

**Institute of Zoology
Faculty of Life Sciences
University of the Punjab, Lahore**



Course Outline

Programme	BS Zoology	Course Code	ZOOL-314	Credit Hours	2
Course Title	Developmental Biology				
Course Introduction					
Developmental biology is the science that investigates how a variety of interacting processes generate an organism’s heterogeneous shapes, size, and structural features that arise on the trajectory from embryo to adult, or more generally throughout a life cycle. It encompasses experimental examination of the development of multicellular organisms’ growth, differentiation and remodeling to give rise to the adult form, using molecular, cellular, tissue, organ and whole organism methodology. Understanding how embryos form, grow and shape remains fundamental to developmental biologists but now also includes the exciting fields of growth and differentiation of stem cells in adults.					
Learning Outcomes					
On the completion of the course, the students will:					
<div><div>1. Familiarize with the transmission of traits from the parents in their gametes, the formation of zygote and its development</div><div>2. Get knowledge about external and internal fertilization.</div><div>3. Acquire the ability to label macromeres, mesomeres, and micromeres and know how three basic germinal layers (ectoderm, endoderm, and mesoderm) are formed.</div><div>4. Elucidate the problems associated with cellular differentiation through fate mapping.</div><div>5. Know about the developmental processes that lead to the establishment of the body plan of the vertebrates at the cellular and genetic level.</div></div>					
Course Content				Assignments/Readings	
Week 1	Introduction <ul style="list-style-type: none">History and Basic Concepts of Developmental BiologyTheories of Preformation and Epigenesis				
	Reproduction <ul style="list-style-type: none">Principles of developmentlife cycle of sexually reproducing organisms				
Week 2	Gametogenesis <ul style="list-style-type: none">Mammalian spermatogenesis as model for all vertebratesSpermiogenesis or (spermateliosis)				
	Spermatogenesis <ul style="list-style-type: none">The role of Sertoli and Leydig cells in spermatogenesisThe role of Paracrine and endocrine factors during spermatogenesis				
Week 3	Oogenesis in Mammals <ul style="list-style-type: none">Primates Menstrual cycleHormonal control of oogenesis				
	Oogenesis in Amphibians <ul style="list-style-type: none">Previtellogenic and postvitellogenic stagesRole of Maturation promoting factor (MPF) and cytotstatic factor (CSF)				

Week 4	Oogenesis in Birds <ul style="list-style-type: none"> Anatomy of chick reproductive tract Yolk, albumin deposition and shell formation 	
	Oogenesis in Insects <ul style="list-style-type: none"> Role of nurse cells in Germarium 	
Week 5	<ul style="list-style-type: none"> Ultra structure of Sperm Ultra structure of various Eggs 	
	External Fertilization, (Sea Urchin as a model for aquatic animals) <ul style="list-style-type: none"> Species-specific recognition of sperm and egg The Acrosomal Reaction 	
Week 6	<ul style="list-style-type: none"> Recognition of own specie Egg's extracellular coat Fusion of male and female cell membranes & Genetic materials 	
	<ul style="list-style-type: none"> Block to polyspermy 	
Week 7	Activation of Egg metabolism <ul style="list-style-type: none"> Release of Calcium ions Role of Calcium ions during fertilization & to resume metabolic activities of fertilized egg 	
	<ul style="list-style-type: none"> Early Responses Late Responses 	
Week 8	Internal Fertilization (Mouse or human as a model) <ul style="list-style-type: none"> Gametes Translocations Capacitation 	
	<ul style="list-style-type: none"> Thermotaxis & Chemotaxis Recognition at the Zona pellucida 	
Week 9	<ul style="list-style-type: none"> Acrosomal Reaction Gamete, genetic materials fusions and prevention to polyspermy 	
	IN VITRO Fertilization (IVF) <ul style="list-style-type: none"> History, Steps and advantages of IVF Disadvantages and risk factors 	
Week 10	Cleavage and Blastulation <ul style="list-style-type: none"> Trip from fertilization to Cleavage Mid blastula transition 	
	<ul style="list-style-type: none"> Patterns of embryonic cleavage Holoblastic & Meroblastic cleavage Mechanisms of Cleavage 	
Week 11	Gastrulation in General <ul style="list-style-type: none"> Morphogenetic movements 	
	Cleavage and Gastrulation in Amphibians <ul style="list-style-type: none"> Unequal Radial holoblastic cleavage Mid-blastula transition: preparing for gastrulation Gastrulation 	
Week 12	Cleavage and Gastrulation in Birds <ul style="list-style-type: none"> Discoidal meroblastic cleavage 	
	<ul style="list-style-type: none"> Gastrulation (Hypoblast & Primitive Streak formation) 	
Week 13	Cleavage and Gastrulation in Mammals	

	<ul style="list-style-type: none"> • Rotational holoblastic cleavage in Mammals • Blastocyst formation • concept of Totipotency VS Pluripotency of blastomeres 	
	<ul style="list-style-type: none"> • Zona Hatching & Blastocyst Implantation • Gastrulation through primitive streak formation 	
Week 14	<ul style="list-style-type: none"> • formation of extraembryonic membranes • Twins and Chimeras 	
	<ul style="list-style-type: none"> • Development of placenta and its different types and functions 	
Week 15	<ul style="list-style-type: none"> • Cryopreservation • Gametes • Embryos • Medical and ethical considerations about cryopreservation 	
	<i>Organizers and induction</i> <ul style="list-style-type: none"> • Formation of organizer • Hans Spemann's Primary embryonic induction 	
Week 16	<ul style="list-style-type: none"> • Molecular mechanism of primary embryonic induction 	
	Early vertebrate development <ul style="list-style-type: none"> • Germinal Layers (ectoderm, mesoderm, endoderm) derivatives 	

Textbooks and Reading Material

1. Gilbert, S. F. 2013. Developmental Biology, Sinauer Associates, Sunderland, MA.
2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw-Hill.
3. Scott F. Gilbert and Michael J. F. Barres. 2016. Developmental Biology. Sinauer Associates, Sunderland, MA.
4. Jamie. A. Davies. 2014. Life Unfolding: How the Human Body Creates Itself. Oxford University Press, USA
5. Balinsky, B. I. 1985. An Introduction to Embryology, Saunders.
6. Oppenheimer, S.S. 1984. Introduction to Embryonic Development, Allen and Bacon.
7. Saunders, J. W. 1982. Developmental Biology, McMillan and company.
8. Ham, R. G., Veomett, M. J. 1980. Mechanism of Development. C. V. Mosby Co.

Teaching Learning Strategies

Class lectures, class discussions, group work, Short videos/films

Assignments: Types and Number with Calendar

Written assignments, class quizzes, presentation, class participation/attendance

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.