

BIOL 6964 - Advanced Molecular Genetics

Fall 2026 Syllabus, Section 01, CRN 44076,

Credit hours: 3

Instructor

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Public Instructor Information

Instructor Title: *Assistant Professor*

Instructor Professional Qualifications: **PhD (Botany, Kunming Institute of Botany, 2020); Master's in Science (Botany, Tribhuvan University, 2015);**

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Course Description

6964. Advanced Molecular Genetics. An examination of the mechanisms of transcription, translation, DNA replication, and RNA processing and transposition in both prokaryotes and eukaryotes. Prereq.: BIOL 4890 Molecular Genetics or permission of instructor. 3 s.h.

Course Readings

Group	Title	Author	ISBN
Required	Genetics: From genes to genomes	Hartwell et al	0-07-246248-5
Optional	Molecular Biology	Weaver RF	978-0-07-352532-7
Optional	Selected contemporary CRISPR-Cas research articles (2020–2026)	Various	

The course readings are subject to change in the event of extenuating circumstances, research developments, current events, and/or to ensure better learning.

Advanced Molecular Genetics

Day	Date	Reading(s)	Proposed Topic	Due/To Prepare for Class
Mon	8/24	Course materials	Introduction to Advanced Molecular Genetics – Course overview; molecular mechanisms, genomics, and research-based learning	Review syllabus and course expectations
Wed	8/26	R introductory materials	Practical: Introduction to R/RStudio – Data import, objects, tables, and basic data handling	Bring laptop; install R/RStudio
Fri	8/28	Research project overview	Graduate Research Project Introduction – Stellera chamaejasme, genomic resources, RNA-seq data, and TE research questions	Review project overview
Mon	8/31	Selected reading	Genome Organization – Prokaryotic and eukaryotic genomes, genes, regulatory regions, and repetitive DNA	Reading
Wed	9/2	R/data tutorial	Practical: Biological Data in R – Metadata, expression matrices, data organization, and visualization	R exercise
Fri	9/4	Selected CRISPR paper	CRISPR Paper Discussion I – Contemporary CRISPR-Cas application	Read and summarize paper

Mon	9/7	Selected reading	DNA Replication – Mechanisms, enzymes, replication fidelity; prokaryotes vs. eukaryotes	Reading
Wed	9/9	Practical materials	Practical: Genome Data – Reference genomes, FASTA files, genome annotations, and sequence information	R/data exercise
Fri	9/11	Project materials	Research Analysis – Genome and annotation exploration	Research activity
Mon	9/14	Selected reading	DNA Damage, Repair & Genome Stability – Mutation, DNA repair pathways, and genome integrity	Reading
Wed	9/16	Practical materials	Practical: Genome Variation – Exploring sequence variation and molecular consequences	R exercise
Fri	9/18	Selected CRISPR paper	CRISPR Paper Discussion II – Genome editing and DNA repair	Read and summarize paper
Mon	9/21	Selected reading	Transcription – RNA polymerases, promoters, initiation, elongation, and termination	Reading
Wed	9/23	RNA-seq tutorial	Practical: Introduction to RNA-seq – Counts, sample metadata, and expression matrices	R exercise
Fri	9/25	Project dataset	Research Analysis – Exploring the Stellera RNA-seq dataset	Research activity
Mon	9/28	Selected reading	Regulation of Transcription – Promoters, enhancers, transcription factors, and gene regulation	Reading
Wed	9/30	R/RNA-seq materials	Practical: Gene Expression in R – Normalization concepts and expression visualization	R exercise
Fri	10/2	Selected CRISPR paper	CRISPR Paper Discussion III – CRISPR-mediated gene regulation	Read and summarize paper
Mon	10/5	Selected reading	RNA Processing – RNA maturation, capping, polyadenylation, introns, and splicing	Reading
Wed	10/7	Practical materials	Practical: Gene & Transcript Structure – Genes, transcripts, exons, and introns	R exercise
Fri	10/9	Project materials	Research Analysis – RNA-seq exploration and visualization	Research activity
Mon	10/12	Selected reading	Alternative Splicing & RNA Regulation – Alternative transcripts and post-transcriptional regulation	Reading
Wed	10/14	R tutorial	Practical: Expression Visualization – PCA, heatmaps, and expression plots	R exercise
Fri	10/16	Mid-term exam	Paper Discussion (randomly selected manuscript): evaluation/grading based on presentation style/contents/interpretation/critiques/recommendations (each 8-10 min)	
Mon	10/19	Selected reading	Translation – Genetic code, ribosomes, initiation, elongation, and termination	Reading
Wed	10/21	Practical materials	Practical: From Transcript to Protein – Coding sequences, annotation, and predicted proteins	Data exercise
Fri	10/23	Project materials	Research Analysis – Molecular interpretation and preparation for TE analysis	Research activity

Mon	10/26	Selected reading	Regulation of Gene Expression – Transcriptional, post-transcriptional, and translational regulation	Reading
Wed	10/28	RNA-seq/R materials	Practical: Differential Expression – Fold change, statistical significance, and visualization	R exercise
Fri	10/30	Selected CRISPR paper	CRISPR Paper Discussion V – Functional validation of genes/phenotypes	Read and summarize paper
Mon	11/2	Selected TE reading	Transposable Elements I – TE classes and mechanisms of transposition	Reading
Wed	11/4	TE analysis materials	Practical: TE Annotation & Classification – TE classes, superfamilies, and families	TE/R exercise
Fri	11/6	Project dataset	TE Research Project: Genome Landscape – Characterizing TEs in the Stellera genome	Research analysis
Mon	11/9	Selected TE reading	Transposable Elements II – Retrotransposons, DNA transposons, and genome consequences	Reading
Wed	11/11	No Class	Legal holiday-university closed	
Fri	11/13	Project materials	Research Analysis: TE Landscape – Interpretation and research-question refinement Practical: TE Landscape in R – TE abundance, composition, and visualization	TE/R exercise
Mon	11/16	Selected TE reading	Transposable Elements III: TE Regulation – Silencing, chromatin, methylation, and genome defense	Reading
Wed	11/18	Project dataset	Practical: TE Expression from RNA-seq – Identifying transcriptionally active TE families	TE/R exercise
Fri	11/20	Selected CRISPR paper	CRISPR Paper Discussion VI – CRISPR and genome/gene regulation	Read and summarize paper
Mon	11/23	Selected reading	TE Activity & Genome Dynamics – TE activation, suppression, genome regulation, and phenotypic variation	Reading
Wed	11/25	NO CLASS	No Class-university closed	
Fri	11/27	NO CLASS	No Class – Thanksgiving Break	
Mon	11/30	Selected reading	Integrating Molecular Genetics – Transcription, genome regulation, and TE activity	Reading
Wed	12/2	Project dataset	Practical: Comparative TE Activity – Comparing PP, RW, and RWh using R Practical: Final TE Analysis & Visualization – Research-quality figures and major patterns	Draft figures/results
Fri	12/4	Project materials	Research Project Workshop – Interpretation, Project progress limitations, and research synthesis	
Mon	12/7	Selected reading	Emerging Directions in Molecular Genetics – Contemporary approaches to genome regulation	Reading
Wed	12/9	Project materials	Research Project Synthesis/presentation – Final figures, conclusions, and presentation preparation	Finalize project
Fri	12/11	Final Exam	Graduate Course Synthesis/Exam	

The course schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better learning.