Post-translational Modifications in Microbiology

MCB 6937

Summer 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 serving 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 email (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 700 min of contact time associated with this 1 credit course.

Credits - 1

Course Description

MCB 6937 Post-translational Modifications in Microbiology. Credits: 1; 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 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)**

<table>
<thead>
<tr>
<th>Points</th>
<th>Assignment Description</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Group project – preliminary list of references (05/19 - deadline)</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Group project - written report (05/26 – deadline)</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Group project - oral report (06/02 – deadline)</td>
<td></td>
</tr>
</tbody>
</table>

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). **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.**

Students need to choose one of the modifications listed below (see *List of post-translational modifications for group projects*) and follow the format (see *Post-translational modification - required aspects of the paper*). The students will present this information in written and oral (recorded 15-20 min presentation) format.

1. **Written format**

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.

2. Oral presentation

Students present contents of their written report by slide presentation followed by Q&A. Each presentation should not exceed 20 minutes plus 10 minutes for any questions from instructors and peers.

3. Guidelines

Post-translational modification (PTM) - required aspects of the 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/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

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)

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 – 5/12)
- Introduction to course
- Overview of the different types of post-translational modifications found in bacteria and archaea
- Assignment of students to group projects
- Example of ideal group project – presented by faculty instructor

Week 2 (5/15 – 5/19)
- Students work on group projects
- Group project - at least five references related to group project (deadline – 05/19)

Week 3 (5/22 – 5/26)
- Group project - written report due at end of week (deadline - 05/26)

Week 4 (5/29- 6/02)
- Group project – oral report due at end of week (deadline - 06/02)

Week 5 (6/05- 6/09)
- Students work on peer evaluation of group projects

Week 5 (6/12- 6/16)
- Scientific peer evaluation of group projects due at end of week (deadline - 06/16)

[Exam Dates/Calendar/Critical dates and deadlines]

Deadlines
05/19 Group project – preliminary reference list
05/26 Group project - written report
06/02 Group project - oral report
06/16 Scientific peer evaluation of group projects

Evaluation of Learning/Grades

MCB 6937 learning will be evaluated based on the following criteria:
- 50 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
- 350 points total
[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</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 - 100 %</td>
<td>A</td>
</tr>
<tr>
<td>90 - 94 %</td>
<td>A-</td>
</tr>
<tr>
<td>87 - 89 %</td>
<td>B+</td>
</tr>
<tr>
<td>84 - 86 %</td>
<td>B</td>
</tr>
<tr>
<td>80 - 83 %</td>
<td>B-</td>
</tr>
<tr>
<td>77 - 79 %</td>
<td>C+</td>
</tr>
<tr>
<td>74 - 76 %</td>
<td>C</td>
</tr>
<tr>
<td>70 - 73 %</td>
<td>C-</td>
</tr>
<tr>
<td>60 - 69 %</td>
<td>D</td>
</tr>
<tr>
<td>Less than 60 %</td>
<td>E</td>
</tr>
</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
Excused absences are consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation. Excused absences from exams and/or assignments (e.g., illness, serious family emergency, military obligations, religious holidays) must be communicated by formal signed documentation to the instructor prior to the missed exam or assignment. Appropriate documentation MUST be provided for the absence caused by serious illness, accident, jury duty or death in the immediate family. You MUST contact the instructor IN ADVANCE of the missed exam or assignment. An alternative time for the exam and/or assignment will be arranged by the instructor.

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 Resources
Resources are available on campus for students having personal problems or lacking clear career and academic goals, which interfere with their academic performance. These resources include:

Health and Wellness
- **U Matter, We Care**: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
- **Counseling and Wellness Center**: http://www.counseling.ufl.edu/cwc/Default.aspx, 392-1575;
- **Sexual Assault Recovery Services (SARS) at the Student Health Care Center**, 392-1161.
- **For emergencies call**: University Police Department, 392-1111 (or 9-1-1 for emergencies). 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.
- **Library Support**, 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/

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. 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/.

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/sccr/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.