B.Sc. (Honours) Zoology

(Under the Framework of Honours School System)
The Department of Zoology is one of the oldest and well-established departments in North India, which has completed more than 100 years of teaching and research. It was shifted from Hoshiarpur to present campus at Chandigarh in July 1960. The department has many landmarks as its teaching and research activities changed from classical to the most recent ones in Zoology, and remained at the forefront both nationally and internationally. Based on the performance of teaching and research potentials of the staff members, UGC had recognized the Department for Special Assistance Programme (SAP) in 1985 and extended it for two terms. Under the COSIST Programme, a grant of Rs. 42.5 lakhs was sanctioned for a five year term (1996-2001). 3rd Phase of SAP started from 2001-2006 with financial aid of Rs. 65.75 lakhs. On completion of the 3rd Phase of SAP, UGC review committee upgraded the department for CAS(Centre of Advance Study) in Biodiversity: Cell and Molecular Biology, with the financial assistance of Rs. 78.25 lakhs from 2007-2012. In 2013 the department was recognised by the DST under its FIST programme and sanctioned a grant of 1.10 crores for 5 years. In 2015 the department has received grant of Rs. 161.55 lacs + 2 Project Fellows under Phase II CAS Programme.

The Department is well equipped with teaching and research laboratories. There are three laboratories for undergraduate students and two for post-graduate students where course practicals are conducted. There are six specialized laboratories for research students (M.Sc.,M.Phil & Ph.D.) which are maintained as per the specific needs of the research areas including Cell and Animal Physiology, Aquatic Biology, Cytogenetics, Entomology & Parasitology. There is a central sophisticated instruments laboratory equipped with advanced instruments such as Real-time PCR, Flow Cytometer, 2D Gel Electrophoresis system, HPLC, Nanodrop etc along with other basic research instruments. The Department also has a well equipped computer lab., which are open for use by students and staff. The Department has a seminar room with modern audio visual facility and interactive class-room.

**Library**
The department library is well stocked with highly informative 10,000 textbooks and reference books having general information related to the subject of Zoology. The library also receives good scientific research journals of national and international repute for the benefit of research scholars and the faculty. New books and journals are regularly added and updated.

**Museum**
The department has two state of art museums with a wealth of 3000 specimens belonging to different animal phyla.
OUTLINES OF TESTS

OBJECTIVE OF THE COURSE

To teach the various concepts of Zoology and their applications, the syllabus pertaining to B.Sc. (Honors) Zoology (3 Year course & 6 Semesters) in the subject of Zoology under Honors School Framework has been upgraded as per provision of the UGC module for CHOICE BASED CREDIT SYSTEM and demand of the academic environment. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills according to UGC.

Semester I

CORE COURSE (ZOOLOGY)

Theory Papers:
Core Course-1 (C 1): 100 Marks (4 credits)
Core Course-2 (C 2): 100 Marks (4 credits)

Practicals:
Core Course-1 Practical (C 1 Lab): 50 Marks (2 credits)
Core Course-2 Practical (C 2 Lab): 50 Marks (2 credits)

GENERIC ELECTIVE (ZOOLOGY)

Theory Papers:
Each student from other disciplines may opt any two of the generic electives offered by the Science Departments of Panjab University out of following:
Generic Elective -1 (GE-1) 100 Marks (4 credits)
Generic Elective -2 (GE-2) 100 Marks (4 credits)

Practicals:
Generic Elective -1 Practical (GE-1 Lab) 50 Marks (2 credits)
Generic Elective -2 Practical (GE-2 Lab) 50 Marks (2 credits)

EVALUATION

1. There shall be one Mid Term Examination of 20% Marks (20 marks) in each semester.
2. End semester examination will be of 80% of total marks (80 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks (10 marks). The final examination will be of 80% marks (40 marks).

Pattern of end semester question paper
(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions
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(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
(iii) The remaining eight questions will have Four Units comprising two questions from each Unit.
(iv) Students will attempt one question from each unit and the compulsory question.

ABILITY ENHANCEMENT COMPULSORY COURSE FOR CHEMISTRY STUDENTS
Each student of Zoology Department has to opt one Ability Enhancement Compulsory Course of the following:
1. English Communication (2 credits)
2. Environmental Science (2 credits)

Semester II

Outlines for Semester II will be same as for Semester I

A Department will run a particular Generic Elective Course only if the minimum number of students opting for that course is 10.
## COURSE STRUCTURE

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*C: Core Courses; GE: General Elective; AECC: Ability Enhancement Compulsory Courses; SEC: Skill Enhancement Courses; DSE: Discipline Specific Elective*
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*: GE subjects are to be selected by the students from the pool of GE Subjects offered by various Departments of the University.

**SKILL ENHANCEMENT COURSES (any one per semester in semesters 3-4)

1. BZO-SEC1: Apiculture
2. BZO-SEC2: Aquarium Fish Keeping
3. BZO-SEC3: Medical Diagnostics
4. BZO-SEC4: Research Methodology

**DISCIPLINE SPECIFIC ELECTIVE COURSES (any two per semester in semesters 5-6)

1. BZO-DSE1: Animal Biotechnology
2. BZO-DSE2: Biology of Insecta
3. BZO-DSE3: Endocrinology
4. BZO-DSE4: Fish and Fisheries
5. BZO-DSE5: Immunology
6. BZO-DSE6: Parasitology
7. BZO-DSE7: Reproductive Biology
8. BZO-DSE8: Wild Life Conservation and Management

**Courses under these will be offered only if a minimum of 10 students opt for the same

**GENERIC ELECTIVE SUBJECTS (Offered by Zoology Department) for students of other departments

1. BZO-GE1*: Animal Diversity
2. BZO-GE2*: Aquatic Biology
3. BZO-GE3*: Immunology
4. BZO-GE4*: Human Physiology
5. BZO-GE5*: Insect Vector and Diseases
6. BZO-GE6*: Evolution and Palaeontology
B.Sc (Hons.) Zoology

Semester I

BZO-C1: Non-Chordates I : Protists to Pseudocoelomates

THEORY

Total Lectures: 60                                                                                      Credits : 4

Objectives:
• To enable the students to develop an appreciation for the biodiversity of invertebrate species.
• To impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Protista, Parazoa and Metazoa (19hrs)

General characteristics and Classification up to classes*
Study of *Euglena, Amoeba and Paramecium*
Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoebahistolytica*
Locomotion and Reproduction in Protista
Evolution of symmetry and segmentation of Metazoa

UNIT 2: Porifera and Ctenophora (11 hrs)

*Porifera*: General characteristics and Classification up to classes of phylum Porifera*. Canal system and spicules in sponges.
*Ctenophora*: General characteristics and Evolutionary significance of phylum Ctenophora.

UNIT 3: Cnidaria (12hrs)

*Cnidaria*: General characteristics and Classification up to classes of phylum Cnidaria*. Metagenesis in Obelia, Polymorphism in Cnidaria, Corals and coral reefs.

UNIT 4: Platyhelminthes & Nematelminthes (18 hrs)

*Platyhelminthes*: General characteristics and Classification up to classes*. Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*. 
Nemathelminthes: General characteristics and Classification up to classes*. Life cycle and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*. Parasitic adaptations in helminthes.

*Note: Classification to be followed from “Barnes, R.D. (1982). Invertebrate Zoology, V Edition”*

**BZO-C1: Non-Chordates I : Protists to Pseudocoelomates**

**PRACTICALS**

**Total Lectures : 60**

**Credits : 2**

1. **Protozoa**: Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium; Examination of pond water collected from different places for diversity in protista.


4. **Ctenophora**: One specimen/slide of any ctenophore.

5. **Platyhelminthes**: Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/microphotographs).

6. **Nemathelminthes**: Study of adult *Ascaris lumbricoides* and its life stages (Slides/microphotographs).


**SUGGESTED READING**


Objectives:
- To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles.
- To enable the students understand the adaptations of the animals to their environment.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Introduction and Applied to Ecology (10 hrs)


UNIT 2: Population (24 hrs)
Unitary and Modular populations
Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.
Exponential and logistic growth, equation and patterns, r and K strategies.
Population regulation - density-dependent and independent factors.
Population interactions, Gause’s Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses.

UNIT 3: Community (12 hrs)
Community characteristics: species richness, dominance, diversity, abundance, vertical stratification.
Ecotone and edge effect.
Ecological succession with one example.
Theories pertaining to climax community.

UNIT 4: Ecosystem (14 hrs)
Types of ecosystems with one example in detail.
Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web.
Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies.
Nutrient and biogeochemical cycle with one example of Nitrogen cycle.
Human modified ecosystem.

**BZO-C2: Principles of Ecology**
**PRACTICALS**

**Credits : 2**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

**SUGGESTED READING**

Semester II

BZO-C3: Non-chordates II: Coelomates

THEORY

Total Lectures : 60                                                                                           Credits : 4

Objectives:
- To acquaint the students with the non-chordates i.e. Annelids, Arthropoda and Mollusca, Onychophora and Echinodermata and study their functional anatomy.
- To enable the students to understand the difference in their morphology and general anatomy and to classify and study their general characters.
- To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
- To impart in depth knowledge to students about the different modes of living and structural modification acquired to suit varied living conditions.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Introduction to Coelomates, Annelida (12 hrs)

Introduction to Coelomates: Evolution of coelom and metamerism.
Annelida: General characteristics and Classification up to classes, Excretion in Annelids.

UNIT 2: Arthropoda (17 hrs)

Arthropoda: General characteristics and Classification up to classes, Respiration in Arthropoda. Metamorphosis in Insects, Social life in:
- a. Bees: Species, Castes, Division of labour, Nest architecture and Swarming.
- b. Termites: Castes, Nest architecture, Swarming and Colony formation.

UNIT 3: Mollusca (15 hrs)

Mollusca: General characteristics and Classification up to classes, Respiration in Mollusca, Torsion and detorsion in Gastropoda, Pearl formation in bivalves, Evolutionary significance of trochophore larva.

UNIT 4: Echinodermata and Onychophora (16 hrs)

Echinodermata: General characteristics and Classification up to classes, Water-vascular system in Asteroidea, Larval forms in Echinodermata, Affinities with Chordates.
Onychophora: General characteristics and Evolutionary significance.
B.Sc (Hons.) Zoology

BZO-C3: Non-chordates II: Coelomates

PRACTICALS

Credits : 2

1. Study of following specimens:
   **Annelids** - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria.
   **Arthropods** - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termites and honey bees.
   **Onychophora** - Peripatus.
   **Molluscs** - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus.
   **Echinodermates** - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon.

2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm.
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
4. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta*.
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusk and echinoderm).

**Note:** Classification to be followed from “Ruppert and Barnes (2006) Invertebrate Zoology, 8th edition, Holt Saunders International Edition”

**SUGGESTED READINGS**

Semester II
BZO-C4: Cell Biology

THEORY

Total Lectures : 60                                                                                                     Credits : 4

Objectives: Cell Biology deals with the detailed study of a cell including cell structure, cell composition, cell organelles and the interaction of cells with other cells and the larger environment in which they exist.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Cell and Plasma membrane(10 hrs)

Overview of Cells: Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions.

UNIT 2: Cytoskeleton and Nucleus (20 hrs)

Nucleus: Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome).

UNIT 3: Endomembrane System, Mitochondria and Peroxisomes (18 hrs)


UNIT 4: Cell division and Cell Signalling (12 hrs)
Cell Division: Mitosis, Meiosis, Cell cycle and its regulation.
Cell Signaling: GPCR and Role of second messenger (cAMP).

BZO-C4: Cell Biology

PRACTICALS

Credits : 2

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
   i DNA by Feulgen reaction
   ii DNA and RNA by MGP
   iii Mucopolysaccharides by PAS reaction
   iv Proteins by Mercurobromophenol blue/Fast Green

SUGGESTED READINGS

B.Sc (Hons.) Zoology

BZO-GE1: ANIMAL DIVERSITY
THEORY

Total Lectures: 60 Credits: 4

Objectives:
• To enable the students to develop an appreciation for the biodiversity of invertebrate and vertebrates.
• To impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1 (16 hrs)
Protista: General characters of Protozoa; Life cycle of Plasmodium.
Porifera: General characters and canal system in Porifera.
Radiata: General characters of Cnidarians and polymorphism.
Aceolomates: General characters of Helminthes; Life cycle of Taeniasolium
Pseudocoelomates: General characters of Nemethehelminthes; Parasitic adaptations.

UNIT 2 (15hrs)
Coelomate Protostomes: General characters of Annelida; Metamerism.
Mollusca: General characters of mollusca; Pearl Formation
Protochordata: Salient features.

UNIT 3 (15 hrs)
Pisces: Osmoregulation, Migration of Fishes.
Amphibia: General characters, Adaptations for terrestrial life, Parental care in Amphibia.

UNIT 4 (14 hrs)
Aves: The origin of birds; Flight adaptations
Mammalia: Early evolution of mammals; Primates; Dentition in mammals.
B.Sc (Hons.) Zoology

**BZO-GE1: ANIMAL DIVERSITY PRACTICALS**

Credits: 2

1. Study of following specimens:

**Non Chordates:** Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Hermitercab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon.

**Chordates:** Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.

2. Study of following Permanent Slides:

3. Temporary mounts of
   - Septal & pharyngeal nephridia of earthworm.
   - Unstained mounts of Placoid, cycloid and ctenoid scales.

4. Dissections of*
   - Digestive and nervous system of Cockroach.
   - Urinogenital system of Rat

**SUGGESTED READINGS**


*As per UGC guidelines.*
B.Sc (Hons.) Zoology

BZO-GE2: AQUATIC BIOLOGY
THEORY

Total Lectures: 60
Credits: 4

Objectives:
- To enable the students understand the different fresh water habitats, the classification of waterbodies based on various physicochemical and biological parameters and the importance of fishery science.

Instructions for the Paper Setters and Examiners:
Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Aquatic Biomes (20 hrs)
Aquatic Biomes: Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT 2: Freshwater Biology (20 hrs)
Streams: Different stages of stream development, Physico–chemical environment, Adaptation of hill-stream fishes.

UNIT 3: Marine Biology (20 hrs)

UNIT 4: Management of Aquatic Resources (20 hrs)
Management of Aquatic Resources: Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment; Water quality assessment- BOD and COD.
BZO-GE2: AQUATIC BIOLOGY 
PRACTICALS

Credits: 2

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/Fisheries Institutes.

SUGGESTED READINGS

B.Sc (Hons.) Zoology

BZO-GE3: IMMUNOLOGY
THEORY

Total Lectures :60                                                                                                                            Credits :4

Objectives:

• To acquaint the students with the basic concepts of immunology and the immune effector mechanisms. To make the student understand the role of immunity in controlling the pathogenic infection.

Instructions for the Paper Setters and Examiners:

Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT 1: Overview of Immune System, Innate and Adaptive Immunity. (20 hrs)

Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system.

UNIT 2: Antigens and Immunoglobulins. (18 hrs)

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes.
Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.

UNIT 3: Major Histocompatibility Complex and Cytokines. (10 hrs)

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation.
Properties and functions of cytokines, Therapeutics Cytokines.

UNIT 4: Complement System, Hypersensitivity and Vaccines. (12 hrs)

Components and pathways of complement activation.
Gell and Coombs’ classification and brief description of various types of hypersensitivities.
Various types of vaccines.
B.Sc (Hons.) Zoology

BZO-GE3: IMMUNOLOGY 
PRACTICALS

Credits: 2

1*. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3*. Preparation of stained blood film to study various types of blood cells.
5*. ABO blood group determination.
6*. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of :
   a. ELISA
   b. Immuno-electrophoresis

* The experiments can be performed depending upon usage of animals in UG courses.

SUGGESTED READINGS

BZO-GE4: HUMAN PHYSIOLOGY

THEORY

Total Lectures: 60

Credits: 4

Objectives:

• To enable the students know about all the physiological processes going on in the human body.
• To make the students understand the functions of hormones and their mechanism of action.

Instructions for the Paper Setters and Examiners:

• Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. The students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Unit 1: Digestion and Absorption of Food. (12 hrs)

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (in brief).

Unit 2: Respiratory Physiology and Renal Physiology. (14 hrs)


Unit 3: Functioning of Excitable Tissue (Nerve and Muscle) and Cardiovascular Physiology. (20 hrs)

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction. Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG.

Unit 4: Endocrine and Reproductive Physiology (14 hrs)

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle.
B.Sc (Hons.) Zoology

**BZO-GE4: HUMAN PHYSIOLOGY**

**PRACTICALS**

*Credits: 2*

2. Preparation of haemin and haemochromogen crystals.
3*. Estimation of haemoglobin using Sahli’s haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

*The experiments can be performed depending upon usage of animals in UG courses.*

**SUGGESTED READINGS**