

BIOLOGICAL SCIENCES 597

**RNA STRUCTURE, FUNCTION AND METABOLISM**  
(U/G level course), Fall 2012

- Instructor:** Dr. Madhusudan Dey  
Lapham 460  
Phone: 414-229-4309
- Lecture times:** Wednesdays 3.00 PM to 5.00 PM, Lapham 182
- Office hours:** Monday, 2.00 PM to 3.00PM  
Or by appointment (e-mail: [deym@uwm.edu](mailto:deym@uwm.edu))  
If you e-mail us, please read some hints for successful communication from Student Support Services:  
[www4.uwm.edu/sss/Email-Etiquette.html](http://www4.uwm.edu/sss/Email-Etiquette.html)
- Course topics:** RNA world hypothesis; structural and functional complexity of RNA; RNA processing - conventional and nonconventional RNA splicing; functional diversity of RNA - as genetic material, enzymes and regulators; micro RNAs as potential therapeutics
- Textbook:** **The RNA World, Third Edition** (*Cold Spring Harbor Monograph Series 43*) **Book Series:** Cold Spring Harbor Monograph Series **Subject Area(s):** Molecular Biology; Biochemistry; Biophysics Edited By Raymond F. Gesteland, *University of Utah, Salt Lake City*; Thomas R. Cech, *University of Colorado, Boulder*; John F. Atkins, *University of Utah, Salt Lake City*  
[ISBN number: 978-0-879699-46-8, 2010](https://doi.org/10.1101/2010.01.01.9780879699468)
- Instructor will provide the latest literature as required
- Class format:** There will be pre-class reading assignments, and students will be expected to have read up on the basics before they come to a class. Each lecture (a blend of chalkboard and PowerPoint presentations) will be followed by a classroom discussion. If you miss class, please find out what you have missed from your classmates. This is your responsibility.
- Prerequisites:** While students are required to have basic knowledge of Cell Biology (Bio Sci 315 or consent of the instructor), the course will cover the basics of Biochemistry and Bioinformatics as required.

**Grading:** Grades will be allocated in the following manner:

**Undergraduate students:** Exam I, Exam II, and a cumulative final exam; classroom presentation is optional.

**Graduate students:** Exam I, Exam II, a cumulative final exam (70% combined; see below), and a classroom presentation (30%). A 30 min classroom presentation on a topic related to signal transduction is required. Students will be trained to present a formal talk.

**Evaluation:** **Undergraduate students:** Grades will be based on the three exams (see course schedule below), 30% (Exam I), 30% (Exam II), and 40% (Final exam).

**Graduate students:** Grades will be based on the three exams (see course schedule below) and classroom presentation: 20% (Exam I), 20% (Exam II), 30% (Final exam), 30% (presentation).

Letter grades will be assigned based on the final total points as listed below:

|    |           |    |          |
|----|-----------|----|----------|
| A  | 92 – 100% | C  | 71 – 75% |
| A- | 89 – 91%  | C- | 68 – 70% |
| B+ | 86 – 88%  | D+ | 65 – 67% |
| B  | 82 – 85%  | D  | 61 – 64% |
| B- | 79 – 81%  | D- | 56 – 60% |
| C+ | 76 – 78%  | F  | 0 – 55%  |

**Special Accommodation:** Students who require note-taking or test-taking accommodations in order to meet any of the requirements of this course, please contact me as soon as possible to make suitable arrangements

### **Course Description:**

Over the past three decades, major advances have been made in ribonucleic acid (RNA) research. As a result, the 'RNA world' hypothesis has been formulated that places RNA at the origin of life. The functional repertoire of RNA is incredibly vast. RNA can carry genetic information (e.g. RNA genomes of viruses), serve as the chemical blueprint for protein synthesis (messenger RNA), and regulate gene expression (e.g. micro RNA). Remarkably, RNA molecules

can also act as enzymes (ribozymes) that catalyze various biological reactions. The instructor has been actively engaged in multidisciplinary research focusing on various aspects of RNA structure and function, including RNA processing, non-conventional RNA splicing and mechanisms of RNA cleavage. The instructor has designed this course to provide comprehensive coverage of RNA biology as a key to our understanding of life.

Two specific goals of this course are: (I) to increase the students' understanding of various aspects of RNA biology such as RNA synthesis, processing, maturation and structure/function, and (II) to increase the students' ability to think logically, critically, and creatively about modern scientific research, including the research in which he/she may already be involved. Progress towards the first goal will be evaluated via interim two exams. Achievement of the second goal will be evaluated by the students' ability to analyze and present scientific literature. At the end of this course, students will acquire a comprehensive knowledge of RNA biology and improve their skills at understanding, analyzing, and interpreting scientific data. The course aims to intellectually enrich students regardless of their future career choices but also aims to inspire them to pursue research careers in interdisciplinary areas of cell/molecular biology, microbiology, immunology, neurobiology or developmental biology.

While students are required to have basic knowledge of Genetics (Bio Sci 325 or consent of the instructor), the course will cover the basics of Biochemistry and Bioinformatics as required.

### Course Schedule:

| Week   | Topic                                                                                                                                                                                                          | Reading due                                                   | Graduate vs under-graduate requirements |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------|
| Week 1 | <b>Lecture/discussion – 2 hours</b><br>RNA world hypothesis, messenger RNA (mRNA), antisense RNA, transfer RNA (tRNA), ribosomal RNA (rRNA), microRNA (miRNA), small interfering RNA or silencing RNA (siRNA). | Book - The RNA World                                          |                                         |
| Week 2 | <b>Lecture/discussion – 2 hours</b><br>In prokaryotes – mRNA-coupled transcription and translation. In eukaryotes: pre-mRNA, intron, RNA processing - splicing (cis- and                                       | Handouts/notes<br>Lehninger,<br>Principles of<br>Biochemistry |                                         |

|        |                                                                                                                                                                                                                         |                                                                                 |                                                                                                             |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|        | trans-) and mRNA maturation.                                                                                                                                                                                            |                                                                                 |                                                                                                             |
| Week 3 | <b>Lecture/discussion – 2 hours</b><br>Unconventional RNA splicing. Modern concept in mechanisms of RNA cleavage and ligation.                                                                                          | Handouts/notes<br>Science 312,<br>2006, 906-910                                 |                                                                                                             |
| Week 4 | <b>Lecture/ discussion –2 hours</b><br>mRNA features and functional roles – 5'UTR and 3-UTR. Internal ribosomal Entry sites (IRES) in viral and eukaryotic mRNAs. General mechanisms of riboswitch or ribozyme in mRNA. | Handouts/notes<br>Nature Reviews<br>Genetics 11,<br>2010, 75-87                 |                                                                                                             |
| Week 5 | <b>Exam I</b><br><b>Lecture – 1.5 hr</b><br><b>rRNA:</b> Composition of ribosomal RNA. Secondary and tertiary structure of prokaryotic and eukaryotic rRNA. Ribosomal proteins and their roles.                         | Handouts/notes<br>Cellular and<br>molecular life<br>sciences 64,<br>2007, 29-49 | <b>Undergraduate:</b><br>Multiple choice<br>quiz questions<br><b>Graduate:</b><br>Short answer<br>questions |
| Week 6 | <b>Lecture/discussion – 2 hours</b><br><b>MicroRNA:</b> History of micro RNA, definition, composition, Dicer, RNA induced silencing complex (RISC), modern concepts on their roles in translation inhibition.           | Handouts/notes<br>Annu. Rev. Cell<br>Dev. Biol. 23,<br>2007, 175–205            |                                                                                                             |
| Week 7 | <b>Lecture/discussion – 2 hours</b><br><b>siRNA:</b> History of siRNA, composition and structure, roles in post-transcriptional gene silencing and potential as therapeutics                                            | Handouts/notes<br>Nature 3, 2004,<br>318-329                                    |                                                                                                             |
| Week 8 | <b>Exam II</b><br><b>Lecture – 1.5 hr</b><br><b>RNA modification</b>                                                                                                                                                    | Handouts/notes<br>Nature 443,<br>2006, 302-307                                  | <b>Undergraduate:</b><br>Multiple choice<br>quiz questions<br><b>Graduate:</b><br>Short answer<br>questions |

|             |                                       |  |                                                                                                                                               |
|-------------|---------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Week 9      | <b>RNA modification – methylation</b> |  |                                                                                                                                               |
| Weeks 10-15 | <b>Student Seminars</b>               |  | <b>Undergraduate:</b><br>Present the take-home message of the literature<br><b>Graduate:</b><br>Critically examine and present the literature |
| Week 16     | <b>Review Cumulative Exam</b>         |  |                                                                                                                                               |

(Schedule is subject to change)

### **Missed exams**

Make-up exams will only be given for **legitimate reasons** (illness, emergency, religious holidays), which must be documented. Except for extreme emergencies, notification of absence from an exam must be given *prior to* the exam date to avoid a grade of 0%.

### **Some University Guidelines of Interest**

#### **Academic Misconduct**

The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. A more detailed description of Student Academic Disciplinary Procedures may be found in Regents Policy Statements, UWS Chapter 14 and UWM Faculty Document #1686.

#### **Complaint Procedures**

Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a specific university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy.

#### **Grade Appeal Procedures**

A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides. These procedures are available in writing from the respective department chairperson or the Academic Dean of the College/School.

A more detailed description of the grade Appeal Policy may be found in UWM Selected Academic and Administrative Policies, Policy #S-28 and UWM Faculty Document #1243.

### **Sexual Harassment**

Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well being of students, faculty, and staff. The University will not tolerate behavior between or among members of the University community which creates an unacceptable working environment.

"For further information on these and other university policies, refer to <http://www.uwm.edu/Dept/SecU/SyllabusLinks.pdf>."