Methods in Cell Biology and Genomics  
(Fall Semester, 2019-2020)

Course Number and Title  
Methods in Cell Biology and Genomics: PLS 539 (3 credits)  
Cross-listed as GENE MCB PCOL PLS PSIO 539 FA19 001

Course Description  
This course is designed to provide students with an in-depth understanding of selected experimental methods that are currently employed in addressing questions in cell biology, genomics, and biotechnology. The course will be taught as formal lectures, accompanied by occasional visits to laboratories and core facilities. The course may also involve guest lectures.

The course content is designed as a series of technical modules. It is aimed to provide students with an in-depth understanding of the novel techniques employed in studying questions in structural and functional genomics, and is accompanied by a description of the results obtained using these methods.

Instructor Information  
Instructor: Dr. David W. Galbraith  
Address and contact information: 341 Keating (office), 302 Keating (laboratory)  
Office phone: 621-9153  
Email: galbraith@arizona.edu  
Website: http://cals.arizona.edu/galbraith  
Office hours: Office hours are held at any reasonable time. Please call ahead (email is best) for an appointment.

I was born in England and obtained my B.A., M.A., and Ph.D. degrees from Cambridge University. After postdoctoral work at Stanford University, I worked for 11 years in the School of Biological Sciences at the University of Nebraska-Lincoln, first as an Assistant, then an Associate Professor. I have been Professor of Plant Sciences at the University of Arizona since 1989. Further information can be found at my website.

Course Objectives  
The course objectives are

1) to make students aware of the outstanding scientific problems and issues that are being currently addressed in basic and applied biological research, emphasizing cell biology and genomics,  
2) to introduce them to the experimental tools, instruments and methods that are available, and that are being developed, to address these problems and issues,  
3) to describe the scientific principles associated with the development and use of these methods, and  
4) to demonstrate how to productively integrate these into the student's research activities.

Learning Outcomes  
At the end of the class, students should be able to:

1) Describe cutting edge techniques and approaches in cell biology and genomics used to analyze living organisms.  
2) Explain the mechanistic principles underlying these methods and technologies, and how they can be productively used in the laboratory setting.  
3) Describe how they might employ these methods and technologies in their own projects, and how these technologies might be improved and adapted in the future, understanding their limitations, if any.  
4) Summarize concisely, in writing, the objectives, main results, and conclusions described in research publications involving cell biology and genomics methods.  
5) Demonstrate the ability to productively to acquire, process, and disseminate scientific knowledge at a level appropriate for the designated audience.

400/500 Co-convened Course Information  
Not applicable.

Required Texts and Materials  
None.
Schedule of Topics and Activities

The organizational meeting will be held on August 26 at 9 AM, in Room 302 of the Modern Languages Building. If you have any questions regarding this class, please contact David Galbraith (galbraith@arizona.edu)

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<tr>
<th>LOCATION</th>
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<tr>
<td>MLB 302</td>
<td>Monday, August 26</td>
<td>Introduction to the Course.</td>
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<tr>
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<td>Wednesday, August 28</td>
<td>Lecture 1. An Introduction to Flow Cytometry: Genome Size Measurements and the C-value paradox.</td>
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<td>Friday, August 30</td>
<td>Lecture 2. Subdividing the Genome: Chromosome sorting.</td>
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<td>Monday, September 2</td>
<td>LABOR DAY. No class.</td>
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<td>Monday, September 9</td>
<td>Lecture 5. Optical mapping for large scale assemblies. What is the cheapest way to sequence and assemble your favorite genome?</td>
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<td>Friday, September 13</td>
<td>Lecture 7. Gene Expression: Agnostic sampling of expression states and cell types.</td>
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<td>Monday, September 16</td>
<td>Lecture 8. Gene Expression: models, annotation and ENCODE.</td>
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<td>Friday, September 20</td>
<td>Lecture 10. Somatic Chimerism and Genome Editing.</td>
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<td>Monday, September 23</td>
<td>Lecture 11. Genome Editing (continued). (A sample exam from 2016 will be provided on D2L).</td>
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<td>Wednesday, September 25</td>
<td>Lecture 12. Genome Editing (continued).</td>
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<td>Friday, September 27</td>
<td>Guest lecture and Tour of AGI with Dave Kudrna. Meet in Keating lobby at 9:55am.</td>
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Assignment of Examination 1. Your response is due 1 week after assignment.


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<tr>
<td>MLB 302</td>
<td>Monday, September 30</td>
<td>Lecture 13. Microscopy</td>
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<td>Wednesday, October 2</td>
<td>Lecture 14. Fluorescence and Confocal Microscopy</td>
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<td>Friday, October 4</td>
<td>Lecture 15. Introduction to Markers.</td>
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<td>Monday, October 7</td>
<td>Lecture 16. Fluorescent Proteins.</td>
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<td>Wednesday, October 9</td>
<td>Lecture 17. Fluorescent Proteins (continued).</td>
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<td>Friday, October 11</td>
<td>Lecture 18. FRET, STED+Structured Illumination, Introduction to Optogenetics.</td>
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<td>Monday, October 14</td>
<td>Lecture 19. Optogenetics (continued).</td>
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<td>Wednesday, October 16</td>
<td>Lecture 20. Inorganic Fluorescent and Luminescent Markers.</td>
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<td>Friday, October 18</td>
<td>Lecture 21. EM and CLEM.</td>
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<td>Wednesday, October 23</td>
<td>Lecture 23. RNA imaging in situ (continued). MER-FISH. ExM.</td>
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Module 3. The Interactions of Cellular Components.

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<td>Wednesday, October 30</td>
<td>Lecture 26. Protein-protein interactions; microarrays.</td>
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<td>Friday, November 1</td>
<td>Lecture 27. Self-assembling Arrays and Electrophoresis.</td>
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<td>Wednesday, November 6</td>
<td>Lecture 29. Mass Spectrometry (continued).</td>
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MLB 302  Friday, November 8  Lecture 30. The CyTOF; Imaging Mass Spectrometry.

Assignment of Examination 2. Your response is due 1 week after assignment.

MLB 302  Monday, November 11  Veterans’ Day. NO CLASS.
MLB 302  Wednesday, November 13  Student-led general discussion of interesting journal articles.
Keating  Friday, November 15  Tour of the UA Proteomics Facility with Krishna Parsawar (Director). Meet in the Keating lobby at 9:55am.
MLB 302  Monday, November 18  Student-led general discussion of interesting journal articles (continued).
MLB 302  Wednesday, November 20  Lecture 31. Single cell proteomics (Penn Symposium).
MLB 302  Friday, November 22  Lecture 32. Combined single cell ATAC-Seq and RNA-Seq; multiplexed beads (Penn Symposium).
MLB 302  Monday, November 25  Lecture 33. In silico analyses. Combining methods and platforms.


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<tr>
<td>MLB 302</td>
<td>Monday, December 2</td>
<td>Lecture 34. Synthetic and Systems Biology. Synthesizing life.</td>
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<td>MLB 302</td>
<td>Wednesday, December 4</td>
<td>Lecture 35. Synthetic and Systems Biology (Recoding the genome).</td>
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<td>MLB 302</td>
<td>Friday, December 6</td>
<td>Lecture 36. Recoded genomes, and their uses. CAR-T.</td>
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<td>MLB 302</td>
<td>Monday, December 9</td>
<td>Lecture 37. Synthetic and Systems Biology (continued). Synthesizing a minimal cell.</td>
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<td>MLB 302</td>
<td>Wednesday, December 11</td>
<td>General discussion. Assignment of Final Examination.</td>
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Assessments
There will be two examinations during the semester and one final. All will be short essay format. The university scale will be employed for grading purposes. Dependent on performance, I reserve the right to scale up (but not down!) the scores of individual examinations or the class as a whole. Exams may not be missed except for medical emergencies (doctor’s note required), or for circumstances leading to a University approved absence form. In these cases, make-up exams will be provided. Incomplete grades will only be given under exceptional circumstances, and these require a written agreement between the student and the instructor, specifying the work to be completed and the timeframe.

Grading Scale and Policies
There will be 30 points for each of the two semester examinations and 30 points for the final. This gives a total of 90 points. The grade will be calculated from percentages using the following scale:

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<tr>
<td>≥90%</td>
<td>≥80%</td>
<td>≥70%</td>
<td>≥60%</td>
<td>&lt;60%</td>
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University Policies
These are available at: https://academicaffairs.arizona.edu/syllabus-policies.

Subject To Change Notice
Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the course instructor.