Post-translational Modifications in Microbiology

MCB 6937

Sections 03B2 (online) and
03A6 (on campus)

Summer C 2017

Rationale for course

The overall goal of this class is to enhance student learning in the field of microbiology and to network students with professionals within the scientific community. To this end, the course will take an innovative approach to student learning through interactive group projects. The students will prepare projects that will undergo a scientific review by their class peers and faculty instructors. Projects that pass the scientific review process will be made publicly available through Canvas with the ultimate-goal to provide a searchable web portal of post-translational modifications in microbiology. While proteomics and other systems biology approaches have facilitated the identification of a wide-variety of novel post-translational modifications, high-throughput data related to these modifications are
not well synthesized and readily available to the scientific community (particularly data related to bacteria and archaea). This course will therefore serve as a resource to the scientific community. Students in the group will benefit from being listed as co-authors on the projects (with student permission). In addition to synthesizing published research findings, the group projects will require students to think ‘outside the box’ and develop innovative proposals that take advantage of post-translational modifications to improve human health and the food, agricultural, and natural resources. Overall, this course is designed to provide an opportunity for students to not only learn about how post-translational modifications work but also how they can be of service to their profession and community.

Instructors

Mariola Edelmann, Ph.D.

Contact information: email: medelmann@ufl.edu, Department of Microbiology and Cell Science, office location Microbiology and Cell Science Bldg 981 Museum Rd., Rm 1048 phone 352-846-0954, office hours Tuesday/Thursday 4-5 PM or by appointment.

Preferred method for communication with the instructor regarding the course is by e-mail (medelmann@ufl.edu)

Julie A. Maupin-Furlow, PhD.

Contact information: email:jmaupin@ufl.edu, Department of Microbiology and Cell Science, office location Microbiology and Cell Science Bldg 981 Museum Rd., Rm 1153 phone 352-392-4095, office hours Tuesday/Thursday 3-4 PM or by appointment

Preferred method for communication with the instructor regarding the course is by email.

Please resolve technical issues by contacting the UF helpdesk (e.g. http://helpdesk.ufl.edu; (352) 392-HELP (4357); helpdesk@ufl.edu · HUB 132).

Delivery Method/Meeting time

ALL ASSIGNMENTS, QUESTION /ANSWER SESSIONS AND OTHER MATERIALS WILL BE AVAILABLE ONLINE ASYNCHRONOUSLY. Class discussion/review sessions will be held in Canvas through ‘conferences’ for off-campus students to ask questions and interact with their instructor. The on-campus sessions will be taped for those students who attend the class online. Students will have 1400 min of contact time associated with this 2 credit course.
Credits - 2

Course Description
MCB 6937. Post-translational Modifications in Microbiology. Credits: 2; Prereq: CHM 2211 (C) & (MCB 3020 or 3023) (C) & (MCB 3020L or 3023L) (C). Students will learn about post-translational modifications (PTMs) in microbiology. Topics will include: i) the different types, functions, and mechanisms of PTM, ii) the methods used to identify PTMs, and iii) the impact PTMs have on cell biology, human health, and biotechnology.

Course Objectives/Goals/Learning Outcomes
- To become knowledgeable on the molecular and cellular biology of post-translational modifications (PTMs)
- To gain the concepts and skills needed to understand and critically evaluate research articles that address PTMs
- To creatively apply knowledge of PTMs to current problems (e.g. controlling pathogenesis, sequestering carbon dioxide, engineering microbial biocatalysts in the production of renewable fuels and chemicals)
- To improve teamwork skills
- To utilize knowledge and skills in reviewing peer's projects

Course Material and Assignments
All required course materials will be available through the Canvas e-Learning site (http://elearning.ufl.edu/). Instructions for and submission of assignments will also be through Canvas.

Group Project (250 points total – see below for details)

10 points       Quiz 1 (ProctorU, 05/16)
5 points        Quiz 2 (Canvas 05/23)
100 points      Quiz 3 (ProctorU, 05/30)
25 points       Group project – division of work and 1-page draft of the proposed project (06/08 deadline)
20 points       Group project – preliminary list of references (5 references per student, 06/15 deadline)
100 points      Group project - written report (06/29 deadline)
100 points      Group project - oral report (07/13 deadline)
100 points      Scientific peer evaluation of group projects (07/27 deadline)
Students will be assigned to groups and tasked with gathering and synthesizing the following information for a specific type of post-translational modification (assigned by the instructors) from one of the modifications listed below (see List of post-translational modifications for group projects). Please focus on the post-translational modifications in ARCHAEA and/or BACTERIA and on/or ubiquitin modifications in Eukaryota catalyzed by enzymes from bacterial pathogens.

List of post-translational modifications for group projects

1. Phosphorylation  
   a. Arginine  
   b. Serine/Threonine and Tyrosine  
   c. Histidine and Aspartic Acid  
2. ADP-ribosylation  
3. Methylation  
4. Glycosylation  
5. Acetylation (Nα- and Nε-acetylation)  
6. Lipidation  
7. S-Nitrosylation and S-Sulfhydration  
8. S-Glutathionylation  
9. Methionine oxidation – as a reversible process  
10. Uridylylation  
11. Adenylylation  
12. Unique modifications of translation elongation factors (including attachment of ethanolamine phosphoglycerol, diphthamide and hypusine)  
13. Ubiquitin-like modifications (sampylation, pupylation)  
14. Ubiquitin modification in Eukaryota catalyzed by bacterial (pathogen) enzymes  
15. Targeted proteolysis (select a regulatory protease – e.g., Clp, Lon, Proteasome)  
16. Specific polypeptide cleavage (e.g., removal of signal peptides)

The students will gather, synthesize and present this information in written and oral format as outlined below.

A. Written portion of project - guidelines

The aim of this paper is to provide a summary of a chosen post-translational modification published in scientific journals by using a scheme described below. The summary paper should include up to 20 pages. A title page and appropriate figures/tables are required. Tables should require the modified protein name, modified protein Accession Number, modified residue (including amino acid position if known), enzymes which catalyze this modification and appropriate reference(s). References are required and should be included on additional pages (no page limit). Font requirements are the following: 1-inch margins, font size must be 11 points or larger (smaller text in figures, graphs, diagrams and charts is acceptable). Please upload the paper through Canvas e-learning. This
paper will be scanned by TurnItIn for plagiarism. Contact us if you have doubts what constitutes plagiarism. Each student will be graded individually (not as a single group grade) for the contributions they have made to the group project. Thus, students are required to list their name on the portions of the written project for which they have contributed.

**Required aspects of the post-translational modification paper**

1. Definition
2. Detailed chemistry
3. Enzyme(s) catalyzing addition of the modification (with EC number and InterPro Domain)
4. Enzyme(s) catalyzing the removal of the modification (with EC number and InterPro Domain)
5. General distribution/function of the PTM among the three domains of life (i.e., is this type of PTM observed in Archaea, Bacteria and/or Eukaryotes?)
6. Detailed list of known protein targets (and affected residues) in Archaea and/or Bacteria - table format with references.
7. Biological function of the PTM.
8. A figure displaying how the modification impacts the biology of the cell, which will be based on a specific example.
9. Methods used for detection of the modification
10. Insight into how this post-translational modification may benefit human health and and/or the food, agricultural, and natural resources
11. Quote by scientific leader in the field (obtained by interview – in person or by e-mail)
12. References

**B. Oral group presentation portion of the project**

Students present contents of their written report by a recorded slide presentation. Each presentation should not exceed 20 minutes. Instructors and peers will ask questions in Canvas ‘Chat’ related to the material in the slide presentation. Each group is responsible for answering the questions that are related to the material of their presentation in the Canvas ‘Chat’. Each student will be graded individually (not as a single group grade) for the contributions they have made to the group project. Thus, students are required to introduce themselves during the project and initial the slides for which they have contributed.

**Guidelines for recording the slide presentation**

1. Within the first few days of class, develop a general outline for the slide presentation and use this as a guide to evenly divide up the labor.
2. Record the slide presentation including slides and an audio recording designed to teach/guide the viewer. Identify yourself during the recording.
3. Use of the ‘record slide show’ option of Powerpoint version 2016 or higher is recommended for recording the group presentation.

4. The recordings can be performed separately by each student in the group and then merged into a single Powerpoint (.ppt) file.
5. Once complete, the presentations should be sent to the instructor electronically.
6. The instructor will upload each group presentation for the class to view in Canvas.

Scientific Peer Evaluation of Group Projects (100 points):

Students will provide a scientific review (500-700 words) of projects presented by their peers. The reviews will include strengths/weaknesses and scores (1 highest – 10 lowest) for each of the following criteria as well as a written summary about each modification:

- Scientific Accuracy
- Approach
- Innovation
- Impact

Examples of literature to get you started

Overview
- (Cain et al., 2013)
• (Eichler and Maupin-Furlow, 2013)
• (Bastos et al., 2016)

Phosphorylation
• (Esser et al., 2016)
• (Trentini et al., 2016)

Ubiquitin-like modifications (sampylation, pupylation)
• (Maupin-Furlow, 2014)

Acetylation (Nα- and Nε-acetylation)
• Lysine (Ouidir et al., 2016)
• N-terminal modifications (Giglione et al., 2015)

Methylation
• Lysine (Lanouette et al., 2014)

Lipidation
• (Nakayama et al., 2012)

Glycosylation
• (Schaffer and Messner, 2016)

Methionine oxidation – as a reversible process
• (Drazic and Winter, 2014)

S-Nitrosylation and S-Sulfhydration
• (Lu et al., 2013)

S-Glutathionylation
• (Grek et al., 2013)

Uridylylation
• (Merrick, 2014)

Adenylylation
• (Itzen et al., 2011)

Unique modifications of translation elongation factors
• (Greganova et al., 2011)

Targets of regulated protein turnover by Clp, Lon, proteasome, etc.
• (Gur, 2013)

Specific polypeptide cleavage
• (Berry et al., 2016)

References for Reading Material and Writing Assignments


Weekly Course Schedule

Week 1 (5/08 – 5/11)
- Introduction to course and syllabus
- Example of ideal group project – presented by faculty instructor
- Chat meeting with instructors to answer any questions (05/09)

Week 2 (5/14 – 5/18)
- Quiz 1: syllabus content and example of ideal group project (10 points, 05/16)
- Overview of the different types of post-translational modifications found in bacteria and archaea

Week 3 (5/21 – 5/25)
- Quiz 2: what do I know about proteins? (5 points for participation, not graded, 05/23)
- Assignment of students to group projects

Week 4 (5/28- 6/01)
- Quiz 3: Overview of the different types of post-translational modifications found in bacteria and archaea (100 points)
- Students work on group projects

Week 5 (6/04- 6/08)
- Group project – division of work and 1-page draft of the proposed document indicating division of work (deadline – 06/08)

Week 6 (6/11- 6/15)
- Group project - at least five references/student related to group project (deadline – 06/15)

Week 7 (6/18- 6/22)
- Group project – students work on written report
Week 8 (6/25- 6/29)
• Group project - written report due at end of week (deadline - 06/29)

Week 9 (7/02- 7/06)
• Group project – students work on oral report

Week 10 (7/09- 7/13)
• Group project – oral report due at end of week (deadline - 07/13)

Week 11 (7/16- 7/20)
• Students work on peer evaluation of group projects (oral presentations)

Week 11 (7/23- 7/27)
• Scientific peer evaluation of group projects (deadline - 07/27)

[Exam Dates/Calendar/Critical dates and deadlines]

**Deadlines**
Quiz 1 05/16
Quiz 2 05/23
Quiz 3 05/30
Group project - division of work and 1-page draft of the proposed project 06/08
Group project – preliminary list of references 06/15
Group project - written report 06/29
Group project - oral report 07/13
Scientific peer evaluation of group projects 07/27

**Evaluation of Learning/Grades**

**MCB 6937 learning will be evaluated based on the following criteria:**

10 points  Quiz 1
5 points  Quiz 2
100 points  Quiz 3
25 points  Group project - division of work and 1-page draft (in bullet points) of the proposed project
20 points  Group project – preliminary list of references
100 points  Group project - written report
100 points  Group project - oral report
100 points  Scientific peer evaluation of group projects
[Materials and Supplies Fees]
There are no additional fees for this course.

Grading Policy
Final grades will be based on the following performance standard:

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
</tr>
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<tbody>
<tr>
<td>95 - 100 %</td>
<td>A</td>
</tr>
<tr>
<td>90 - 94.9 %</td>
<td>A-</td>
</tr>
<tr>
<td>87 - 89.9 %</td>
<td>B+</td>
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<tr>
<td>84 - 86.9 %</td>
<td>B</td>
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<tr>
<td>80 - 83.9 %</td>
<td>B-</td>
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<tr>
<td>77 - 79.9 %</td>
<td>C+</td>
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<tr>
<td>74 - 76.9 %</td>
<td>C</td>
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<tr>
<td>70 - 73.9 %</td>
<td>C-</td>
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<tr>
<td>60 - 69.9 %</td>
<td>D</td>
</tr>
<tr>
<td>Less than 60.0 %</td>
<td>E</td>
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</tbody>
</table>

More information on grades and grading policies is here: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Class Attendance and Make-Up Policy
Class attendance and make-up policies are according to the university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx).

Students Requiring Accommodations
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Campus Helping Resources
Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university’s counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for
currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance:

**Health and Wellness**
- *University Counseling & Wellness Center*, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu/cwc/](http://www.counseling.ufl.edu/cwc/)
  - Counseling Services
  - Groups and Workshops
  - Outreach and Consultation
  - Self-Help Library
  - Wellness Coaching
- *U Matter We Care*, [www.umatter.ufl.edu/](http://www.umatter.ufl.edu/)
- *Career Resource Center*, First Floor JWRU, 392-1601, [www.crc.ufl.edu/](http://www.crc.ufl.edu/)

**Emergencies**
For emergencies call: University Police Department, 392-1111 (or 9-1-1 for emergencies). [http://www.police.ufl.edu/](http://www.police.ufl.edu/)

**Academic Resources**
- E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. [https://lss.at.ufl.edu/help.shtml](https://lss.at.ufl.edu/help.shtml).
- Library Support, [http://cms.uflib.ufl.edu/ask](http://cms.uflib.ufl.edu/ask). Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. [http://teachingcenter.ufl.edu/](http://teachingcenter.ufl.edu/)

**Course Evaluation**
Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at [https://evaluations.ufl.edu](https://evaluations.ufl.edu). Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at [https://evaluations.ufl.edu/results/](https://evaluations.ufl.edu/results/).

**Class demeanor**
Students are expected to arrive to class on time and behave in a manner that is respectful to the instructor and to fellow students. Please avoid the use of cell phones and restrict eating to outside of the classroom. Opinions held by other students should be respected in discussion, and conversations that do not contribute to the discussion
should be held at minimum, if at all.

**Netiquette guide for online courses**
It is important to recognize that the online classroom is in fact a classroom, and certain behaviors are expected when you communicate with both your peers and your instructors. These guidelines for online behavior and interaction are known as netiquette.

**University Honesty Policy**
UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (https://www.dso.ufl.edu/scrr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**Software Use**
All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

**Microsoft Office 365 Software is free for UF students**
http://www.it.ufl.edu/gatorcloud/free-office-365-downloads/

**Other free software is available at:**
http://www.software.ufl.edu/
To check for availability of the media and technical requirements, contact the UF Computing Help Desk at (352)392-HELP(4357).

**University of Florida Complaints Policy and Student Complaint Process**
Most problems, questions and concerns about the course will be resolved by professionally communicating with the instructor or the TAs.
The University of Florida believes strongly in the ability of students to express concerns regarding their experiences at the University. The University encourages its students who wish to file a written complaint to submit that complaint directly to the department that manages that policy.

If a problem really cannot be resolved by communicating with the instructor or the TAs you can contact


**University of Florida U Matter**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Plagiarism**

Please note that plagiarism is against the UF honor code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/)

“(a) **Plagiarism.** A student shall not represent as the student's own work all or any portion of the work of another. Plagiarism includes but is not limited to:

1. Quoting oral or written materials including but not limited to those found on the internet, whether published or unpublished, without proper attribution.”

You must use your own words to communicate oral and written materials presented in the oral reports, scientific evaluations, and summaries of this course.

Online modules are available to assist you with making ethical decisions regarding plagiarism and other codes of conduct at https://www.dso.ufl.edu/sccr/seminars-modules/.