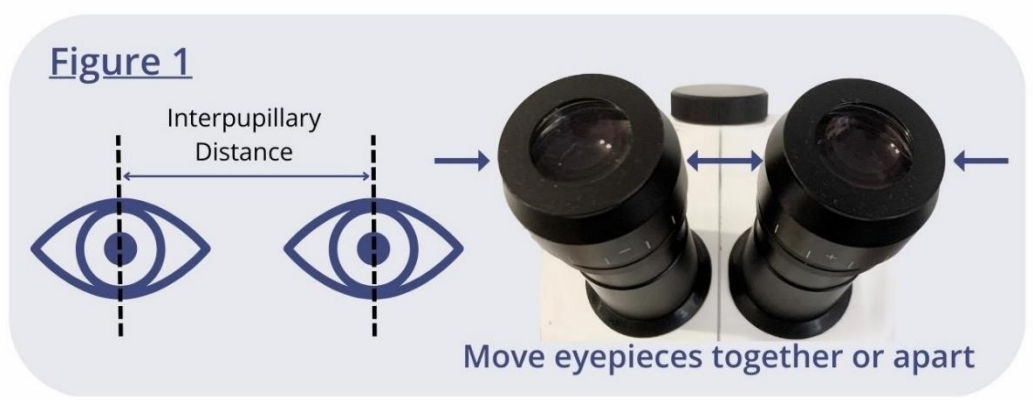
Hot or cold light sources? It's best to use a light source that is considered "cold". With cold light sources the light is generated in the main body of the lamp which then travels along the glass filaments in the neck, so they don't get hot like the old filament lamps — you do not want to get specimens too hot as they can be ruined.

Setting up a Stereo Microscope

1. Make sure the microscope and lights are plugged in and switched on. If you are using an external light source, make sure the lights are angled onto the specimen.

2. Place a specimen on the stage under the objective (make sure the objective cap has been taken off the objective).

3. Adjust the eyepieces to the correct interpupillary distance to suit you. Do this by moving the eyepieces closer together or farther apart until a single field of view is observed (Figure 1).



4. Turn the dioptric adjustment rings on both eyepieces to zero i.e., so the zero matches up with the line on the lower half of the dioptric ring (Figure 2).

5. Use the magnification knob to set the highest magnification.

6. Turn the focus knob to focus on the specimen. Centre the image on a clear point of detail on the specimen.

7. Now, turn the magnification knob to the lowest magnification, the image may be slightly out of focus but do not alter the focus knob.

8. Instead, adjust the dioptric rings for each eye separately. Close one eye and adjust the eyepiece of whichever side you are looking through by turning the dioptric ring until you can clearly view the specimen. Now, switch eyes and do the same to the other eyepiece. Open both eyes and you should be able to see the specimen clearly. Your microscope should now be “parfocal” meaning that as you change the microscope from high to low magnification (using the magnification adjustment knob), the image will stay in focus through the entire range. Everyone will have a different setting so remember to do this any time you start using a different microscope.

Sourcing a Microscope

Once you know what type of microscope works best for your studies, it is a case of purchasing your own or finding study groups that allow you to use their equipment.

The Field Studies Council BioLinks project used microscopes from:

- GT Vision
- Brunel Microscopes

New microscopes are a significant investment, but there are opportunities to buy second-hand models to reduce the cost. Universities and other education centres may sell their old microscopes when updating their equipment.

The Quekett Microscopical Club

This organisation provide a list of 'UK sources of used microscopes' as well as a wealth of information about microscopes and how to use them.

"The Club is the leading organisation for all who are interested in the microscope and microscopy. We have an international membership, with both amateur and professional microscopists who freely share their knowledge with beginners and new members. The Club is a registered charity and 'learned society' – our stated aims are to promote the understanding and use of all aspects of the microscope." - *Quekett Microscopical Club*

https://www.quekett.org/

Our Top Tips

Lighting and contrast are very important when observing specimens down the microscope. Poor contrast or lighting can hinder your chances of finding key features.

- The stage plate is reversible, with a black and white side. If you are struggling to find features, try flipping the stage plate to see if a change in the background provides better contrast.
- More light is better than too little. When looking at morphological features, try moving your lights around to illuminate the specimen from multiple angles.

Some invertebrates (generally those from wet collections) are best observed when immersed in a liquid (e.g ethanol). When observing these through the microscope, ensure the specimen is fully submerged to avoid glare and distortion.

Forceps and a dissecting needle seeker (a needle fixed onto a wooden or plastic handle) enable you to manipulate the specimen and find key features.

Specimens are often symmetrical... If you're struggling to see a feature on one side, check the other side in case it's clearer!

Useful Resources

This guidance note is part of a series that can help you with biological recording. Other documents in the series include:

- Field Studies Guidance Note: Biological Recording
- Field Studies Guidance Note: Grid References for Biological Recording
- Field Studies Guidance Note: Introduction to Taxonomy

All these documents can be downloaded from Applied Ecology Resources.

References

Brown. K. D. (2019) *National Earthworm Recording Scheme: Earthworm Recorder's Handbook*. Earthworm Society of Britain.

Quekett Microscopical Club (2023) *The Quekett Microscopical Club*. Available at: https://www.quekett.org/ (Accessed 12th January 2023)

Field Studies Council

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