



Established by Tribal Development Department, Govt. of Gujarat

School of Science
B.Sc. (Zoology) Programme

Subject Code & Name: BS06MJZOO2 Embryology, Evolution and Animal Behaviour

Teaching and Evaluation Scheme:

Teaching Scheme				Examination Scheme			
Credits				Component Weightage			
				CCE		SEE	
L	T	P	Total	TH	PWE	TH	PWE
4	-	-	4	50 %	-	50 %	-

Programme Name	B.Sc. Zoology
Semester	VI
Course Code	BS06MJZOO2
Course Title	Embryology, Evolution and Animal Behaviour
Course Content Type (Th./Pr.)	Theory
Course Credit	4
Theory Sessions	4
Total Teaching/Lab. Hours	60 Theory Hours

Learning Objectives

- Student will learn about Fundamentals of Embryology like gametogenesis, fertilization and minute details of growth and development. They get understanding of development of Chick and Applied Embryology.
- They will be able to understand Evolution by various theories and components like natural selection types genetic drift, variation and Isolation speciation.
- Student will learn about basics of animal behaviour like communication methods and social organization, migration mechanisms and parental care across species.

Prerequisites (if any)

- Students should have knowledge about cells, types of cells, and cell divisions.
- One has knowledge about sexual as well as asexual means of reproduction.
- Students should know about basics ecology and genetics.

Learning Outcomes

On the Completion of this course, students will able to:

- Recognize developmental stages from gametogenesis to germ layer formation.
- Study the mechanics of chick embryo development and learn the organogenesis from germ layers.
- Contrast Lamarckism, Darwinism and Neo-Darwinism.
- Utilize Hardy-Weinberg Principle for calculating allele frequencies.
- Differentiate types of speciation and reproductive isolation.
- Learn Innate and Learned and Social behaviour and also learn how animal communicates.



बिरसा मुंडा ट्रायबल युनिवर्सिटी

Birsa Munda Tribal University

राजपिपला, जि. नर्मदा Rajpipla, Dist. Narmada

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Detailed Contents		
UNIT	TOPIC/SUB-TOPIC	TEACHING HOURS
I	Fundamentals of Embryology/Developmental Biology • Definition and Scope of Embryology Gametogenesis • Spermatogenesis: Process, phases and ultrastructure of a mature mammalian sperm. • Oogenesis: Process, phases and types of eggs based on yolk quantity and distribution. • Vitellogenesis: The process of yolk formation and its significance. • Fertilization and Early Development: Mechanism of Fertilization: Physico-chemical events. • Cleavage: Definition, planes, and patterns, Factors affecting cleavage. • Blastulation: Formation and types of blastulae in different vertebrates (Coeloblastula, Discoblastula etc.) • Gastrulation: Epiboly, Emboly (Invagination, Involution, Ingression and Delamination). • Fate Maps: Concept and construction of fate maps in Frog and Chick.	15
II	Development of Chick and Applied Embryology Chick (<i>Gallus gallus domestics</i>) Embryology: • Typical structure of Egg and study of chick embryo development from 18 to 96 hours of incubation. • Extra-embryonic Membranes and Placentation: Extra-embryonic Membranes: Structure, development, and functions of Amnion, Chorion, Allantois, and Yolk sac in Chick. • Placentation in Mammals: Classification of placenta based on histology and distribution of villi; physiological functions of the placenta. • Regeneration: Mechanisms of regeneration in invertebrates (Hydra/Planaria) and vertebrates (Limb regeneration in Salamander). • Stem Cells: Elementary idea, types (Totipotent, Pluripotent), and their applications in modern medicine. • In Vitro Fertilization (IVF): Overview of Assisted Reproductive Technologies (ART), causes of infertility and the process of embryo transfer.	15



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III	Evolutionary Biology • Definition and Evidences of evolution Theories of Evolution: • Lamarckism, Darwinism and Neo-Darwinism Mechanisms of Evolution: • Variations: Sources and types of Variations • Natural Selection in Action: Types of selection (Directional, Stabilizing and Disruptive); Industrial Melanism as a case study • Hardy-Weinberg Equilibrium: The law of genetic equilibrium and factors upsetting it ($p^2 + 2pq + q^2 = 1$). Speciation and Macroevolution: • Species Concept: Biological and Evolutionary species concepts • Modes of Speciation: Allopatric, Sympatric and Parapatric speciation • Isolation: Mechanism and types Pre-zygotic and Post-zygotic Isolation • Patterns of Evolution: Convergent, Divergent, and Parallel evolution; Adaptive Radiation Origin of Life and Paleontology: • Oparin-Haldane Hypothesis and Miller-Urey Experiment • Geological Time Scale • Human Evolution from Australopithecus to Homo sapiens	15
IV	Animal Behaviour (Ethology) Introduction to Ethology: • Innate vs. Learned behavior Patterns of Learning • Imprinting: Filial and Sexual imprinting (Lorenz's experiments) • Classical Conditioning: Pavlovian learning Social Behavior and Communication • Social organization in Honey bees and Ants • Communication in Animals: Chemical (Pheromones), Visual, Auditory, and Tactile communication Biological Rhythms and Foraging • Circadian Rhythms, Biological clocks; diurnal and nocturnal activity patterns • Migration: Mechanisms of navigation in birds and fishes (Stellar, Magnetic, and Olfactory cues) • Parental Care: Parental investment in fishes, amphibians and birds	15





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1. Chordate Embryology by P.S. Verma and V.K. Agarwal, S. Chand & Company
2. Developmental Biology by K.V. Sastry and Vineeta Shukla, Rastogi Publications
3. Developmental Biology by Arumugam N., Saras Publication
4. A Textbook of Embryology by Dr. P.C. Jain and Dr. M.S. Dalela, Jai Prakash Nath & Co.
5. Introduction to Embryology by A.K. Berry, Emkay Publications
6. Manual of Practical Zoology: Chordates by P.S. Verma, S. Chand & Company
7. Organic Evolution by V.B. Rastogi, Rastogi Publications
8. Animal Behaviour (Ethology) by Dr. Reena Mathur, Rastogi Publications
9. Animal Behaviour by V.K. Agarwal, S. Chand & Company
10. Ethology (Animal Behaviour) by N. Arumugam, Saras Publication
11. A Textbook of Organic Evolution by Dr. Himanshu Arora & Dr. Mohan Arora, Himalaya Publishing House
12. Evolutionary Biology by B.S. Tomar & S.P. Singh, Rastogi Publications
13. Evolutionary Biology by Veer Bala Rastogi, Kedar Nath Ram Nath
14. Life (Evolution, Adaptation, Ethology) by Dr. Sanjib Chattopadhyay, Books & Allied Pvt. Ltd.
15. Student's Book on Organic Evolution, Systematics and Taxonomy by S.K. Saikia, New India Publishing Agency

1. Developmental Biology by Scott F. Gilbert and Michael J.F. Barresi, Oxford University Press
2. An Introduction to Embryology by B.I. Balinsky, W.B. Saunders / Cengage Learning
3. Foundations of Embryology by Bradley M. Patten and Bruce M. Carlson, McGraw-Hill Education
4. Developmental Biology by Werner A. Müller, Springer-Verlag
5. Analysis of Biological Development by Klaus Kalthoff, McGraw-Hill
6. Evolutionary Analysis by Scott Freeman & Jon C. Herron, Pearson Education
7. Evolution by Douglas Futuyma et al. Oxford University Press
8. Evolutionary Biology by Eli C. Minkoff, Addison-Wesley
9. A Textbook of Animal Behaviour by Gundeia & Singh, S. Chand Publishing
10. Textbook of Animal Behaviour by Fatik Baran Mandal, PHI Learning / Google Books
11. Animal Behavior: An Evolutionary Approach by John Alcock, Oxford University Press
12. Principles of Animal Behavior by Lee Alan Dugatkin, W. W. Norton & Company
13. An Introduction to Animal Behaviour by Aubrey Manning & Marian Stamp Dawkins, Cambridge University Press
14. Evolution and Animal Behaviour by Kailash Choudhary, Two Brothers Publications
15. Ethology, Evolution & Zoogeography by G. Mallanagoud & Vedavyasa Sagar, Gayathri Prakashana



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Web Resources

1. Understanding Evolution: <https://evolution.berkeley.edu/>
2. HHMI BioInteractive (Evolution Collection): <https://www.biointeractive.org/topics/evolution>
3. The Smithsonian National Museum of Natural History (Human Origins):
<https://humanorigins.si.edu/>
4. Tree of Life Web Project: <http://tolweb.org/tree/>
5. Nature Education Evolutionary Genetics):
<https://www.nature.com/scitable/knowledge/evolutionary-genetics-13228157/>
6. Animal Behavior Society: <https://www.animalbehavioursociety.org/web/education.php>
7. Cornell Lab of Ornithology (All About Bird Biology): <https://academy.allaboutbirds.org/>
8. The Association for the Study of Animal Behaviour (ASAB): <https://www.asab.org/education>
9. Encyclopedia of Ethology: <https://www.ethology.eu/>
10. YouTube - Oxford University (Animal Behaviour Lectures):
<https://www.youtube.com/@oxforduniversity>
11. Free Online Courses (MOOCs) Coursera (Introduction to Genetics and Evolution):
<https://www.coursera.org/learn/genetics-evolution>
12. edX (Animal Behaviour and Welfare): <https://www.edx.org/learn/animal-behavior>
13. Swayam / NPTEL (Indian Context): <https://swayam.gov.in/>

L:: Lecture, **T::** Tutorial, **P::** Practical

CCE:: Continuous and Comprehensive Evaluation

(CCE Theory includes Mid Semester Examination, Assignment, MCQ quizzes, Seminar, Reflective notes, class participation, case analysis and presentation, slip tests (announced/surprised), attendance etc. or any combination of these)

PWE:: Practical Work Examination

(PWE includes Laboratory practical work, project work, viva simulation exercise work etc.)

SEE:: Semester End Evaluation

