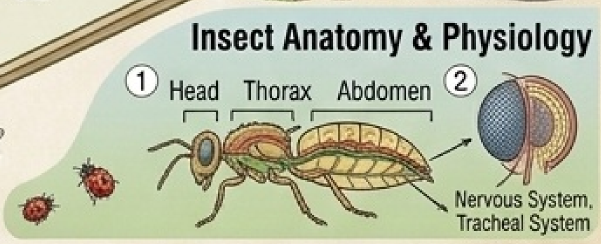
T.Y. B.Sc ZOOLOGY

JOURNAL

GOGATE JOGALEKAR COLLEGE (AUTONOMOUS)
RATNAGIRI
DEPARTMENT OF ZOOLOGY

Course Code: 25_USZOV511
Topic:- Entomology and Pest Management Practical
Credit:- 02



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R. E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE

AND

R. V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS), RATNAGIRI

NAAC Accredited 'A' Grade (4th Cycle)

Ratnagiri – 415612, Maharashtra, India

CERTIFICATE

This is to certify that Mr./Ms. ____ of T. Y. B. Sc. (Bachelor of Science) has satisfactorily completed and submitted the Practical Journal of Zoology (VSC) prescribed under the autonomous syllabus for Semester V/VI during the academic year 20 – 20 . The journal contains a record of practical work performed by the student according to the syllabus of the Bachelor of Science (B.Sc.) Programme of this college.

Course Teacher | Head, Department of Zoology

Place: Ratnagiri | Date: / / 20

1. COURSE OUTCOMES

After successful completion of the **T.Y. B.Sc. Zoology – VSC Practical Course**, students will be able to:

CO1: Apply knowledge of insect diversity, morphology, taxonomy and behaviour in the practical study and identification of insects.

CO2: Understand the ecological roles of insects, particularly in pollination, biological interactions and ecosystem functioning.

CO3: Develop an understanding of the economic importance of insects in apiculture, sericulture, agriculture and pest management.

CO4: Apply the principles of insect pest monitoring, damage assessment and sustainable pest management, including Integrated Pest Management and biological control.

CO5: Understand the principles underlying the classification, mode of action and responsible use of insect pest-control methods.

CO6: Develop scientific skills in field observation, specimen documentation, experimentation, data recording, analysis and interpretation while following appropriate safety, environmental and ethical practices.

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2. PRACTICAL LEARNING OUTCOMES

After completing the practical course, students will be able to:

1. Collect and identify selected insects using appropriate collection methods and basic taxonomic keys.
2. Observe and identify important morphological features, appendages and sensory organs of insects.
3. Prepare, mount, pin, label and preserve insect specimens using appropriate techniques.
4. Record and interpret selected insect behaviours using systematic observation methods.
5. Document insect pollinators and record their visitation patterns and floral associations.
6. Identify the important stages and economic products associated with honeybees and silkworms.
7. Study insect responses to light and record the diversity of insects attracted under field conditions.
8. Identify important crop and stored-product pests and assess the nature and extent of pest damage.
9. Prepare an Integrated Pest Management plan using appropriate cultural, mechanical, biological and other prescribed control approaches.
10. Observe and evaluate the role of biological control agents in insect pest management.
11. Classify insecticides on the basis of available label information and modes of action.
12. Document anti-predator adaptations and defensive mechanisms in selected insects.
13. Record observations from prescribed comparative efficacy or bioassay studies and interpret the experimental data.
14. Prepare comparative documentation on traditional, modern and integrated pest-control techniques.
15. Maintain systematic field and laboratory records using appropriate tables, calculations, graphs, diagrams and scientific terminology.
16. Follow laboratory and field safety procedures and environmentally responsible practices during practical work.

3. GENERAL LABORATORY AND FIELD RULES

1. Students must attend practical and field sessions regularly and report at the prescribed time.
2. Students should bring the practical journal, field notebook and necessary stationery to every practical session.
3. Instructions provided by the teacher must be understood before beginning any laboratory or field activity.
4. The laboratory bench and working area should be kept clean and organised.
5. Insects, preserved specimens, slides and other biological materials should be handled carefully and responsibly.
6. Collection and observation of insects should be carried out only in areas and by methods permitted by the teacher or institution.
7. Students should avoid unnecessary disturbance or destruction of insects and their habitats.
8. All collecting equipment, microscopes, hand lenses and other instruments should be handled carefully.
9. Labels on chemicals, preservatives and other laboratory materials must be read carefully before use.
10. Chemicals and reagents should be used only in the prescribed quantity and under appropriate supervision.
11. Unused chemicals should not be returned to their original containers.
12. Eating and drinking inside the laboratory are strictly prohibited.
13. Mobile phones may be used for photography or documentation only when permitted for academic purposes.
14. All specimens and equipment should be returned to their designated places after use.
15. Any injury, insect sting, allergic reaction, chemical spill, breakage or equipment malfunction should be reported immediately to the teacher.
16. Students should not conduct unauthorised experiments or handle hazardous materials without supervision.
17. Laboratory and field waste should be disposed of according to institutional procedures.
18. Hands should be washed thoroughly after completing laboratory or field activities.
19. Discipline, cleanliness and responsible scientific conduct must be maintained at all times.

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4. SAFETY PRECAUTIONS

1. Always follow the instructions of the teacher and laboratory or field supervisor.
2. Wear appropriate protective clothing and footwear during field visits and practical sessions, wherever required.
3. Avoid direct contact with chemicals, preservatives, insecticides and other potentially hazardous materials.
4. Chemicals or biological materials should never be tasted or intentionally inhaled.
5. Mouth pipetting is strictly prohibited.
6. Insect specimens should be handled carefully to avoid bites, stings or allergic reactions.
7. Students should avoid handling unknown live insects with bare hands.
8. When using collecting equipment, pins, needles or forceps, work carefully to avoid injury.
9. Insect pins and other sharp instruments should be stored safely after use.
10. Preservatives and chemical agents should be handled only under proper supervision and according to laboratory instructions.
11. Experiments involving insecticides, repellents or other pest-control agents should be performed only with prescribed materials and under the supervision of the concerned teacher.
12. Pesticide formulations should not be opened, mixed or used beyond the requirements of the prescribed practical activity.

13. Field studies should be conducted with due consideration for weather conditions, terrain and local environmental conditions.
14. Students should avoid entering restricted, unsafe or private areas without appropriate permission.
15. Collection activities should minimise unnecessary harm to non-target organisms and the environment.
16. Any experiment involving live organisms should follow applicable institutional and ethical guidelines.
17. In case of an accident, sting, chemical exposure or injury, inform the teacher immediately.
18. Students should be aware of the location of the first-aid facilities and emergency contacts during field activities.
19. Wash hands thoroughly before leaving the laboratory or field site.
20. Follow all institutional safety, environmental and ethical guidelines applicable to the practical course.

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5. INSTRUCTIONS FOR MAINTAINING THE PRACTICAL JOURNAL

1. The practical journal should be maintained neatly and regularly throughout the academic year.
2. The student's name, class, division, roll number and academic year should be clearly mentioned in the appropriate spaces.
3. An index of practicals should be maintained at the beginning of the journal.
4. Each practical should be recorded according to the prescribed sequence.
5. Every practical should include, wherever applicable:
    - Practical Number and Title
    - Date
    - Aim
    - Principle
    - Requirements
    - Procedure
    - Observations
    - Calculations
    - Tables and Graphs
    - Diagrams
    - Result/Conclusion
    - Precautions
    - Student Exercise
6. Observations should be recorded clearly and accurately during or immediately after the practical or field activity.
7. Field observations should include relevant details such as date, location, habitat and other parameters prescribed for the activity.
8. Observation tables should be properly ruled, titled and labelled.
9. Calculations should include the appropriate formula, substitution of values and relevant units.
10. Graphs should be drawn using suitable scales, with clearly labelled axes and appropriate titles.
11. Diagrams of insects and their structures should be neat, proportionate and properly labelled.
12. Scientific names and technical terminology should be written correctly and consistently.
13. Insect specimen labels and field records should contain the information prescribed in the practical.
14. Photographs, where included for documentation, should be properly captioned with relevant details.
15. Corrections should be made neatly, and excessive overwriting should be avoided.
16. Each completed practical should be submitted for checking and authentication within the prescribed time.
17. The journal should be updated regularly and should not be completed hurriedly at the end of the term.

18. The practical journal should serve as an authentic record of laboratory and field work performed by the student.
19. The completed journal should be submitted for examination as per the instructions of the Department and applicable academic regulations.

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6. EVALUATION SCHEME

The practical performance of students may be assessed through **continuous internal assessment and end-semester practical examination**, as per the applicable academic regulations.
The evaluation may include the following components:

Component	Parameters for Assessment
Practical and Field Performance	Understanding of the activity, correct procedure, observation skills and proper handling of materials
Insect Identification	Identification of insects using relevant diagnostic characters and scientific terminology
Specimen Preparation and Documentation	Proper collection, mounting, pinning, labelling, preservation and maintenance of records
Field Observation and Data Recording	Accuracy, completeness and systematic presentation of field and laboratory observations
Calculations and Graphs	Correct formulae, calculations, units, graphical representation and interpretation
Pest Assessment and Management Studies	Understanding and interpretation of pest damage, monitoring and management approaches
Practical Journal	Completeness, neatness, regularity, diagrams, field records and proper presentation
Viva-Voce	Understanding of principles, procedures, observations, applications and interpretations
Laboratory and Field Discipline	Regularity, responsible conduct, safety awareness and environmentally responsible practices

General Guidelines for Assessment

1. Students should be assessed on both practical skills and conceptual understanding.
2. Greater importance should be given to the student's ability to observe, identify, document and interpret practical findings rather than merely reproducing theoretical information.
3. The practical journal and field records should be checked periodically during the academic term.
4. Students should demonstrate appropriate handling of insects, specimens, collecting equipment and laboratory instruments.
5. Field-based activities should be assessed on systematic observation, accurate documentation and scientific interpretation.
6. Viva-voce questions should assess understanding of the principle, procedure, observations, calculations and applications of the practical activity.
7. Diagrams, tables, calculations, graphs and results should be assessed for accuracy and scientific presentation.
8. Activities involving pest-control agents, insecticides or bioassays should be assessed in accordance with prescribed institutional safety, environmental and ethical guidelines.
9. The final distribution of marks should strictly follow the **applicable autonomous syllabus, examination pattern and academic regulations**.

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T.Y. B.Sc. Zoology – VSC Practical Journal

Practical 1: Insect Collection and Identification

Aim

To standardise collection techniques across major insect orders and systematically identify specimens using dichotomous taxonomic keys.

Principle

Insect orders inhabit varied niches (aquatic, terrestrial, aerial, soil). Effective collection requires group-tailored techniques (e.g., sweep nets for Orthoptera/Lepidoptera, aspirators for micro-Hymenoptera/Diptera, Berlese funnels for soil mesofauna). Identification uses diagnostic characters (wing venation, tarsal formula, antennae structure) systematically checked against bifurcating taxonomic keys.

Requirements

- **Field Gear:** Sweep net, aerial net, aquatic kick net, insect aspirator, killing jar (ethyl acetate).
- **Extraction & Sorting:** Berlese funnel, sorting trays, fine forceps, hand lens ($10\times$).
- **Identification:** Stereo-dissecting microscope, regional dichotomous insect keys.

Procedure

1. **Field Sampling:**
    - Sweep net: Sweep through tall grass in a figure-8 pattern for Orthoptera and Hemiptera.
    - Aspirator: Collect small Diptera or Hymenoptera from flower heads directly into vials.
    - Berlese Funnel: Place leaf litter on mesh under a 60W light source for 24 hours to collect soil micro-arthropods into 70% ethanol.
2. **Keying Out Specimen:**
    - Examine wing presence/structure (Pterygota vs. Apterygota).
    - Evaluate mouthpart orientation and structure (chewing, piercing-sucking, siphoning).
    - Follow the dichotomous key step-by-step from Order to Family level.

Observations & Results

- **Specimen A:** Forewings hardened into elytra meeting in a straight dorsal line **Order Coleoptera**.
- **Specimen B:** Two pair membranous wings covered in scales, siphoning proboscis **Order Lepidoptera**.
- **Specimen C:** Single pair of functional wings, hind wings reduced to halteres **Order Diptera**.

Conclusion

Collection methodology directly dictates sample diversity. Dichotomous keys allow precise identification down to family level based on morpho-taxonomic markers.

Student Exercise

1. Draw a flowchart showing the primary dichotomous split separating Hemiptera, Coleoptera, and Hymenoptera.
2. What safety precautions are necessary when handling ethyl acetate in killing jars?

Practical 2: Study of Insect Morphology & Sensory Organs

Aim

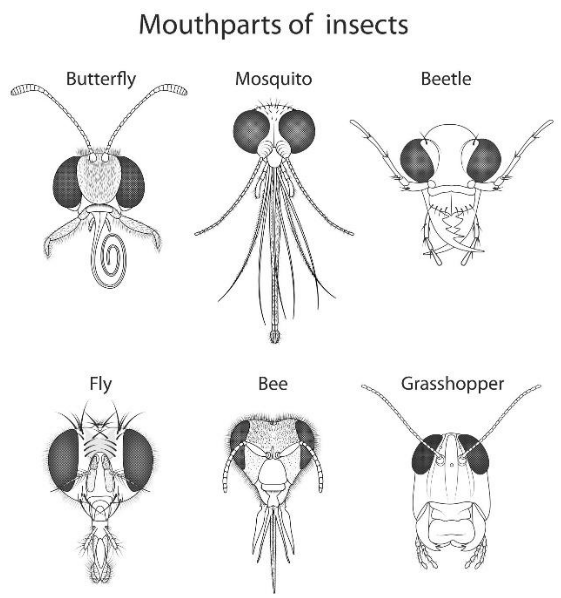
To dissect and observe insect body parts (mouthparts, wings, legs) and examine sensory organs under a compound microscope.

Principle

Insect survival depends on structural adaptations. Mouthparts adapt to feeding modes (chewing, piercing-sucking, siphoning, sponging). Legs modify for locomotion or predation (cursorial, fossorial, raptorial, saltatorial). Compound eyes (ommatidia units) and antennae (tactile/chemoreceptive) govern sensory perception.

Requirements

- Cockroach (*Periplaneta americana*), Honeybee (*Apis cerana*), or Housefly specimens.
- Dissecting tray, fine needles, forceps, slide preparation kit, glycerine, cover slips, compound microscope.



Procedure

1. **Mouthparts:** Carefully detach labrum, mandibles, maxillae, and labium from a cockroach head; mount on a slide in glycerin.
2. **Legs & Wings:** Remove foreleg, midleg, and hindleg. Identify coxa, trochanter, femur, tibia, and tarsus.
3. **Sensory Organs:** Mount an antenna and a thin transverse section of the compound eye to observe ommatidia.

Observations & Results

- **Mouthparts (Chewing type):** Heavily chitinized mandibles with serrated teeth for grinding.
- **Hind Leg:** Broadened tibia and basitarsus forming a pollen basket (*corbicula*) in honeybees.
- **Eye Unit:** Array of hexagonal facets representing individual ommatidia lenses.

Conclusion

Morphological adaptations in appendages and sense organs directly correspond to ecological roles and feeding behaviours.

Student Exercise

1. Sketch and label the 5 basic segments of an insect leg.
2. Compare aristate antennae (Diptera) with geniculate antennae (Hymenoptera) in your laboratory notebook.

Practical 3: Preparation of Insect Specimens

Aim

To master mounting, pinning, card-pointing, and wet preservation techniques for an entomological collection.

Principle

Standardized pinning prevents specimen damage and standardises taxonomic study. Pinning positions vary by order (e.g., right side of thorax for Coleoptera, scutum for Diptera/Hymenoptera) to keep key diagnostic features intact.

Requirements

- Stainless steel insect pins (Nos. 1, 2, 3), spreading board, card points, staging blocks.
- Preservation: 70% ethanol, 5% glycerine, specimen vials, archival paper labels, p-DCB / camphor.

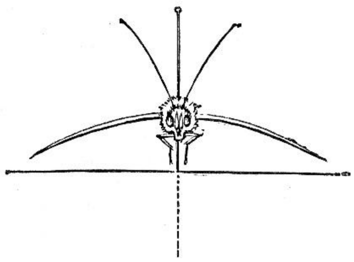


Fig. 99.—Front view of properly pinned-out insect.

Procedure

1. **Pinning:** Insert pin vertically through the mesothorax (or right elytron in beetles) leaving ~8 mm above the body.
2. **Spreading:** Place Lepidoptera on a spreading board. Align hind margins of forewings perpendicular to the body axis; secure with paper strips (do not pierce wings).
3. **Card Pointing:** Mount insects < 3 mm onto triangular card points using water-soluble glue.
4. **Labelling:** Attach two standard labels (1: Location/Date/Collector, 2: Taxon name).

Observations & Results

Specimens preserved with correct vertical alignment, spread wings, and standard 2-tier data labels.

Conclusion

Proper preparation preserves structural integrity and historical data for decades in museum collections.

Student Exercise

1. Design a mock 2-tier entomological label with field parameters (1.5 cm× 0.7cm).
2. State why formaldehyde is avoided for long-term insect tissue preservation.

Practical 4: Observation of Insect Behaviour

Aim

To quantify and interpret insect behaviours related to foraging, mating display, and defensive reactions.

Principle

Insect behaviour combines innate fixed action patterns (FAPs) and environmental responses (taxis/kinesis). Ethograms track timed behavioural states to evaluate energetic investment in foraging or defence.

Requirements

- Observation arena / observation hive/terrarium, stopwatch, ethogram tally sheets, experimental ant colony (*Camponotus* or *Pheidole*).

Procedure

1. Place a sugar drop 15cm from an ant nest entrance.
2. Record individual behaviors every 30 seconds for 20 minutes (foraging, recruitment trail laying, grooming, defence posture).
3. Plot a temporal activity graph.

Observations & Results

- Initial scout discovery triggers abdominal dragging (pheromone trail deposition).
- Recruitment density increases exponentially within 8 minutes.

Conclusion

Social insects rely on chemical communication to optimize colony-level foraging efficiency.

Student Exercise

1. Define the difference between phototaxis and photokinesis with insect examples.
2. Construct a 15-minute raw ethogram table for a local butterfly or wasp species.

Practical 5: Pollinator Observation and Documentation

Aim

To document local insect pollinators, calculate visitation rates, and evaluate floral preferences.

Principle

Insects provide key ecosystem services through pollination. Morphological co-adaptations (e.g., proboscis length vs. floral tube depth) determine pollinator efficiency and host specificity.

Requirements

- Field notebook, camera/smartphone, digital timer, quadrant frame $1m^2$, floral species identification key.

Procedure

1. Select a $1m^2$ floral patch in a local garden/field.
2. Observe for 30 minutes during peak sunshine (10 AM - 12PM).
3. Record insect taxon, visit duration per flower, and pollen transfer behavior (pollen dusting vs. nectar feeding).

Observations & Results

Pollinator Group	**Mean Visit Duration (s)**	**Primary Reward Sought**
Honeybees (*Apis*)	4.2 ± 0.8	Nectar + Pollen
Hoverflies (*Syrphidae*)	8.5 ± 1.2	Nectar
Butterflies (*Lepidoptera*)	12.1 ± 2.0	Nectar

Conclusion

Hymenopterans demonstrate higher visitation speed and pollen payload transport compared to Dipterans and Lepidopterans.

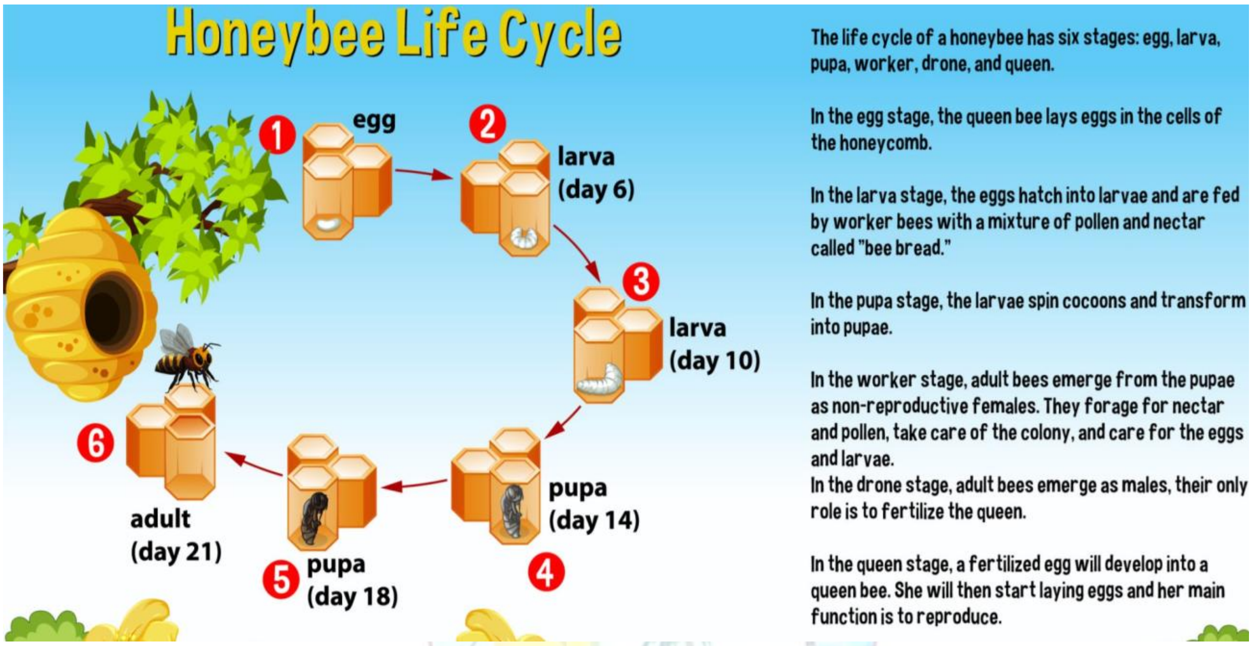
Student Exercise

1. What is "pollen buzz pollination," and which insect group specializes in it?
2. Explain how declining wild pollinator populations affect agricultural yield security.

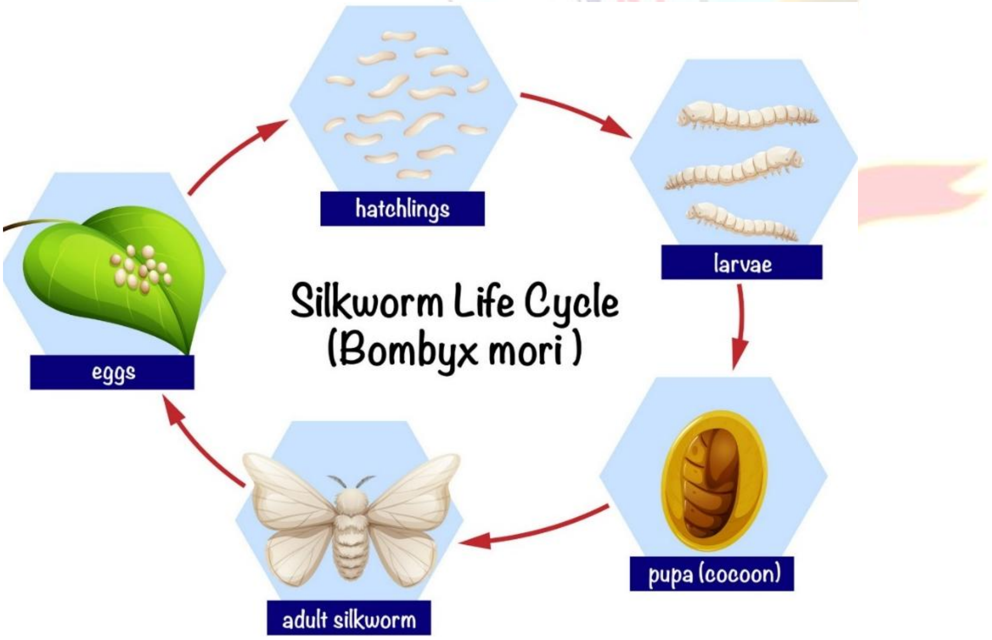
Practical 6: Economic Importance of Honeybee and Silk Moth

Aim

To analyze the life cycles, commercial rearing methods, and production of honey and silk.



Honeybee Life Cycle. Source: blueringmedia / Getty Images



Silkworm Life Cycle. Source: blueringmedia / Getty Images

Principle

Apis mellifera (Apiculture) and *Bombyx mori* (Sericulture) convert plant resources into economically valuable natural commodities (honey, beeswax, raw silk fiber).

Requirements

- Permanent slides/models of *Apis* castes (Queen, Worker, Drone) and *Bombyx mori* stages (Egg, Larva, Pupa/Cocoon, Adult).

- Honey refractometer, raw silk cocoon samples, boiling bath, teasing needles.

Procedure

1. **Sericulture:** Stifle cocoons using hot air/steam, reel silk filaments in hot water to dissolve sericin binder protein.
2. **Apiculture:** Examine worker bee adaptations (wax glands, pollen baskets, hypopharyngeal glands). Test honey purity using refractometer for moisture content <18%.

Observations & Results

- *Bombyx mori*: Complete metamorphosis (holometabolous). Continuous silk strand per cocoon averages 600 - 900 meters.
- *Apis*: Caste system determined by royal jelly feeding during larval stage.

Conclusion

Both insects provide high economic yields when reared under controlled environmental and disease-free conditions.

Student Exercise

1. Differentiate between fibroin and sericin proteins in silk.
2. Describe the dance language (Waggle dance) used by honeybees to communicate food distance.

Practical 7: Experiment on Light Attraction in Insects

Aim

To evaluate insect positive phototaxis using a light trap and classify attracted nocturnal taxa.

Principle

Many nocturnal insects exhibit positive phototaxis, navigating by transverse orientation relative to natural light sources (moon/stars). Artificial point sources disrupt this geometry, drawing insects toward the light trap.

Requirements

- Light trap frame, UV/Black light source (365 nm), incandescent white bulb, collection funnel, ethyl acetate killing jar.

Procedure

1. Set up the light trap in an open field from 7:00 PM to 9:00 PM.
2. Run Trial A using UV light; count and categorise captured insects by order.
3. Clean the trap and run Trial B on a subsequent night using incandescent white light.

Observations & Results

- **UV Light Trap:** High capture rates dominated by Lepidoptera (moths), Coleoptera, and Hemiptera.
- **Incandescent Light Trap:** Significantly lower total catch count.

Conclusion

Near-UV wavelength light 350-400nm elicits stronger phototactic responses in nocturnal insects than longer-wavelength visible light.

Student Exercise

1. Briefly explain the optical basis of the "transverse orientation hypothesis."
2. List two ecological consequences of artificial light pollution (ALAN) on insect populations.

Practical 8: Field Studies of Pests and Damage Assessment

Aim

To identify key crop pests in the field and quantify crop damage levels.

Principle

Field pests cause direct damage via sap-sucking, leaf-chewing, fruit-boring, or galls. Assessing per cent defoliation or pest density per unit area determines whether control measures are needed.

Requirements

- Field quadrat ($50 \times 50\text{ cm}$), hand lens, scoring sheets, crop field access (e.g., cotton, paddy, vegetables).

Procedure

1. Randomly select 10 plants along a diagonal transect across the field.
2. Count pest numbers per leaf/plant (e.g., Aphids, Whiteflies, Helicoverpa larvae).
3. Score plant damage using a 0-5 visual defoliation index scale.

Observations & Results

Pest Density = Total Insects Counted \ Total Plants Sampled

Percent Damage = Damaged Leaves \ Total Leaves Observed × 100

Conclusion

Establishing field damage percentages helps growers determine whether pest populations have reached the Economic Threshold Level (ETL).

Student Exercise

1. What is the difference between Economic Injury Level (EIL) and Economic Threshold Level (ETL)?
2. Sketch the symptoms of stem borer damage ("dead heart") vs. sap-sucking insect damage.

Practical 9: Integrated Pest Management (IPM) Case Study

Aim

To formulate an Integrated Pest Management (IPM) plan for a target crop pest (e.g., *Helicoverpa armigera* on Tomato/Cotton).

Principle

IPM integrates cultural, physical, biological, and selective chemical methods to keep pest populations below the Economic Injury Level while minimising environmental impact.

Requirements

- Case study datasheet, pest life history data, economic threshold tables, IPM matrix template.

Procedure

1. Define the target pest ecology and vulnerable crop growth stages.
2. Select multi-tier control interventions:
    - **Cultural:** Deep summer ploughing, trap cropping (e.g., marigold with tomato).
    - **Mechanical:** Pheromone traps 12/ha, yellow sticky traps.
    - **Biological:** Release of *Trichogramma* egg parasitoids 1,50,000/ha.
    - **Chemical:** Spot application of biopesticides (NPV / Azadirachtin) or low-risk insecticides as a last resort.

Observations & Results

Integrated approach reduces chemical spray frequency by 60-70%, maintaining high natural enemy populations without yield loss.

Conclusion

IPM offers a sustainable alternative to chemical-only pest management.

Student Exercise

1. Complete the table below for a target pest of your choice:

Intervention Tier	**Specific Action / Material Used**	**Target Pest Stage**
Cultural		
Mechanical		
Biological		
Chemical		

Practical 10: Use of Biological Control Agents

Aim

To evaluate parasitoid-host interactions (*Trichogramma* spp. on *Corcyra* eggs) and compute biocontrol parasitism rates.

Principle

Biological control uses natural enemies (parasitoid, predators, pathogens) to reduce pest numbers. *Trichogramma* wasps deposit eggs inside host eggs, killing the host embryo before it hatches.

Requirements

- *Trichogramma* cards (Tricho-cards), host eggs (*Corcyra cephalonica*), glass vials, stereomicroscope, incubator 25 ± 2^0C.

Procedure

1. Expose a card with 100 *Corcyra* eggs to a mated female *Trichogramma* inside a glass tube for 24 hours.
2. Remove the female and incubate host eggs at 25^0C.
3. Count black (parasitised) vs. yellow/unparasitized eggs on Day 4.

Observations & Results

Parasitism Rate (%) = Number of Blackized Eggs/Total Host Eggs × 100

- Observed parasitism rate: 84% under controlled lab conditions.

Conclusion

High parasitism rates validate *Trichogramma* as an effective inundative biocontrol agent for lepidopteran pests.

Student Exercise

1. Differentiate between a parasitoid and a true predator.
2. Why is timing critical when deploying egg parasitoids in field conditions?

Practical 11: Examination of Insecticides & Modes of Action

Aim

To classify chemical insecticides based on entry route and chemical class, and review their target nervous system pathways.

Principle

Insecticides act on specific physiological pathways (e.g., acetylcholinesterase inhibition, GABA-gated chloride channel block, sodium channel modulation). Understanding these modes of action prevents insecticide resistance build-up.

Requirements

- Sample insecticide formulations (commercial labels/containers): Organophosphates, Synthetic Pyrethroids, Neonicotinoids, Diamides, IRAC classification chart.

Procedure

1. Read commercial formulation labels (Active Ingredient, EC/WP percentage, toxicity triangle band).
2. Classify each agent according to IRAC (Insecticide Resistance Action Committee) mode of action.

Observations & Results

Chemical Class	**Example Chemical**	**Primary Mode of Action**	**IRAC Group**
Organophosphates	Chlorpyrifos	Acetylcholinesterase (AChE) inhibitor	Group 1B
Synthetic Pyrethroids	Cypermethrin	Voltage-gated Sodium channel modulator	Group 3A
Neonicotinoids	Imidacloprid	Nicotinic acetylcholine receptor agonist	Group 4A

Conclusion

Rotating chemical classes with different modes of action is essential to delay resistance development.

Student Exercise

1. What do red, yellow, blue, and green bands indicate on pesticide packaging?
2. Explain bioaccumulation using DDT as an example.

Practical 12: Stored-Product Pest Detection and Prevention

Aim

To identify common stored-product pests in food samples and evaluate low-cost physical/botanical control methods.

Principle

Stored grain pests (primary borers and secondary feeders) cause weight loss, heating, and contamination. Prevention relies on reducing moisture levels and applying non-toxic physical or botanical treatments.

Requirements

- Infested grain samples (wheat, rice, pulses).
- Sieves (mesh size 10, 20), stereomicroscope, neem oil, inert dust (diatomaceous earth), sealed containers.

Procedure

1. Sieve 250 g of grain sample to isolate adult and larval insects.
2. Identify pests (*Sitophilus oryzae*, *Tribolium castaneum*, *Callosobruchus maculatus*).
3. Set up 3 grain treatment jars: (A) Control, (B) % w/w Diatomaceous Earth, (C) 0.5% v/w Neem Oil. Observe adult emergence after 14 days.

Observations & Results

- *Sitophilus oryzae* (Rice Weevil): Identified by elbowed antennae and rostrum.
- Diatomaceous earth reduces insect survival by desiccating epicuticular wax layers.

Conclusion

Inert dusts and botanical oils offer chemical-free, safe protection for stored grains.

Student Exercise

1. Identify this pest from morphology: Small red-brown beetle, flattened body, three-segmented antennal club → Answer: _____________.
2. How does grain moisture content (>14) impact pest outbreaks in godowns?

Practical 13: Anti-Predator Mechanisms in Insects

Aim: To observe and document structural, behavioural, and chemical anti-predator adaptations in insects.

Principle: Insects use survival strategies like cryptic colouration (camouflage), Batesian/Müllerian mimicry, reflex bleeding, and aposematism to avoid predation.

Requirements

- Live or preserved specimens: Stick insect (*Phasmida*), Praying Mantis, Ladybird beetle (*Coccinellidae*), Monarch butterfly (*Danaus plexippus*).

Procedure

1. Observe stick insects on natural foliage; record immobility and twig-mimicking posture (*catalepsy*).
2. Gently disturb a ladybird beetle; observe reflex bleeding (alkaloid excretion from leg joints).
3. Document warning coloration (aposematism) in toxic/distasteful species.

Observations & Results

- **Stick Insect:** Cryptic morphology makes it visually indistinguishable from host plant twigs.
- **Ladybird Beetle:** Exudes bitter hemolymph from knee joints when threatened.

Conclusion: Morphological and chemical defences reduce predation pressure and increase survival rates.

Student Exercise

1. Distinguish between Batesian mimicry and Müllerian mimicry with neat diagrams/examples.
2. Define "flash coloration" and state its defensive purpose.

Practical 14: Insecticide Efficacy Test (Natural vs. Synthetic)

Aim

To perform a comparative bioassay testing natural repellents (Neem extract) against a synthetic pyrethroid on a target insect.

Principle

Contact bioassays evaluate mortality/repellency rates over time to calculate effectiveness (LC50 or percentage mortality).

Requirements

- Target insect (e.g., *Mosquito larvae* or *Aphids*).
- Extracts: 5% Aqueous Neem Seed Kernel Extract (NSKE), 0.1% Cypermethrin solution, distilled water (Control).
- Petri dishes, filter paper, pipettes, stopwatch.

Procedure

1. Place filter paper discs saturated with equal volumes of treatment solutions in separate Petri dishes.
2. Release 10 healthy insects into each dish (3 replicates per treatment).
3. Count knockdown/mortality at 15, 30, 60, and 120 minutes.

Observations & Results

Corrected Mortality (%) = % Test Mortality - % Control Mortality /100 - % Control Mortality

- Synthetic pyrethroid shows rapid knockdown <15mins.
- Neem extract acts slower 60-120 mins, through antifeedant and growth disruption pathways.

Conclusion

Synthetic insecticides act faster, but botanical extracts offer eco-friendly, sustainable pest suppression with lower non-target toxicity.

Student Exercise

1. What active compound in *Azadirachta indica* gives it antifeedant properties?
2. Graph mortality (%) vs. time (minutes) for the three treatment groups using your lab data.

Practical 15: Documentation of Pest Control Techniques

Aim

To prepare a comparative analytical summary contrasting traditional and modern pest control strategies.

Principle

Agricultural pest control has evolved from traditional, ecologically aligned methods to synthetic chemical solutions, and now toward modern biotechnological interventions (RNAi, Bt crops, precision drone spraying).

Requirements

- Reference literature, agricultural extension bulletins, comparative analysis matrix.

Procedure

1. Gather field data comparing traditional practices (ash dusting, crop rotation, neem sprays) with modern approaches (GMOs, synthetic molecules, automated precision tech).
2. Analyse efficacy, environmental persistence, economic cost, and resistance risk.

Observations & Results

Parameter	**Traditional Methods**	**Modern Synthetic Methods**	**Integrated / Precision Tech**
Environmental Impact	Minimal	High (soil/water run-off)	Target-specific / Low
Pest Resistance Risk	Low	High	Managed via refugia
Cost / Labour	Labor-intensive	High input cost	High initial investment

Conclusion

Combining traditional ecological wisdom with modern precision technology yields the most sustainable pest management framework.

Student Exercise

1. Outline how Bt-cotton expresses insecticidal proteins (*Cry* toxins) targeting bollworms.
2. Summarise two drawbacks of relying solely on synthetic broad-spectrum chemical insecticides.