A Syllabus of

Four-Years Undergraduate Program (FYUGP)

in

ZOOLOGY

As per instructions of the NEP Implementation Committee, Gauhati University

Prepared by-

Department of Zoology
Gauhati University

GENERAL CURRICULAR STRUCTURE
of
FIRST 3 YEARS (WITH MAJOR) OF FYUGP

Total "CREDITS" to be acquired by a student (including MAJOR + MINOR + SEC/VAC/MDC/AEC + Internship) in the first 03-year period = 120 credits

"MAJOR" courses to be opted by a student in the period of 03 years = 11

Semester-1			Semester-2		
Type	**Course**	**Credit**	**Type**	**Course**	**Credit**
Major	Major-1	4	Major	Major-2	4
Minor	Minor-1	4	Minor	Minor-2	4
SEC	SEC-1 (Major oriented)*	3	SEC	SEC-2 (Major oriented)*	3
AEC	AEC-1	4	AEC	AEC-2	4
MDC	MDC-1	3	MDC	MDC-2	3
VAC	VAC-1	2	VAC	VAC-2	2
TOTAL		**20**	**TOTAL**		**20**

Semester-3			Semester-4		
Type	**Course**	**Credit**	**Type**	**Course**	**Credit**
Major	Major-3	4	Major	Major-5	4
	Major-4	4		Major-6	4
Minor	Minor-3	4		Major-7	4
SEC	SEC-3 #	3		Major-8	4
MDC	MDC-3	3	Minor	Minor-4	4
VAC	VAC-3	2			
TOTAL		**20**	**TOTAL**		**20**

Semester-5			Semester-6		
Type	**Course**	**Credit**	**Type**	**Course**	**Credit**
Major	Major-9	4	Major	Major-12	4
	Major-10	4		Major-13	4
	Major-11	4		Major-14	4
Minor	Minor-5	4		Major-15	4
Internship		4	Minor	Minor-6	4
TOTAL		**20**	**TOTAL**		**20**

NOTE
Boxes indicate the number of MAJOR courses for <u>ONE SUBJECT as MAJOR</u> per Semester

COURSE STRUCTURE OF THE FIRST THREE YEARS OF FYUGP WITH ZOOLOGY AS ONE OF THE MAJOR SUBJECTS

Semester	Course Name	Code	Credit
1	**Major-1** Diversity of Non-chordates	ZLG0100104	3
	Practical		1
2	**Major-2** Diversity of Chordates	ZLG0200104	3
	Practical		1
3	**Major-3** Basic Genetics (To be adopted from SWAYAM)	ZLG0300104	4
	Practical		
	Major-4 Entomology & Fisheries	ZLG0300204	3
	Practical		1
4 **(Any one of the Optional DSE papers to be opted)**	**Major-5** Animal Taxonomy, Systematics & Biostatistics	ZLG0400104	3
	Practical		1
	Major-6 Animal Physiology & Endocrinology	ZLG0400204	3
	Practical		1
	Major-7 Fundamentals of Ecology (To be adopted from SWAYAM)	ZLG0400304	4
	Practical		
	Major-8 *DSE-I*: Comparative Anatomy of Vertebrates	ZLG0400404 (DSE-I/ DSE-II/ DSE-III)	3
	Practical		1
	DSE-II: Animal Behaviour and Chronobiology		3
	Practical		1
	DSE-III: Parasitology		3
	Practical		1
5 **(Any one**	**Major-9** Cell Biology	ZLG0500104	3

of the Optional DSE papers to be opted)	Practical		1
	Major-10 Fundamentals of Biochemistry	ZLG0500204	3
	Practical		1
	Major-11 *DSE-I*: Immunology (To be adopted from SWAYAM)	ZLG0500304 (DSE-I/ DSE-II/ DSE-III)	4
	Practical		
	DSE-II: Reproductive Biology		3
	Practical		1
	DSE-III: Developmental Biology		3
	Practical		1
6 (**Any one of the Optional DSE papers to be opted**)	**Major-12** Wildlife Conservation & Management	ZLG0600104	3
	Practical		1
	Major-13 Molecular Biology	ZLG0600204	3
	Practical		1
	Major-14 Biochemistry of metabolic processes & Regulation	ZLG0600304	3
	Practical		1
	Major-15 *DSE-I*: Fundamentals of Bioinformatics (To be adopted from SWAYAM)	ZLG0600404 (DSE-I/ DSE-II/ DSE-III)	4
	Practical		
	DSE-II: Advanced Entomology		3
	Practical		1
	DSE-III: Animal Cell Culture & Genetic Engineering		3
	Practical		1

MAJOR-4
ENTOMOLOGY AND FISHERIES
Code: ZLG0300204
Credit: 3 (T) + 1 (P)

Course Outcomes:

Upon completion of the course, the students should be able to:

1. Identify and classify the diversity of insects and fishes based on their morphological characters
2. Interpret the body design and plan of insects and fishes in a simpler form.
3. Categorize the common vectors of human diseases and common phytophagous pests
4. Compare and contrast capture and culture fisheries resources of India
5. Appraise the importance of fish as a model organism in research and develop skills on induced breeding of Indian Major Carps, soil and water quality in aquaculture.

MAJOR-4
ENTOMOLOGY AND FISHERIES
Code: ZLG0300204
Credit: 3 (T) + 1 (P)

THEORY	**Hours**
Unit 1: **General Features of Insects**, Classification of insects up to orders, causes of success of insects on earth, role of insects in pollination, Basic concept on collection, preservation and culture techniques of insects **General Morphology of insects** -compound Eyes, antennae, Mouth parts and legs. Structure of integument. Molting and metamorphosis. **Insects as Vectors & Pest**: Insects as mechanical and biological vectors of pathogens and parasites, Common insect vectors (Aedes, Culex, Anopheles, Phlebotomus, Musca domestica), Insects as plant pests.	23
Unit 2: **Introduction to fish** - General description of a fish; Account of systematic classification of freshwater teleosts of NE India (up to Order) **Morphology and Physiology** - Types of fins and their modifications; Locomotion in fishes; Types of Scales; Structure and functions of Gills, basic mechanism of gas exchange; Swim Bladder - types, role in Respiration and buoyancy; Osmoregulation in Elasmobranchs; Electric organs	09
Unit 3: **Capture Fisheries** - Inland Capture Fisheries resources of India; marine fisheries; Fishing crafts and Gears; Application of remote sensing and GIS in fisheries; Fisheries rules and regulations; Climate change and its impact on fisheries; Fishery by-products **Culture fisheries** - Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of Indian Major Carps; Management of hatcheries; Role of soil and water quality in aquaculture	13

Fish in research - Transgenic fish, Zebrafish as a model organism in research

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ENTOMOLOGY AND FISHERIES

Practical	Hours
1. Study of different types of mouth parts/ antenna of insects through slides/specimens.	30
2. Study of insect vectors through permanent slides or photographs or model: *Aedes, Culex, Anopheles*, *Pediculus*, *Cimex*, *Phlebotomus* (sand fly), and *Musca domestica* (house fly).	
3. Preparation of project report on any one vector and diseases transmitted by the vector (*Aedes/Culex/Anopheles*/ lice/ bed bug, sand fly/ house fly).	
4. Identification of insects belonging to different orders, common insect pest of paddy, tea, stored grain, citrus and sugarcane.	
5. Classification and characterization of commercially important food and ornamental fishes of NE India.	
6. Study of different types of indigenous/locally available fishing gears.	
7. Estimation and interpretation of pH of pond soil; dissolved oxygen (D.O.) and free carbon dioxide (fCO_2) in pond water.	
8. Dissection and display of Pituitary Gland of Indian Major Carp.	
9. Demonstration of induced breeding of IMCs (video)	

Suggested Readings:

1. Pradhan, S. (1969). Insect Pests of Crops. National Book Trust, India Book House.
2. Atwal, A.S. (1993) Agricultural pest of India and South East Asia. Kalyani Pub., New Delhi.
3. Chapman, R. F. The Insects: Structure and Function. Cambridge University Press, UK
4. S. Hill. (2005) Agricultural Insect pests of the tropics and their management, Cambridge University press.
5. Pedigo L. P. (2002). Entomology and Pest Management, Prentice Hall Publication
6. Tembhare, D.B. Modern Entomology
7. David, B.V. and Ananthakrishnan (2004). General and Applied Entomology.
8. Bone, Q. & Moore, R. H. (2008). Biology of Fishes. 3rd edition, Taylor & Francis
9. Evans, D. H., Claiborne, J. B. & Curie, S. (2014). The Physiology of Fishes. 4th edition, CRC Press
10. Handbook of Fisheries and Aquaculture (2013). Published by the Indian Council of Agricultural Research, New Delhi
11. Khanna, S. S. & Singh, H. R. (2014). Textbook of Fish Biology and Fisheries. 3rd edition, Narendra Publishing House
12. Jayaram, K. C. (2010). The Freshwater Fishes of the Indian Region. 2nd edition, Narendra Publishing House
13. Vishwanath, W. (2021). Freshwater Fishes of the Eastern Himalayas. 1st edition, Elsevier

SEMESTER V

MAJOR-9
CELL BIOLOGY
Code: ZLG0500104
Credit: 3 (T) + 1 (P)

Course Outcomes:
Upon completion of the course, students should to be able to:

1. Identify different cell types.
2. Infer about the composition of cells and cellular compartments and detail study about the functioning of these organelles.
3. Interpret cellular energetics and concept of protein sorting
4. Compare and contrast different levels of DNA packaging within the cells and the types of chromosomes.
5. Define cellular growth and division, communication among different cells and mode of cellular homeostasis by apoptosis and necrosis.

MAJOR-9
CELL BIOLOGY
Code: ZLG0500104
Credit: 3 (T) + 1 (P)

THEORY	**Hours**
Unit 1 **Over view of Cells**: Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions. **Plasma Membrane:** Various models of plasma membrane structure, Transport across membranes: Active and Passive transport, Facilitated transport, Types of transporters **Cell junctions:** Structure and functions of Tight junctions, Desmosomes, Gap junctions **Endomembrane System**: Structure and Functions of Endoplasmic Reticulum, Golgi Apparatus and Lysosomes	15
Unit 2 **Mitochondria:** Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis **Peroxisomes:** Structure and functions **Cytoskeleton**: Structure and Functions of Microtubules, Microfilaments and Intermediate filaments, Cillia and flagella **Nucleus**: Structure of Nucleus (Nuclear envelope, Nuclear pore complex, Nucleolus)	15
Unit 3 **Chromosomes:** Giant chromosome (Polytene and lampbrush), Types of eukaryotic chromosomes based on centromeres, Euchromatin and Hetrochromatin, DNA packaging within the nucleus (nucleosome model)	15

Cell Division: Mitosis, Meiosis, Cell cycle and its regulation
Cell to Cell communications: Types of signalling molecules, Cell surface receptors and its types, second messengers, Mechanism of signal transductions of peptide and steroid hormones.
Cell Deaths: Necrosis and apoptosis, significance of apoptosis in cellular homeostasis, Mechanism of apoptosis

CELL BIOLOGY

Practical	Hours
1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis **2.** Study of various stages of meiosis in testis (Grasshopper/Cockroaches/Mice/Rat). **3.** Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells. **4.** Preparation of permanent slide of blood and study of different types of blood cells **5.** Preparation of histological slides from tissues as liver, Lung, Stomach, Intestine, Kidney, Pancreas, Testes and Ovary. **6.** Preparation of permanent slide for cytochemical demonstration of a. DNA by Feulgen reaction b. Mucopolysaccharides and Glycogen by PAS reaction c. Proteins by Mercuro bromophenol blue/FastGreen d. Lipid by Sudan black B	30

Suggested Readings:

1. Cooper, G. M. (2018). 8th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605357072
2. Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13 : 978-0815345244
3. Lodish H et al. (2003). 5th Revised edition. Molecular Cell Biology. W.H.Freeman & Co Ltd; ISBN13 : 978-0716743668
4. Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2016). 9th Edition. The world of the cell. San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 -0321934925.
5. Karp, G. (2019). 9th Edition. Cell and molecular biology: New Jersey, USA: Wiley Publishers. ISBN-978—1-119-59816-9

MAJOR-10
FUNDAMENTALS OF BIOCHEMISTRY
Code: ZLG0500204
Credit: 3 (T) + 1 (P)

Course Outcomes:

Upon completion of this course, students should be able to:

1. Identify and define the basic principle, structure and function of biomolecules like carbohydrates, proteins and nucleic acids.
2. Interpret the role of these molecules in the functioning of animal systems.
3. Relate the characteristics, kinetics, regulation and inhibition of enzymes.
4. Describ the biochemical system of the body.
5. Apply and develop practical skills isolate, identify and quantify different functional groups present in these molecules.

MAJOR-10
FUNDAMENTALS OF BIOCHEMISTRY
Code: ZLG0500204
Credit: 3 (T) + 1 (P)

THEORY	**Hours**
Unit1: Carbohydrates and Lipids Carbohydrates: Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates Lipids: Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids	15
Unit 2: Amino Acids, Proteins and Nucleic Acids Amino acids: Structure, Classification and General properties of α- amino acids; Physiological importance of essential and non-essential α- amino acids. Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins. Nucleic Acids: Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA. Types of DNA and RNA, Complementarity of DNA**.**	15
Unit 3: Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Regulation of enzyme action and Different types of Enzyme Inhibition (Competitive, Non-competitive and Uncompetitive Inhibition). Multi-substrate reactions; Allosteric enzymes and their kinetics; Regulation of enzyme action	15

FUNDAMENTALS OF BIOCHEMISTRY

Practical	Hours
1. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 2. To determine the iodine number of given oil/fat. 3. Estimation of a reducing sugar in a given sample. 4. To find the pKa value of acetic acid. 5. To study the activity of Salivary Amylase and Determination of Amylase Number. 6. To study the absorption spectrum of proteins and DNA. 7. Demonstration of proteins separation by SDS-PAGE.	30

Suggested Readings:

1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., NewYork.
2. Berg,J.M.,Tymoczko,J.L.andStryer,L.(2007).Biochemistry,VIEdition,
3. W.H. Freeman and Co., New York. Murray,R.K.,Bender,D.A.,Botham,K.M.,Kennelly,P.J.,Rodwell.
4. V.W.and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill CompaniesInc.
5. Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd.,U.K.
6. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, PearsonPub.
7. Das M, Dutta A and Kalita A (2022). Advanced Biochemistry. Kalyani Publications.

MAJOR-11

IMMUNOLOGY

Code: ZLG0500304 (DSE-I)

Credit: 3 (T) + 1 (P)

TO BE ADOPTED FROM SWAYAM

By Prof. Sudip Kumar Ghosh, Prof. Agneyo Ganguly; IIT Kharagpur

Course Outcomes:

The course will provide basic knowledge of Immunology for UG students in the field of Life Science and Biotechnology. The course introduces students to a wide range of topics in immunology starting from cells of immune system, innate and adaptive immune systems, humoral immunity, antibody structure and function, basic immunological techniques, autoimmunity, hypersensitivity and vaccine production. The course is well balanced with the basics of immunology as well as advanced topics delivered easily for UG students in particular.

THEORY
Credit: 03

Course layout

Week 1: Introduction to immune System, Immune cell types, Hematopoiesis, B and T lymphocytes, NK cells, Lymphoid organs (primary and secondary)

Week 2: Features of/introduction to inflammation, Adaptive immune system, Innate Immune system

Week 3: Antibody structure, Generation of antibody diversity

Week 4: Generation of antibody diversity and TCR rearrangement

Week 5: Major histocompatibility complex, Antigen presentation, APCs

Week 6: Immuno-diffusion assay, ELISA (Sandwich), Immuno-blotting, flowcytometry.

Week 7: T-cell development, negative/positive selection,co-stimulatory molecules.

Week 8: Humoral immunity/Cell-mediated immunity, T cell subtypes: Th1, Th2, Th17, Tregs etc.

Week 9: B-cell maturation/activation BCR signaling, memory B and T cell

Week 10: Pro-inflammatory and anti-inflammatory cytokines,cell polarization/Complement activation (classical/alternate), hypersensitivity

Week 11: Autoimmunity, host vs graft reaction

Week 12: Active immunization Vaccines, , Vaccine production, passive immunization. , polyclonal and monoclonal antibodies

IMMUNOLOGY
Credit: 01

Practical	**Hours**
1. Histological study of spleen, thymus and lymph nodes through slides/ photographs.	30
2. Preparation of stained blood film to study various types of blood cells.	
3. ABO blood group and Rh factor determination.	
4. Demonstration of - a) ELISA; b) Immunoelectrophoresis	
5. Isolation of lymphocytes from blood.	

Suggested Readings:

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.
4. Janeway's Immunobiology by K. Murphy, P. Travers and M. Walport, Publisher: Garland Science.

MAJOR-11
REPRODUCTIVE BIOLOGY
Code: ZLG0500304 (DSE-II)
Credit: 3 (T) + 1 (P)

Course Outcomes:

Upon completion of the course, students should be able to:

1. Identify the processes of reproductive endocrinology in mammals.
2. Interpret the functional anatomy of male and female reproductive systems in mammals.
3. Describe various hormones involved in the process of reproduction and also the roles that they perform in the body.
4. Develop practical skills related to understanding the reproductive biology in mammals.
5. Perform further studies on the topics related to reproductive biology.

MAJOR-11
REPRODUCTIVE BIOLOGY
Code: ZLG0500304 (DSE-II)
Credit: 3 (T) + 1 (P)

THEORY	**Hours**
Unit 1: Reproductive Endocrinology Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones and prostaglandins, hypothalamo–hypophyseal–gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.	15
Unit 2: Functional anatomy of male reproduction Outline and histological study of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract	20
Unit 3: Functional anatomy of female reproduction Outline and histological of female reproductive system in rat and human;	10

Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Fertilization, implantation and pregnancy in mammals

REPRODUCTIVE BIOLOGY
Credit: 3 (T) + 1 (P)

Practical	**Hours**
1. Study of estrous cycle in rat/mice.	30
2. Study of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems.	
3. Study of histological sections from photomicrographs/ permanent slides of sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.	
4. Total sperm count and determination of sperm motility in mammal	

Suggested Readings:

1. Austin, C.R. and Short, R.V. Reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. andJameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al.(eds). The Physiology of Reproduction. Raven Press Ltd.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.
5. Johnson, M.H. (2018). Essential Reproduction, Wiley-Blackwell, 8th Edition
6. Zarrow, M. (1964). Experimental Endocrinology-A source book of basic techniques, Elsevier, 1st Edition

MAJOR-11
DEVELOPMENTAL BIOLOGY
Code: ZLG0500304 (DSE-III)
Credit: 3 (T) + 1 (P)

Course Outcomes:

Upon completion of the course, students should be able to:

1. Define the role of mitosis and meiosis cell division, cellular differentiation during gametogenesis.
2. Interpret how fertilization happens and the factors that affect fertilization event.
3. Correlate the basic embryonic development and organogenesis.
4. Compare the role different hormones and of cellular signalling during development through metamorphosis and teratogenesis.
5. Appraise the importance of IVF, amniocentesis and embryonic stem cells.

MAJOR-11
DEVELOPMENTAL BIOLOGY
Code: ZLG0500304 (DSE-III)
Credit: 3 (T) + 1 (P)

THEORY	**Hours**
Unit 1: **Gametogenesis:** Spermatogenesis and Oogenesis Type of animal eggs, egg membrane and vitellogenesis, **Fertilization:** External and internal fertilization**,** sperm-egg interactions, biochemical events, post-fertilizations events. **Parthenogenesis**: Natural haploid, diploid and cyclic parthenogenesis. Artificial stimulus for parthenogenesis and its significance.	15
Unit 2: Planes and patterns of cleavage; Types of Blastula; Embryonic induction and Organizer, Fate map construction in frog and chick. **Organogenesis:** Development of heart and eye in vertebrates Development of chick embryo up to three germ layer formation. Extra embryonic membranes in bird and mammal.	15
Unit 3: **Placenta:** Types, function and physiology **Metamorphosis: types of metamorphosis, metamorphic changes**, hormonal regulations of metamorphosis in insects and amphibians. **Teratogenesis:** Teratogenic agents and their effects on embryonic development In vitro fertilization, Embryonic Stem cell (ESC), Amniocentesis.	15

DEVELOPMENTAL BIOLOGY

Practical	Hours
1. **Collection and study of different type of eggs** 2. **Examination of gametes of frog/rat/mice:** Sperm and ova through permanent slides or photomicrographs. 3. **Study of developmental stages of Frog:** Whole mounts and sections through permanent slides of cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages. 4. **Study of developmental stages of Chick embryo:** Whole mounts of chick through permanent slides (Hamburger and Hamilton Stages): Stage 3 (Intermediate Streak, 13 hours), Stage 4 (Definitive Streak, 18 hours), Stage 5 (Head Process, 21 hours), Stage 7 (24 hours), Stage 8 (28 hours), Stage10 (33 hours), Stage 11 (40 hours), Stage 13 (48 hours), Stage 19 (72 hours) and Stage 24 (96 hours) of incubation 5. **Study of different types of placenta**: Histological sections through permanent slides or photomicrographs.	30

Suggested Readings:

1. Gilbert, Scott F. *Developmental Biology*. 7th ed. Sunderland, MA: Sinauer Associates, 2003. ISBN: 9780878932580.
2. Wolpert, Lewis. *Principles of Development.* 2nd ed. New York, NY: Oxford University Press, 2001. ISBN: 9780198792918.
3. Kalthoff, Klaus. *Analysis of Biological Development*. 2nd ed. Boston, MA: McGraw-Hill, 2001. ISBN: 0071180788.
4. Slack, J. M. W. *Essential Developmental Biology*. Malden, MA: Blackwell Science, 2001. ISBN: 9780632052332.
5. Bier, Ethan. *The Coiled Spring: How Life Begins*. Plainview, NY: Cold Spring Harbor Laboratory Press, 2000. ISBN 9780879695637.
6. Gerhart, John, and Marc Kirschner. *Cells, Embryos, and Evolution: Toward a Cellular and Developmental Understanding of Phenotypic Variation and Evolutionary Adaptability*. Malden, MA: Blackwell Science, 1997. ISBN: 9780865425743.
7. Russo, V. E. A., et al., eds. *Development: Genetics, Epigenetics, and Environmental Regulation*. New York, NY: Springer, 1999. ISBN: 9783540627548.
8. Arias, Alfonso Martinez, and Alison Stewart. *Molecular Principles of Animal Development.* New York, NY: Oxford University Press, 2002. ISBN: 9780198792840.
9. Rao, Mahendra S., and Marcus Jacobson, eds. *Developmental Neurobiology*. 4th ed. New York, NY: Springer-Verlag, 2005. ISBN: 9780306483301.