



Lahore University of Management Sciences

BI0415/515 – Developmental Biology/Eukaryotic Development

Spring 2024

Instructor	Dr. Muhammad Tariq (lead), Dr. Muhammad Shoaib
Room No.	9-315A
Office Hours	To be decided
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Secretary/Coordinator/TA	
TA Office Hours	To be decided
Course URL (if any)	lms.lums.edu.pk
Lecture	SBASSE 10-202
Lab	None

Course Teaching Methodology

- **Teaching Methodology:** All lectures will be in person, students will be guided to supplementary reading material.
- **Lecture Details:** There will be no pre-recorded lectures. However, links to related reference material available online from different sources will be provided, if necessary.

Course Basics

Credit Hours	4			
Lecture(s)	Nbr of Lec(s)	2 per week	Duration	110 minutes each lecture
Recitation/Lab	Nbr of Lec(s)	1 per week, will be scheduled with students	Duration	
Tutorial	Nbr of Lec(s)	As per need	Duration	

Course Distribution

Core	Core course for Biology major students
Elective	Yes, can be taken as an elective
Open for Student Category	Sophomore, Juniors, Seniors
Close for Student Category	None

COURSE DESCRIPTION

Developmental Biology is an extremely vast subject, which deals with the processes and mechanisms that lead to development of an adult organism from a fertilized egg. This course will introduce students to basic concepts in development and principles that lead to development of multicellular eukaryotes. Both vertebrate and invertebrate models are discussed with special emphasis on *Drosophila* where process of development is understood at mechanistic level in much more detail. In particular, emphasis will be on the genetic and epigenetic basis of development including stem cells, reprogramming of cells and process of regeneration in eukaryotes. Students get research literature published in the field of development to understand how they can experimentally approach different topics of development. Every week students will critically discuss research papers related to ongoing lectures and lead a discussion in class. The review and discussion of research material will enable students to formulate an experimental question and hypothesis to address and design experiments to test the hypothesis. All students should actively participate in all the classes and questions are encouraged in both lecture and paper review sessions. Students must ask questions (no question is ever a stupid question), asking no question is considered a negative attitude in this class. It is also expected that each student should have read and considered all papers before the discussion session. Importantly, students must keep a written record of techniques relevant to specific questions as the course proceeds.

COURSE PREREQUISITE(S)

	BIO216
	BIO221 (Co-req)

COURSE OBJECTIVES



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	<p>The basic purpose of this course is to expose students to:</p> <ul style="list-style-type: none">• Genetic, molecular and biochemical basis of development• Evolutionary conserved molecular and biochemical pathways which lead to development of diverse organisms• Classical and cutting edge research articles which enables them to understand development
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Learning Outcomes

	<p>At the end of course students should be able to understand and explain following key concepts:</p> <ul style="list-style-type: none">• How development from a single fertilized egg proceeds and which developmental processes are involved up to development of adults.• How gene regulation and cell signaling are interconnected in the development of specific organ/tissue.• How developmental pathways are conserved in invertebrates and vertebrates• How to read and grasp research articles about cutting edge molecular, genetic and imaging techniques that are being used to dissect different aspects of development. They must also be able to present and explain the results and data presented in research articles.• Students must be able to start thinking scientifically to develop small research projects utilizing the information and knowledge they gain through this course.
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Grading Breakup and Policy

Assignment(s): 15% (research papers)

Home Work:

Quiz(s): 5% (5-10 Quizzes)

Class Participation:

Attendance:

Mid-term: 40%

Final exam: 40%

Grading will be absolute.

Examination Detail

	<p>Yes/No: Yes</p> <p>There will be total two exams mid-term and a final exam besides research papers discussion and quiz exams. For research papers students will be given research articles which they will discuss and present in weekly recitation. Exams will be scheduled after consultation with students on a date/time feasible for all.</p> <p>Duration: 180 mins (May vary if taken online)</p> <p>Exam Specifications: Closed Book, No cell phones, no notes, nothing extra help.</p>
	<p>Yes/No: Yes</p> <p>Duration: 120~180 mins (May vary if taken online)</p> <p>Exam Specifications: Closed Book, No Calculator. No cell phones.</p>

Makeup Policy

- Please refer to Student Handbook 2019-20, page 37, article 25, titled "Makeup Policy for Graded Instruments".
- *"In case N-X policy is implemented for an instrument having multiple sub instruments then petitions will not be accepted for that instrument".*

Code of Conduct

1. Students are required to show up in classes fully prepared for the lecture, ensure their videos are on and mic's are muted.
2. Quiz will be announced ahead of time, students must ensure their devices are charged and they have a stable internet connection (including smartphones).
3. All assessments including quizzes and exams will be timed. Make sure that you are able to start them on time.



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COURSE OVERVIEW			
Lecture	Topics	Recommended Readings	Objectives/ Application
L1-MT	Introduction: History of developmental biology; what is developmental biology; theories of preformation and epigenesis, germline vs soma, concepts of induction and regulation in development, general principles of development, model systems, primary germ layers (ecto-mesoendoderm) (L1)	<i>Chapter 1: Principles of Development by Lewis Wolpert</i>	
L2-3-MT	Molecular signaling in development: developmental signaling pathways, notch, FGF, Hedgehog, Wnt, JNK, JAK/STAT etc in context of development; Tools to study development: genetic and biochemical tools, tissue specific gene expressions, in situ hybridization, southern, western and northern blots, tissue specific profiling, microarrays, somatic and germ line clones (L2-3)	<i>Chapter 2, Cell signaling Developmental Biology Scott Gilbert</i>	
L4-5-MT	Fertilization: germ cells development and process of fertilization; Oogenesis and Spermatogenesis; Eggshell; Release and activation of the gametes; Fertilization; Behavior of the sperm; Reactions of the Egg; Karyogamy and Cytokinesis; Parthenogenesis and Gynogenesis (L4-5)	<i>Chapter 9 Principles of Development by Lewis Wolpert</i>	
L6-9-MT	Early development and morphogenesis in Drosophila: Setting up the body axes, maternal determinants, patterning early embryo, pair rule genes, segmentation genes, segment identity	<i>Chapter 2 Principles of Development by Lewis Wolpert</i>	
L10-12-MT	Morphogenesis: cell adhesion, cleavage and formation of blastula, gastrulation movements, cell migration	<i>Chapter 8 Principles of Development by Lewis Wolpert</i>	
L13-15-MT	Differentiation: control of gene expression, differential gene expression. Plasticity of gene expression, patterns of gene activity in differentiated cells and Stem cells	<i>Chapter 10 Principles of Development by Lewis Wolpert</i>	
L16-22-MS	Organogenesis: Patterning the plan: somite formation, neural induction and development of the nervous system, neuronal migration and synapse formation, insect eye, wing, leg Development	<i>Chapter 11 Principles of Development by Lewis Wolpert</i>	
L23-24-MS	Plant development: alternation of generations, gamete production in angiosperms, pollination, fertilization	<i>Chapter 7 Principles of Development by Lewis Wolpert</i>	



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	and embryonic development, meristem development, germination, vegetative growth and control of flowering		
L25-MS	Epigenetics of development: epigenetic cellular memory, DNA methylation and chromatin modification as nexus of development. Genomic imprinting, X inactivation development	<i>Chapter 11 Chromatin and Gene regulation by Bryan M. Turner</i>	
L26-MS	Stem cells and regeneration: what are stem cells, types of stem cells i.e. embryonic stem cells, multipotent stem cells, pluripotent adult stem cells, transgenic stem cells induced pluripotent stem cells (iPS). Transdifferentiation and transdetermination and process of regeneration, totipotency (flat worms case)	<i>Chapter 10 Principles of Development by Lewis Wolpert</i>	
L27-28-MS	Sex determination: determination of sexual phenotype in mammals, Drosophila, C. elegans. Dosage compensation of X-linked genes	<i>Chapter 9 Principles of Development by Lewis Wolpert Chapter 12 Chromatin and Gene regulation by Bryan M. Turner</i>	

Textbook(s)/Supplementary Readings	
(i)	Gilbert, Scott F. <i>Developmental Biology</i> . 7th ed. Sunderland, MA: Sinauer Associates, 2003. ISBN: 9780878932580.
(ii)	Wolpert, L., Jessel, T., Lawrence P., Meyerowitz, E., Robertson, E., Smith, J. <i>Principles of Development</i> . 3 rd ed. Oxford University Press. 2002. ISBN 978-0-19-927536-6
(iii)	Bryan M. Turner. <i>Chromatin and Gene regulation: Molecular mechanisms in epigenetics</i> . Blackwell Science Press. 2001. ISBN. 0-865-42743-7

Academic Honesty
<p>A student-teacher relationship is purely based on honesty, integrity and inspiration. Where teacher's role is to make every effort possible to inspire his students about the subject and develop independent thinking and a problem solving attitude about every concept, students are required to uphold values of truth and honesty and eagerness to learn. In this whole learning process honesty, integrity and commitment by students play a major role in their long-term success. It means a student perform all academic work, assignments, exams, quizzes and never gets involved in any unfair activity falling under academic dishonesty like cheating, unauthorized aid of any kind, plagiarism etc. I have also trusted my students, I never invigilate them in exams and trust that they will demonstrate extremely high level of integrity and honesty because if you fail to uphold these core values you will miserably fail in life on every step in the long run. Remember, it's better to fail a small exam rather than cheat and fail in life.</p> <p>Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.</p>
Harassment Policy
<p>SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behavior that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.</p>



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In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end of offending behavior. You can find more details regarding the LUMS sexual harassment policy [here](#). To file a complaint, please write to harassment@lums.edu.pk

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Rights and Code of Conduct for Online Teaching

A misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.

Whenever you write an email and submit exams, assignments and all work your file name should follow following instructions in subject of email as well as in file name.

Subject of email: BIO415-Final exam, mid-term exam, quiz number or assignment number

File name: BIO415-LUMS-ID-type of work i.e., exam number, assignments number etc.