Microscopy Programme

A Classical Microscopy Programme of Investigations
Version 1.0

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Classical Microscopy Programme of Investigations

⚠ **Safety:** Please read the Safety & Disclaimer page before attempting any of the exercises listed below.

How to Use This Programme

The methods used in the exercises listed below are drawn from the general practice of light microscopy. No claim is made to originality in technique.

Rather, the exercises represent a selection and arrangement of established methods, set out for clarity and ease of use and arranged in a progressive series, beginning with the use of the instrument and proceeding through surface structures, internal organisation, living systems, and development.

Each exercise may be undertaken independently, though it is recommended that Series 0 is completed first.

The programme may also be downloaded as a compiled PDF that includes the structure, safety notes, and individual methods.

Series 0 - Basic Discipline with the Instrument

No.	Investigation	Example Specimens	Typical Source	Aim
0.1	Orientation of the Microscopic Field	Stage micrometer	Prepared slide set	Understand image inversion and field orientation.
0.2	Regulation of Illumination	Prepared slide (any specimen)	Prepared slide set	Learn correct condenser focus and illumination control.
0.3	Comparison of Magnifying Powers	Stage micrometer	Prepared slide set	Compare field size and detail at different objectives.
0.4	Calibration of the Eyepiece Graticule	Stage micrometer	Prepared slide set	Establish measurement capability.
0.5	Observation of Limits of Resolution	Diatom test slide, fine fabric fibres	Prepared slide or household cloth	Observe smallest visible detail under high power.
0.6	Recording Observations	Any specimen previously examined	Any earlier specimen	Practice diagrammatic recording and labelling.

Series I - Surface & Exchange

No.	Investigation	Example Specimens	Typical Source	Aim
I.1	Examination of the Epidermis of a Leaf	Ivy (Hedera helix), privet, laurel	Garden shrub or hedge	Observe epidermal cells and surface pattern.
I.2	Observation of Stomata	Spider plant (Chlorophytum), tradescantia, lily leaf	Houseplant or garden	Study stomatal structure and gas exchange.
I.3	Examination of Plant Hairs (Trichomes)	Tomato leaf, geranium, nettle	Garden plant	Observe protective and sensory plant hairs.
I.4	Examination of the Wing of an Insect	Housefly, crane fly, moth wing	Indoor insect or light trap	Observe membrane structure and veins.
I.5	Observation of the Insect Cuticle	Beetle leg, ant, small fly	Garden or indoors	Study segmentation and protective exoskeleton.
I.6	Examination of the Surface of Pollen Grains	Lily, daisy, dandelion	Garden flower or meadow	Observe sculptured pollen surfaces.

Series II - Reproductive Elements

No.	Investigation	Example Specimens	Typical Source	Aim
II.1	Examination of Pollen from Flowering Plants	Lily, tulip, daisy	Garden flower or florist	Observe pollen grain structure.
II.2	Comparison of Pollen from Different Species	Grass, rose, pine pollen	Garden plants or park	Compare pollen morphology.
II.3	Observation of Fern Spores	Bracken (Pteridium), garden ferns	Woodland or garden fern	Examine sporangia and spores.
II.4	Observation of Moss Capsules	Common moss (Bryum, Funaria)	Damp wall or lawn	Study capsule and spore production.
II.5	Examination of Fungal Spores	Bread mould (Rhizopus), penicillium on fruit	Kitchen food spoilage	Observe fungal reproduction.

Series III - Support & Conduction

No.	Investigation	Example Specimens	Typical Source	Aim
III.1	Cross-Section of an Herbaceous Stem	Ivy stem, sunflower stem	Garden plant or hedge	Identify vascular bundles.
III.2	Cross-Section of a Woody Stem	Young twig of ash, elder, or hawthorn	Hedge or woodland	Observe early woody tissue.
III.3	Examination of Leaf Venation	Ivy leaf, holly leaf	Garden plant or hedge	Observe vascular network.
III.4	Observation of Plant Fibres	Celery stalk, flax fibre	Kitchen vegetable	Examine elongated support cells.
III.5	Examination of Root Structure	Onion root, young seedling roots	Kitchen onion or seedlings	Observe root tissues.
III.6	Longitudinal-Section of an Herbaceous Stem	Cleavers, garlic mustard	Garden plant or hedge	Identify vascular bundles.

Series IV - Aquatic Microscopic Life

No.	Investigation	Example Specimens	Typical Source	Aim
IV.1	Survey of Pond Water	Pond, ditch, rainwater barrel	Pond, ditch, or water butt	Identify diverse microorganisms.
IV.2	Examination of Freshwater Algae	Filamentous algae from pond edge	Pond margin or wet stone	Observe algal cell chains.
IV.3	Observation of Diatoms	Pond water, wet stone scrapings	Pond or stream margin	Study silica frustules.
IV.4	Observation of Protozoa	Stagnant pond sample	Pond or ditch	Observe locomotion and feeding.
IV.5	Observation of Rotifers	Pond water with plant debris	Pond vegetation sample	Examine complex microscopic animals.
IV.6	Observation of Pond Micro-Ecosystem	Mature pond sample after several days	Jar culture of pond sample	Observe interactions among organisms.

Series V - Bud Structure

No.	Investigation	Example Specimens	Typical Source	Aim
V.1	Examination of Bud Scales	Horse chestnut, beech	Tree in park or woodland	Observe protective bud coverings.
V.2	Section of a Dormant Bud	Ivy bud, hawthorn bud	Garden hedge or shrub	Examine embryonic leaves.
V.3	Examination of a Developing Leaf	Opening bud of sycamore or rose	Garden plant or tree	Study leaf differentiation.
V.4	Observation of the Shoot Apex	Young shoot tip of ivy or bean plant	Garden plant or seedling	Observe meristematic growth tissue.

Series VI - Decay & Biological Recycling

No.	Investigation	Example Specimens	Typical Source	Aim
VI.1	Observation of Mould Growth	Bread mould, mouldy fruit	Kitchen food spoilage	Observe fungal hyphae.
VI.2	Examination of Decaying Leaf Tissue	Fallen leaf in compost or damp soil	Compost heap or leaf litter	Observe breakdown of plant cells.
VI.3	Observation of Fungal Spore Structures	Mould growing on citrus peel	Kitchen fruit spoilage	Study spore formation.
VI.4	Examination of Microbial Films	Slimy layer on standing water	Garden pond or water butt	Observe microbial communities.
VI.5	Observation of Soil Micro-Organisms	Garden soil suspended in water	Garden soil	Study organisms involved in decomposition.

Seasonal Calendar

The following calendar indicates periods when specimens for each of the above investigations are most readily obtained in the British Isles. Many investigations remain possible outside these periods depending on local conditions.

No.	Investigation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.1	Orientation of the Microscopic Field	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0.2	Regulation of Illumination	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0.3	Comparison of Magnifying Powers	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0.4	Calibration of the Eyepiece Graticule	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0.5	Observation of Limits of Resolution	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0.6	Recording Observations	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
I.1	Examination of the Epidermis of a Leaf			✔	✔	✔	✔	✔	✔	✔			
I.2	Observation of Stomata			✔	✔	✔	✔	✔	✔	✔			
I.3	Examination of Plant Hairs (Trichomes)			✔	✔	✔	✔	✔	✔	✔			
I.4	Examination of the Wing of an Insect				✔	✔	✔	✔	✔	✔	✔		
I.5	Observation of the Insect Cuticle				✔	✔	✔	✔	✔	✔	✔		
I.6	Examination of the Surface of Pollen Grains			✔	✔	✔	✔						
II.1	Examination of Pollen from Flowering Plants			✔	✔	✔	✔						
II.2	Comparison of Pollen from Different Species			✔	✔	✔	✔						
II.3	Observation of Fern Spores						✔	✔	✔	✔			
II.4	Observation of Moss Capsules	✔	✔	✔	✔	✔						✔	✔
II.5	Examination of Fungal Spores	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
III.1	Cross-Section of an Herbaceous Stem			✔	✔	✔	✔	✔	✔	✔			
III.2	Cross-Section of a Woody Stem	✔	✔	✔	✔					✔	✔	✔	✔
III.3	Examination of Leaf Venation			✔	✔	✔	✔	✔	✔	✔			
III.4	Observation of Plant Fibres	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
III.5	Examination of Root Structure	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
III.6	Longitudinal-Section of an Herbaceous Stem			✔	✔	✔	✔	✔	✔	✔			
IV.1	Survey of Pond Water			✔	✔	✔	✔	✔	✔	✔			
IV.2	Examination of Freshwater Algae				✔	✔	✔	✔	✔	✔			
IV.3	Observation of Diatoms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
IV.4	Observation of Protozoa			✔	✔	✔	✔	✔	✔	✔			
IV.5	Observation of Rotifers			✔	✔	✔	✔	✔	✔	✔			
IV.6	Observation of Pond Micro-Ecosystem				✔	✔	✔	✔	✔	✔			
V.1	Examination of Bud Scales	✔	✔	✔	✔							✔	✔
V.2	Section of a Dormant Bud	✔	✔	✔	✔							✔	✔
V.3	Examination of a Developing Leaf			✔	✔	✔							
V.4	Observation of the Shoot Apex			✔	✔	✔	✔	✔	✔				
VI.1	Observation of Mould Growth	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
VI.2	Examination of Decaying Leaf Tissue									✔	✔	✔	✔
VI.3	Observation of Fungal Spore Structures	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
VI.4	Examination of Microbial Films			✔	✔	✔	✔	✔	✔	✔			
VI.5	Observation of Soil Micro-Organisms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

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⚠️ Safety & Disclaimer

This document records a series of personal microscopy investigations and is provided for general educational interest.

General Guidance

The procedures described are intended for careful, small-scale observation using simple equipment. They assume a basic level of care and familiarity with handling sharp tools, glass slides, and biological specimens.

Use at Your Own Discretion

Anyone choosing to follow these procedures does so at their own risk. The author makes no guarantees as to the completeness, suitability, or safety of the methods described in all circumstances.

Not Professional Instruction

These notes are not a substitute for formal laboratory training or supervised instruction. Where appropriate, standard laboratory safety practices should be followed.

Supervision

Children or inexperienced persons should carry out these activities only under appropriate adult supervision.

Sensible Precautions

In all cases, it is recommended to:

- Handle blades and sharp instruments with care
- Take care when working with glass slides and coverslips
- Avoid handling unknown or potentially harmful specimens
- Wash hands after handling biological material

Plant Material

- Take care when collecting plant material from the wild
    - Some species can be harmful if misidentified
    - In particular, members of the carrot family (Apiaceae), such as cow parsley and hogweed, may be confused with poisonous species such as hemlock
    - **Only collect specimens that can be confidently identified, and avoid handling unfamiliar plants**
- Consider the use of disposable gloves when handling unfamiliar or potentially irritant plants

Fungal Material

- Take care when collecting or handling fungal material (e.g. mushrooms, moulds, spores)
    - Some fungi are toxic; avoid unnecessary handling of unfamiliar species

    - Avoid inhaling spores, particularly from dry specimens or spore prints
    - Do not consume any collected specimens
    - Work in a well-ventilated area when examining spores or moulds
    - Wash hands thoroughly after handling fungal material
- Consider the use of disposable gloves when handling unfamiliar fungal specimens, particularly when working with moist or decaying material

Chemical Stains & Reagents

- Some microscopy stains (e.g. methylene blue, iodine solutions) and mounting media may be irritant or harmful if misused
- Avoid skin and eye contact; use disposable gloves where appropriate
- Do not ingest any chemicals or use laboratory materials in food or drink preparation
- Work in a well-ventilated area when using volatile substances
- Clearly label all containers and store chemicals safely
- Wash hands thoroughly after use

Liability

The author accepts no responsibility for any injury, loss, or damage arising from the use of the information provided on this site.

0.1 Orientation of the Microscopic Field

Aim

To understand the inversion and directional behaviour of the microscopic image.

Specimen & Apparatus

- Stage micrometer slide
- Prepared slide (any specimen with distinct features)
- Compound microscope

Method

1. Place the stage micrometer on the stage and bring it into focus under low power.
2. Observe the scale and note its orientation in the field of view.
3. Gently move the slide to the right and observe the apparent direction of movement in the image.
4. Repeat by moving the slide left, forwards, and backwards.
5. Replace with a prepared specimen slide and repeat the same movements.

Observations to Make

- Direction of image movement relative to stage movement.
- Orientation of the image (inverted or reversed).
- Whether behaviour is consistent across different specimens.

⚠️ Safety note: These methods are shared for general educational interest and assume careful, small-scale work with simple equipment.

Use sharp tools, glass slides, coverslips, stains, and specimens with appropriate care. Avoid unfamiliar or potentially harmful material, and supervise inexperienced users appropriately.

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0.2 Regulation of Illumination

Aim

To learn correct control of illumination using mirror and condenser.

Specimen & Apparatus

- Prepared slide (any specimen)
- Compound microscope with sub-stage condenser and mirror

Method

1. Place the slide on the stage and focus under low power.
2. Adjust the mirror to obtain a bright, even field of illumination.
3. Raise and lower the condenser to observe changes in contrast and clarity.
4. Observe the specimen under varying levels of illumination intensity.
5. Repeat under higher magnification.

Observations to Make

- Effect of condenser height on image contrast and detail.
- Differences between strong and subdued illumination.
- Conditions under which structural detail is most clearly seen.
- Any visual artefacts introduced by excessive or insufficient light.

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0.3 Comparison of Magnifying Powers

Aim

To compare field size and visible detail at different magnifications.

Specimen & Apparatus

- Stage micrometer slide
- Prepared slide (any specimen)
- Compound microscope with multiple objectives

Method

1. Focus the stage micrometer under low power.
2. Observe the number of divisions visible across the field.
3. Change to a higher power objective and refocus.
4. Compare the visible field size and clarity of the scale.
5. Repeat the process using a prepared specimen.

Observations to Make

- Change in field diameter with increasing magnification.
- Increase in visible detail at higher powers.
- Reduction in depth of field.
- Any change in brightness or ease of focusing.

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0.4 Calibration of the Eyepiece Graticule

Aim

To establish the scale value of the eyepiece graticule for measurement.

Specimen & Apparatus

- Stage micrometer slide
- Eyepiece graticule
- Compound microscope

Method

1. Insert the eyepiece graticule into the eyepiece.
2. Place the stage micrometer on the stage and bring into focus.
3. Align the graticule scale with the micrometer scale.
4. Determine how many graticule divisions correspond to a known length on the micrometer.
5. Repeat for each objective lens.

Observations to Make

- Number of graticule divisions matching known micrometer distances.
- Variation in scale value between objectives.
- Consistency of alignment across the field.
- Ease or difficulty of precise alignment.

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0.5 Observation of Limits of Resolution

Aim

To observe the limits of detail visible under high magnification.

Specimen & Apparatus

- Diatom test slide or fine fabric fibres
- Compound microscope (high power objective)

Method

1. Place the specimen on the stage and focus under low power.
2. Increase to higher magnification and refocus carefully.
3. Adjust illumination and condenser position to optimise clarity.
4. Examine the finest visible structures in the specimen.

Observations to Make

- Smallest distinguishable structures or lines.
- Points at which detail becomes indistinct or merges.
- Effect of illumination on resolving fine detail.
- Differences between specimens (if more than one is used).

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0.6 Recording Observations

Aim

To practice clear diagrammatic recording of microscopic specimens.

Specimen & Apparatus

- Any previously examined specimen
- Microscope
- Notebook and drawing materials

Method

1. Select a specimen already familiar from earlier observation.
2. Bring the specimen into clear focus at a suitable magnification.
3. Observe the main structural features carefully.
4. Produce a simple line drawing representing the specimen.
5. Add labels to identify key structures.

Observations to Make

- Relative proportions and arrangement of structures.
- Clarity and simplicity of the diagram.
- Accuracy of labelled features.
- Features that are easily observed versus those requiring careful attention.

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I.1 Examination of the Epidermis of a Leaf

Aim

To observe the arrangement and form of epidermal cells in a leaf.

Specimen & Apparatus

- Fresh leaf (e.g. ivy, privet, or laurel)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove a small portion of the leaf.
2. Gently peel a thin strip of the epidermis from the surface using forceps.
3. Place the peel in a drop of water on a slide.
4. Apply a coverslip carefully to avoid air bubbles.
5. Examine under low power, then increase magnification.

Observations to Make

- Shape and arrangement of epidermal cells.
- Appearance of cell walls.
- Presence or absence of chloroplasts.
- Regularity or variation in the cellular pattern.

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I.2 Observation of Stomata

Aim

To study the structure and distribution of stomata in a leaf epidermis.

Specimen & Apparatus

- Fresh leaf (e.g. spider plant, tradescantia, or lily)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Prepare an epidermal peel from the lower surface of the leaf.
2. Mount the peel in a drop of water on a slide.
3. Apply a coverslip carefully.
4. Focus under low power and locate stomata.
5. Increase magnification for detailed examination.

Observations to Make

- Shape and arrangement of guard cells.
- Form of the stomatal aperture.
- Distribution of stomata across the surface.
- Differences between surrounding epidermal cells and guard cells.

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I.3 Examination of Plant Hairs (Trichomes)

Aim

To observe the structure and form of plant hairs (trichomes).

Specimen & Apparatus

- Leaf (e.g. tomato, geranium, or nettle)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove a small portion of the leaf bearing visible hairs.
2. Place directly on a slide in a drop of water.
3. Apply a coverslip gently.
4. Examine under low power to locate hairs.
5. Increase magnification to observe structure.

Observations to Make

- Shape and size of trichomes.
- Whether hairs are simple or branched.
- Distribution across the leaf surface.
- Any internal structure visible within the hairs.

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I.4 Examination of the Wing of an Insect

Aim

To observe the structure of an insect wing, including membrane and veins.

Specimen & Apparatus

- Insect wing (e.g. housefly, crane fly, or moth)
- Slide and coverslip
- Water (if required)
- Compound microscope

Method

1. Remove a wing carefully from the specimen.
2. Place the wing flat on a slide.
3. Add a small drop of water if needed to improve contact.
4. Apply a coverslip gently.
5. Examine under low and then higher magnification.

Observations to Make

- Pattern and branching of veins.
- Transparency and texture of the membrane.
- Presence of hairs or scales.
- Variation in thickness across the wing.

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I.5 Observation of the Insect Cuticle

Aim

To study the structure of the insect cuticle and segmentation.

Specimen & Apparatus

- Insect part (e.g. beetle leg, ant, or small fly)
- Slide and coverslip
- Water or glycerine (optional)
- Compound microscope

Method

1. Place the specimen or part on a slide.
2. Add a drop of water or glycerine if required.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall structure.
5. Increase magnification to study surface detail.

Observations to Make

- Segmentation of the cuticle.
- Surface texture and patterning.
- Presence of joints or articulation points.
- Any fine structures such as hairs or spines.

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I.6 Examination of the Surface of Pollen Grains

Aim

To observe the external form and surface patterning of pollen grains.

Specimen & Apparatus

- Fresh pollen (e.g. lily, daisy, or dandelion)
- Slide and coverslip
- Water
- Compound microscope

Method

1. Transfer a small quantity of pollen to a slide.
2. Add a drop of water to disperse the grains.
3. Apply a coverslip gently.
4. Examine under low power to locate grains.
5. Increase magnification to observe surface detail.

Observations to Make

- Shape and size of pollen grains.
- Surface texture or sculpturing.
- Presence of apertures or pores.
- Variation between grains (if present).

⚠️ Safety note: These methods are shared for general educational interest and assume careful, small-scale work with simple equipment.

Use sharp tools, glass slides, coverslips, stains, and specimens with appropriate care. Avoid unfamiliar or potentially harmful material, and supervise inexperienced users appropriately.

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II.1 Examination of Pollen from Flowering Plants

Aim

To observe the form and surface structure of pollen grains.

Specimen & Apparatus

- Fresh flower (e.g. lily, tulip, or daisy)
- Needle or fine brush
- Slide and coverslip
- Water
- Compound microscope

Method

1. Collect a small quantity of pollen from the anthers using a needle or brush.
2. Transfer the pollen to a slide.
3. Add a small drop of water to disperse the grains.
4. Apply a coverslip carefully.
5. Examine under low power to locate grains, then increase magnification.

Observations to Make

- General shape and size of pollen grains.
- Surface texture or sculpturing.
- Presence of apertures or pores.
- Degree of uniformity among grains.

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II.2 Comparison of Pollen from Different Species

Aim

To compare the form and structure of pollen from different plant species.

Specimen & Apparatus

- Pollen from at least two species (e.g. grass, rose, pine)
- Needle or fine brush
- Slide and coverslip
- Water
- Compound microscope

Method

1. Prepare separate slides for each pollen type, or mount small samples on the same slide with spacing.
2. Add a drop of water to each sample.
3. Apply coverslip carefully.
4. Examine each sample under the same magnification.
5. Compare features directly by alternating between specimens.

Observations to Make

- Differences in size and shape between species.
- Variation in surface texture or ornamentation.
- Presence and form of apertures.
- Degree of variability within each sample.

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II.3 Observation of Fern Spores

Aim

To examine the structure of fern sporangia and spores.

Specimen & Apparatus

- Fertile fern frond (e.g. bracken or garden fern)
- Needle or forceps
- Slide and coverslip
- Water
- Compound microscope

Method

1. Locate sori (clusters of sporangia) on the underside of the frond.
2. Remove a small portion using a needle or forceps.
3. Place on a slide and add a drop of water.
4. Gently tease the material to release spores if necessary.
5. Apply a coverslip and examine under low and then higher magnification.

Observations to Make

- Arrangement of sporangia within the sorus.
- Shape and appearance of individual spores.
- Relative size of spores compared to surrounding structures.
- Any visible surface detail on spores.

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II.4 Observation of Moss Capsules

Aim

To study the structure of moss capsules and their role in spore production.

Specimen & Apparatus

- Moss with capsules (e.g. Bryum or Funaria)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Select a moss plant bearing visible capsules.
2. Remove a capsule using forceps.
3. Place on a slide with a drop of water.
4. Gently open or compress the capsule to release contents if required.
5. Apply a coverslip and examine under low and higher magnification.

Observations to Make

- Shape and structure of the capsule.
- Presence and appearance of spores.
- Any internal structures visible within the capsule.
- Differences between intact and opened capsules.

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II.5 Examination of Fungal Spores

Aim

To observe the structure and distribution of fungal spores.

Specimen & Apparatus

- Fungal growth (e.g. bread mould or penicillium on fruit)
- Needle or mounted pin
- Slide and coverslip
- Water
- Compound microscope

Method

1. Using a needle, collect a very small portion of the fungal material.
2. Transfer to a slide and add a drop of water.
3. Gently tease the material to separate structures.
4. Apply a coverslip carefully.
5. Examine under low power, then increase magnification.

Observations to Make

- Presence and arrangement of spores.
- Shape and size of individual spores.
- Relationship between spores and supporting structures.
- Any variation within the sample.

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III.1 Cross-Section of an Herbaceous Stem

Aim

To identify vascular bundles and general structure in a soft plant stem.

Specimen & Apparatus

- Fresh stem (e.g. ivy or sunflower)
- Sharp blade or razor
- Slide and coverslip
- Water
- Compound microscope

Method

1. Cut a thin transverse section of the stem using a sharp blade.
2. Transfer the section to a slide with a drop of water.
3. Apply a coverslip carefully.
4. Examine under low power to locate major structures.
5. Increase magnification to observe detail.

Observations to Make

- Arrangement of vascular bundles within the stem.
- Differences between outer and inner tissues.
- Shape and distribution of cells in each region.
- Presence of any central cavity or pith.

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III.2 Cross-Section of a Woody Stem

Aim

To observe the structure of early woody tissue in a young stem.

Specimen & Apparatus

- Young woody twig (e.g. ash, elder, or hawthorn)
- Sharp blade or razor
- Slide and coverslip
- Water
- Compound microscope

Method

1. Cut a thin transverse section of the twig.
2. Place the section on a slide in a drop of water.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall structure.
5. Increase magnification to study finer details.

Observations to Make

- Thickness and structure of outer layers.
- Presence and arrangement of woody tissue.
- Differences between inner and outer regions.
- Any evidence of growth patterns or rings.

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III.3 Examination of Leaf Venation

Aim

To observe the arrangement of veins within a leaf.

Specimen & Apparatus

- Leaf (e.g. ivy or holly)
- Slide and coverslip
- Water
- Compound microscope

Method

1. Cut a small, thin portion of the leaf including visible veins.
2. Place the specimen on a slide with a drop of water.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall venation.
5. Increase magnification to examine finer vein structure.

Observations to Make

- Pattern and branching of veins.
- Relative thickness of major and minor veins.
- Arrangement of surrounding tissue.
- Any variation across different regions of the leaf.

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III.4 Observation of Plant Fibres

Aim

To examine the structure of elongated plant cells used for support.

Specimen & Apparatus

- Plant material (e.g. celery stalk or flax fibre)
- Needle or forceps
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove a small portion of fibrous material from the specimen.
2. Tease apart the fibres using a needle if necessary.
3. Place on a slide with a drop of water.
4. Apply a coverslip carefully.
5. Examine under low and then higher magnification.

Observations to Make

- Length and shape of individual fibres.
- Arrangement and alignment of fibres.
- Thickness of cell walls.
- Any internal structure visible within fibres.

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III.5 Examination of Root Structure

Aim

To observe the internal structure of a plant root.

Specimen & Apparatus

- Onion root or young seedling root
- Sharp blade or razor
- Slide and coverslip
- Water
- Compound microscope

Method

1. Cut a thin transverse section of the root.
2. Place the section on a slide in a drop of water.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall structure.
5. Increase magnification to study finer detail.

Observations to Make

- Arrangement of tissues within the root.
- Differences between outer and inner regions.
- Shape and organisation of cells.
- Presence of any central structures.

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III.6 Longitudinal Section of an Herbaceous Stem

Aim

To observe the longitudinal arrangement of tissues in a soft plant stem, including epidermis, vascular elements, and pith.

Specimen & Apparatus

- Fresh herbaceous stem (e.g. cleavers, garlic mustard, or similar)
- Sharp blade or razor
- Slide and coverslip
- Water
- Compound microscope

Method

1. Select a fresh stem segment, preferably including an internode.
2. Secure the specimen to maintain alignment (e.g. lightly held or fixed at the ends).
3. Using a sharp blade, draw along the length of the stem to obtain a thin longitudinal section.
4. Transfer the section to a slide with a drop of water.
5. Apply a coverslip carefully.
6. Examine under low power to observe general structure.
7. Increase magnification to examine finer detail.

Observations to Make

- Alignment of cells along the axis of the stem.
- Differences between outer (epidermal), intermediate (cortical), and inner (pith) tissues.
- Presence of elongated, tube-like vascular elements.
- Surface features such as hairs or projections.
- Differences between node and internode regions (if present).

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IV.1 Survey of Pond Water

Aim

To identify a range of microscopic organisms present in natural water.

Specimen & Apparatus

- Pond, ditch, or rainwater sample
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Collect a small sample of water, including some sediment if present.
2. Transfer a drop to a slide using a pipette.
3. Apply a coverslip carefully.
4. Examine under low power to locate organisms.
5. Increase magnification to observe detail.

Observations to Make

- Variety of organisms present in the sample.
- Differences in size, shape, and movement.
- Distribution of organisms within the drop.
- Presence of plant material or debris.

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IV.2 Examination of Freshwater Algae

Aim

To observe the structure of filamentous algae.

Specimen & Apparatus

- Filamentous algae from pond edge or wet surface
- Forceps or pipette
- Slide and coverslip
- Water
- Compound microscope

Method

1. Collect a small portion of algae.
2. Place on a slide with a drop of water.
3. Arrange the filaments so they lie flat.
4. Apply a coverslip carefully.
5. Examine under low and then higher magnification.

Observations to Make

- Arrangement of cells within filaments.
- Shape and size of individual cells.
- Presence of internal structures.
- Any variation along the filament.

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IV.3 Observation of Diatoms

Aim

To study the form and structure of diatom frustules.

Specimen & Apparatus

- Pond water or scrapings from wet stone
- Pipette or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Place a drop of the sample on a slide.
2. Apply a coverslip carefully.
3. Examine under low power to locate diatoms.
4. Increase magnification to observe detail.
5. Adjust illumination to enhance contrast.

Observations to Make

- Shape and symmetry of diatoms.
- Presence of fine surface markings.
- Variation in form between individuals.
- Clarity of detail under different illumination.

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IV.4 Observation of Protozoa

Aim

To observe the movement and behaviour of protozoa.

Specimen & Apparatus

- Stagnant pond or ditch water sample
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Place a drop of water on a slide.
2. Apply a coverslip carefully, avoiding excessive pressure.
3. Examine under low power to locate moving organisms.
4. Increase magnification to observe behaviour.
5. Adjust illumination as needed to improve visibility.

Observations to Make

- Types of movement (e.g. gliding, swimming).
- Changes in shape during movement.
- Interaction with surrounding material.
- Any visible internal structures.

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IV.5 Observation of Rotifers

Aim

To examine the structure and movement of rotifers.

Specimen & Apparatus

- Pond water with plant debris
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Transfer a drop of water containing debris to a slide.
2. Apply a coverslip carefully.
3. Examine under low power to locate organisms.
4. Increase magnification to observe structure and movement.
5. Adjust illumination to improve contrast.

Observations to Make

- Body shape and segmentation.
- Movement and feeding behaviour.
- Presence of rotating structures at the head.
- Interaction with surrounding particles.

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IV.6 Observation of Pond Micro-Ecosystem

Aim

To observe interactions between different organisms in a pond sample over time.

Specimen & Apparatus

- Pond water sample maintained for several days
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Allow a collected pond sample to stand in a container for several days.
2. Gently mix the sample before taking a drop.
3. Transfer a drop to a slide.
4. Apply a coverslip carefully.
5. Examine under low and higher magnification.

Observations to Make

- Variety of organisms present.
- Interactions between organisms.
- Changes in the sample over time.
- Distribution of organisms within the sample.

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V.1 Examination of Bud Scales

Aim

To observe the structure of protective bud scales.

Specimen & Apparatus

- Bud (e.g. horse chestnut or beech)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove a bud from the plant.
2. Carefully separate one or more outer scales using forceps.
3. Place the material on a slide with a drop of water.
4. Apply a coverslip gently.
5. Examine under low and then higher magnification.

Observations to Make

- Shape and thickness of bud scales.
- Surface texture and structure.
- Arrangement of layers within the scale.
- Any variation between outer and inner scales.

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V.2 Section of a Dormant Bud

Aim

To examine the internal structure of a dormant bud.

Specimen & Apparatus

- Bud (e.g. ivy or hawthorn)
- Sharp blade or razor
- Slide and coverslip
- Water
- Compound microscope

Method

1. Cut the bud longitudinally using a sharp blade.
2. Select a thin section from the cut surface.
3. Place the section on a slide in a drop of water.
4. Apply a coverslip carefully.
5. Examine under low power, then increase magnification.

Observations to Make

- Arrangement of internal structures within the bud.
- Presence of folded or undeveloped leaves.
- Differences between outer and inner regions.
- Compactness of tissues.

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V.3 Examination of a Developing Leaf

Aim

To study the structure of a leaf during early development.

Specimen & Apparatus

- Young leaf from an opening bud (e.g. sycamore or rose)
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove a young, partially expanded leaf from a bud.
2. Place a small portion on a slide with a drop of water.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall form.
5. Increase magnification to study finer structure.

Observations to Make

- Degree of leaf expansion and folding.
- Early development of veins.
- Shape and arrangement of cells.
- Differences between developing and mature tissue (if known).

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V.4 Observation of the Shoot Apex

Aim

To observe the structure of the growing tip of a plant shoot.

Specimen & Apparatus

- Young shoot tip (e.g. ivy or bean seedling)
- Sharp blade or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Remove the tip of a young shoot.
2. Prepare a thin longitudinal section if possible, or examine a small portion directly.
3. Place on a slide with a drop of water.
4. Apply a coverslip carefully.
5. Examine under low power, then increase magnification.

Observations to Make

- Shape and organisation of the shoot tip.
- Presence of very small, closely packed cells.
- Arrangement of developing structures around the apex.
- Differences between the tip and more mature regions.

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VI.1 Observation of Mould Growth

Aim

To observe the structure of fungal hyphae in mould.

Specimen & Apparatus

- Mould (e.g. bread or fruit)
- Needle or mounted pin
- Slide and coverslip
- Water
- Compound microscope

Method

1. Using a needle, collect a very small portion of mould.
2. Transfer to a slide with a drop of water.
3. Gently tease the material to separate structures.
4. Apply a coverslip carefully.
5. Examine under low power, then increase magnification.

Observations to Make

- Presence of filamentous hyphae.
- Arrangement and branching of filaments.
- Differences in thickness or density.
- Relationship between hyphae and surrounding material.

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VI.2 Examination of Decaying Leaf Tissue

Aim

To observe structural changes in plant tissue during decay.

Specimen & Apparatus

- Decaying leaf material
- Forceps or needle
- Slide and coverslip
- Water
- Compound microscope

Method

1. Select a small portion of softened leaf tissue.
2. Place on a slide with a drop of water.
3. Gently tease apart the material if required.
4. Apply a coverslip carefully.
5. Examine under low and then higher magnification.

Observations to Make

- Breakdown of cell structure.
- Presence of microorganisms or fungal growth.
- Changes in colour or texture of tissue.
- Differences between intact and degraded areas.

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VI.3 Observation of Fungal Spore Structures

Aim

To study the structures associated with fungal spore production.

Specimen & Apparatus

- Mould (e.g. on citrus peel)
- Needle or mounted pin
- Slide and coverslip
- Water
- Compound microscope

Method

1. Collect a small portion of mould using a needle.
2. Transfer to a slide with a drop of water.
3. Tease apart gently to expose structures.
4. Apply a coverslip carefully.
5. Examine under low and then higher magnification.

Observations to Make

- Presence of spore-bearing structures.
- Arrangement of spores on supporting filaments.
- Shape and size of spores.
- Differences between vegetative and reproductive structures.

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VI.4 Examination of Microbial Films

Aim

To observe the structure of microbial communities forming surface films.

Specimen & Apparatus

- Surface film from standing water
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Collect a small sample of the surface film using a pipette.
2. Place a drop on a slide.
3. Apply a coverslip carefully.
4. Examine under low power to observe overall structure.
5. Increase magnification to study finer detail.

Observations to Make

- Structure and consistency of the film.
- Presence of different types of organisms.
- Arrangement of material within the film.
- Any visible movement or activity.

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VI.5 Observation of Soil Micro-Organisms

Aim

To study microorganisms present in soil suspensions.

Specimen & Apparatus

- Garden soil
- Water
- Small container
- Pipette or dropper
- Slide and coverslip
- Compound microscope

Method

1. Mix a small quantity of soil with water in a container.
2. Allow heavier particles to settle briefly.
3. Transfer a drop of the suspension to a slide.
4. Apply a coverslip carefully.
5. Examine under low and then higher magnification.

Observations to Make

- Variety of organisms present.
- Differences in size and movement.
- Distribution of organisms within the sample.
- Presence of particulate matter and organic debris.

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