

Scottish Beekeepers' Association

Education and Examination Committee



Syllabus

Of Examination in Apiculture

Microscopy Certificate

April 2022 Update

SCOTTISH MICROSCOPY CERTIFICATE

Module 9

April 2024

AIMS

1. To improve the standard and enjoyment of beekeeping in Scotland.
2. To give beekeepers who have an interest in honeybee anatomy, the detection of honeybee pests and diseases and the identification of pollen and honey, the opportunity to obtain the SCOTTISH MICROSCOPY CERTIFICATE.
3. To give the certificate holder the confidence to give beekeepers practical guidance on the selection and use of microscopes, help them to identify a range of pests and diseases and give them advice on where to find further sources of information.

CONDITIONS OF ENTRY

1. The candidate shall have gained the SCOTTISH BASIC BEEKEEPING CERTIFICATE OR the SCOTTISH JUNIOR BEEKEEPER CERTIFICATE, or an equivalent qualification approved by the Education Committee. The date when this certificate was obtained shall be entered on the application form.
2. The candidate shall have owned and managed bees for at least two years.
3. The appropriate application form and fees shall have been received by the Education Convener prior to the deadline published in the Scottish Beekeeper Magazine and on the SBA Website.
4. The candidate shall be a current member of the Scottish Beekeepers Association.

AWARD OF CERTIFICATE

1. The SCOTTISH MICROSCOPY CERTIFICATE will be awarded at three levels:

Pass	60-69%
Credit	70-79%
Distinction	80%+
2. A Candidate who has gained the SCOTTISH MICROSCOPY CERTIFICATE will not be required to sit the DIAGNOSIS OF ADULT BEE DISEASES section of the SCOTTISH APIARIAN CERTIFICATE.

SYLLABUS

General

1. *The Candidate shall provide:*
 - Suitable microscopes – one dissecting stereo (x20 minimum) and one compound (with a range of magnification up to x1000) and incorporating an oil immersion lens.
 - Dissecting containers, tools and instruments.

- Spare microscope slides and cover slips.
 - Stains, fixatives and mountants.
 - 6 pollen slides and 4 anatomy slides prepared by the Candidate from the lists provided in the syllabus.
 - Approximately 40 freshly killed worker bees.
 - The equipment required to embed one or more bees in wax, for dissection purposes.
 - A laboratory coat and safety glasses.
 - Any other equipment the Candidate may require.
2. Material produced by the Candidate during and prior to the examination will be assessed.
 3. The examination will be conducted at a place and time selected by the Education Committee and shall be of a practical and oral nature.
 4. The examination will normally take 2.5 to 3 hours.
 5. Examiner(s) approved by the Education Committee shall conduct the examination. Normally the Examiner(s) will examine the candidate(s) on a one to one basis but Candidates may be examined by more than one examiner and more than one candidate may be examined at one time. Should the Education Committee wish a Trainee Examiner or a member of the Education Committee to be present as an observer this will be indicated ahead of the examination commencing.

1.0 CONSTRUCTION AND PARTS OF A MICROSCOPE

The Candidate shall discuss with the Examiner:

- 1.1 the essential differences between microscopes used for dissection and those used for examining the detail on smears and specimens down to about 0.25 μ m in size;
- 1.2 the difference between reflected light and transmitted light for illuminating the object and how these are achieved in the construction of a microscope;
- 1.3 the concept of lens magnification for both a single lens and a compound system of lenses in simple terms only;
- 1.4 the purpose of the principal parts of the dissecting microscope;
- 1.5 the purpose of the principal parts of the high power microscope.

2.0 PRINCIPLES AND THEORY OF THE LIGHT MICROSCOPES

The Candidate shall discuss with the Examiner:

- 2.1 the range of magnification required for a dissecting microscope suitable for dissecting a honeybee and how this range is achieved;
- 2.2 the range of magnification of a compound microscope suitable for examining specimens for the detection of honeybee diseases except those caused by viruses;
- 2.3 the minimum sized object that can be seen using a light microscope and an elementary

understanding of the dependence of this on the wavelength of light and the numerical aperture of the objective;

- 2.4 the functions of the stage, condenser/mirror, diaphragm, eyepiece, objective lenses, coarse and fine focus and adjusting the condenser focus for optimum clarity of view of the object in the high power microscope;
- 2.5 the optical features to be taken into consideration in the choice of a microscope. For example, good resolution, minimal distortion of image, a flat optical field, par focal and spring-loaded objectives;
- 2.6 what is meant by the term 'depth of field' and its importance;
- 2.7 the use of oil immersion for higher magnifications and the significance of the refractive index of the oil;
- 2.8 the advantages of using filters of different colours;
- 2.9 the use of an eyepiece graticule and its calibration.
- 2.10 the meaning of the numbers printed on compound microscope objective lenses e.g. 40x, 0.65, 160, 0.17

3.0 SETTING UP MICROSCOPES FOR BEE DISEASES AND POLLEN IDENTIFICATION

The Candidate shall demonstrate to the Examiner:

- 3.1 the setting up of a dissecting microscope for the identification of Acarine;
- 3.2 the setting up of a high power microscope for the identification of Nosema and Amoeba;
- 3.3 the setting up of a high power microscope for oil immersion to view very small specimens, eg. pollen and bacteria.

The Candidate shall discuss with the Examiner:

- 3.4 the magnification required for the identification of Acarine, Nosema, Amoeba, AFB and EFB giving the approximate size of the pathogens;
- 3.5 the magnification required for the identification of pollen giving the approximate range of sizes of pollen grains commonly collected by the honeybee in the UK.

4.0 DIAGNOSIS OF ADULT BEE DISEASES AND COLONY INFESTATIONS

The Candidate shall demonstrate to the Examiner:

- 4.1 the dissection and examination of a worker bee for the presence of Acarine;
- 4.2 the preparation and examination of a sample of bees for Nosema and Amoeba.

The Candidate shall discuss with the Examiner:

- 4.3 the identification of worker bees with signs of Deformed Wing Virus or Chronic Paralysis Virus from specimens or images provided by the Examiner;
- 4.4 the identification of two pests from specimens, slides or images provided by the Examiner and discuss the anatomical features that enabled this identification. These pests will be selected by the Examiner from the following list:

Varroa destructor, Tropilaelaps sp, Braula coeca and the larval, pupal and adult stages of Small Hive Beetle, Greater and Lesser Wax Moths;

- 4.5 the size of the sample required for the examination of adult bee diseases and its statistical significance;
- 4.6 how and where the adult bee sample should be taken from the hive and the reasons involved;
- 4.7 the assessment of the level of infection or infestation and the likely outcomes if treatment is withheld;
- 4.8 what advice should be given to beekeepers on the actions to be taken and sources of information in the event of an adult bee disease or colony infestation being identified.

5.0 DIAGNOSIS OF BROOD DISEASES

The Candidate shall discuss with the Examiner:

- 5.1 the key features of American and European Foul brood including the difference between healthy and diseased larvae;
- 5.2 what advice should be given to beekeepers on actions to be taken/sources of information in the event of AFB or EFB being identified;
- 5.3 the identification of Chalk Brood from specimens or images provided by the Examiner.

6.0 POLLEN IDENTIFICATION

The Candidate shall discuss with the Examiner:

- 6.1 the general construction of a pollen grain;
- 6.2 the collection and preparation of pollen from:
 - (a) flowers, (b) pollen loads from the honeybee, (c) honey;
- 6.3 The candidate shall provide six slides, made by the candidate, labelled with the date the slide was made, the scientific name and the approximate grain size, selected from the following list of pollen grains:

Myosotis sylvatica (forget-me-not), *Taraxacum officinale* (dandelion), *Brassica napus* (rape), *Tilia x europaea* (lime), *Acer pseudoplatanus* (sycamore), *Trifolium repens* (clover), *Crocus purpurea* (crocus), *Salix caprea* (willow), *Calluna vulgaris* (ling heather), *Heracleum sphondylium* (hogweed), *Rosmarinus officinalis* (rosemary), *Crataegus monogyna* (hawthorn), *Corylus avellana* (hazel);
- 6.4 how the slides were made and how they should be stored for long term use;
- 6.5 how the size of the pollen on the slides was determined;
- 6.6 identify the pollens on three pollen slides provided by the examiner;
- 6.7 an outline of how microscopic analysis can be used to determine the floral sources and geographic origin of honey samples including the need to take into account the over and under representation of pollen in a multifloral honey;
- 6.8 how the presence of honeydew in a honey sample can be detected by microscopic examination.

7.0 DISSECTION AND ANATOMY OF THE HONEYBEE

- 7.1 the Candidate shall provide freshly killed workers, demonstrate ability to embed them in wax during the examination and be able to perform and discuss the abdominal dissection as requested by the Examiner;
- 7.2 the Candidate shall make and provide for discussion four labelled anatomical slides with one slide made from each of the following four lists. At least three of these slides should be prepared as permanent hard mounts:

List A	List B	List C	List D
Front, middle and hind leg of worker.	Mouthparts of worker (displayed).	Fore and hind wings of worker or drone.	Sperm.
Comparative slide of a hind leg from drone, queen and worker.	Comparative slide of mandibles of drone, queen and worker.	Antennae of both worker and drone.	Two Varroa (one mounted dorsally and the other ventrally).
Everted endophallus of drone genitalia.	Sting of worker or queen.	Portion of trachea.	Hypopharyngeal gland.

8.0 HEALTH AND SAFETY

The Candidate shall discuss with the Examiner:

- 8.1 the potential hazards of working with chemicals, naked flames, microscopes, electrical devices and dissecting instruments;
- 8.2 the need to undertake a risk assessment before commencing any activity of a practical nature;
- 8.3 the need to wear protective clothing, chemical resistant gloves and goggles when handling hazardous chemicals and to always work safely with respect to themselves and others;
- 8.4 the safe disposal of hazardous waste, e.g chemicals, broken glass slides, scalpel blades and remains of bees.

Reading List: See the **Recommended Reading & Information Sources table on the SBA website at Exams, Modules**

ACKNOWLEDGEMENT

The SBA and the BBKA recognise that there is advantages in harmonising their examination syllabuses and assessment standards.

However, the SBA is autonomous in conducting all of its examinations and in issuing of awards.