

## MCB291: Fundamentals in Genetics, Genomics, and Evolution

Instructors: Elena Kramer ([ekramer@oeb.harvard.edu](mailto:ekramer@oeb.harvard.edu)), Cassandra Extavour ([extavour@oeb.harvard.edu](mailto:extavour@oeb.harvard.edu))

Teaching Assistant: Frederike Alwes ([falwes@oeb.harvard.edu](mailto:falwes@oeb.harvard.edu))

Course Website: <http://my.harvard.edu/icb/icb.do?keyword=k63330>

Mondays 9:00 – 10:30 Northwest Building Room 205  
Wednesdays 1:00 – 2:30 Northwest Building Room 205  
Fridays 9:00 -10:30 BioLabs 1058 (Extavour Section – to be confirmed)  
1:00 – 2:30 BioLabs 4102 (Kramer Section – to be confirmed)

Date	Lecture	Speaker	Lecture Title
W 02-Sep	1	Kramer/Extavour	<b>1. Introduction to MCB291</b>
F 04-Sep	D1	TA	D01. Discussion <i>Choosing organisms for genetic approaches to development and evolution</i>
M 07-Sep	n/a	n/a	Labor Day: <i>No class</i>
W 09-Sep	2	Kramer	<b>2. Mendel in Context</b> <i>Pre-Mendelian ideas, the first model system, rediscovery, macro vs micro mutation</i>
F 11-Sep	D2	TA	D02. Discussion <i>Mendel, Hardy</i>
M 14-Sep	3	Kramer	<b>3. Overview of Classical Genetics</b> <i>Chromosome behavior: centromeres, origins, mitosis and meiosis, Segregation, linkage mapping (Morgan &amp; Handane)</i>
W 16-Sep	4	Kramer	<b>4. Genetics I</b> <i>Introduction to major genetic models, Basic genetic screens &amp; selections, backcrosses, codominance, testcrosses</i>

F 18-Sep	D3		TA	D03. Discussion <i>Classic genetic screens</i>
M 21-Sep	5		Kramer	<b>5. Genetics II</b> <i>Genetic screens II, tricks, insertional screens, enhancers, suppressors, modern mapping</i>
W 23-Sep	6		Kramer	<b>6. Genetics III</b> <i>Genome structure, high throughput analysis</i>
F 24-Sep	D4		TA	D04. Discussion <i>Modern genetic screens</i>
M 28-Sep	7		Kramer	<b>7. Introduction to Epigenetics</b> <i>Chromatin structure, DNA modification, assessing modification in the lab</i>
W 30-Sep	8		Kramer	<b>8. Population Genetics</b> <i>What does population genetics measure and why should you care?</i>
F 02-Oct	D5		TA	D05. Discussion <i>Genome-wide histone modification</i>
M 05-Oct	9		Kramer	<b>9. Species &amp; Speciation</b> <i>How do they form, how are they defined, how immutable are they?</i>
W 07-Oct	10		Kramer	<b>10. Phenotypic Plasticity and GxE</b> <i>West-Eberhard's goat and other examples</i>
F 09-Oct	D6		TA	D06. Discussion <i>Genetic Assimilation</i>
M 12-Oct	n/a	n/a		Columbus Day: <i>no class</i>
W 14-Oct	11		Berry	<b>11. Darwin in Context</b> <i>Pre-Darwinian thought, Evolution as explained by Darwin, what was missing</i>
F 16-Oct	D7		TA	D07. Discussion

*Darwin, Wallace*

M 19-Oct	12	Extavour	<b>12. The tree of life</b> <i>Evolutionary relationships of model systems, evolution of major morphologies</i>
W 21-Oct	13	Extavour	<b>13. Phylogenetics</b> <i>An introduction to trees and how to construct and interpret them</i>
<b>F 23-Oct</b>	<b>Exam</b>	<b>MIDTERM</b>	
M 26-Oct	14	Extavour	<b>14. Homology and Levels Thereof</b> <i>Definitions, history, criteria, hierarchical levels of selection</i>
W 28-Oct	15	Extavour	<b>15. Homoplasy &amp; the Ancestral Genetic Toolkit</b> <i>Convergence, parallelism, homoplasy at morphological &amp; molecular levels</i>
F 30-Oct	D8	TA	D08. Discussion <i>Evaluating homology claims</i>
M 02-Nov	16	Extavour	<b>16. Modularity, Co-Option &amp; Novelty</b> <i>Module definition and implications, modification mechanisms</i>
W 04-Nov	17	Extavour	<b>17. Developmental Constraint vs. Developmental System Drift</b> <i>Constraint definitions and evolution of the concept; evolvability</i>
F 06-Nov	D9	TA	D09. Discussion <i>Understanding constraint as a result of modularity</i>
M 09-Nov	18	Extavour	<b>18. Cis-regulatory Evolution</b> <i>Logic, support, implications, functional mechanisms</i>
W 11-Nov	n/a	n/a	<i>Veteran's Day: No class</i>
F 13-Nov	D10	TA	D10. Discussion <i>Finding hard evidence for cis-regulatory evolution</i>
M 16-Nov	19	Extavour	<b>19. Evolution of Protein Function</b>

*Biochemical evolution, interpretation of heterologous expression*

W 18-Nov 20 Kramer

**20. Gene Duplication**

*Interpreting gene phylogenies, evidence for sub vs. neofunctionalization*

F 20-Nov D11 TA

D11. Discussion

*Identifying cases of protein coding evolution*

M 23-Nov 21 Extavour

**21. New & Emerging Genetic and Genomic Model Systems**

*What kinds of model genetic systems will emerge in the future? Filling in gaps*

W 25-Nov 22 Extavour

**22. Future Challenges for Evolutionary Genetics and Genomics**

*High-throughput technologies in the service of evolution and development*

F 27-Nov n/a n/a

Thanksgiving: *No class*

M 30-Nov D12 TA

Review Discussion

*Outstanding questions, clarification of material for final exam*

**W 02-Dec Exam FINAL**