

MGY428H1**Functional Genomics**

Tuesdays and Thursdays at 1:10 pm- 2:00 pm

Room: PB 255

MGY428 Functional Genomics covers many aspects of genomics, which is the discipline of defining and attributing function to all of the heritable material of an organism on a genome-wide scale. The course encompasses different components of the enterprise, including sequencing, annotation, forward and reverse genetics, mapping regulatory sites and mechanisms, and proteomics. It also covers many different techniques, and several model eukaryotes. The primary and review literature are the basis of all lectures – there is no textbook.

Course Coordinator:**Prof. Timothy Hughes**

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The General Format of Each Class

- There will be one "essential" paper to read for each class and one or two additional "recommended" papers that we would also encourage you to read.
- These papers will be assigned to you through the Blackboard system (see below) at least one week before the relevant lecture. It is your responsibility to download the paper or get it from the library.
- The lecture will use the assigned reading to illustrate principles, facts, approaches and techniques that are central to the theme of the lecture.
- Students will be responsible for the concepts and facts conveyed in the mandatory paper, along with anything presented during the lecture.

Mark Breakdown:

Quizzes of the Day:	22%
Mid-term Exam:	27%
Final Exam:	51%

The Quiz

- The instructors of this class have found that unless properly motivated, many students do not read the assigned reading before the class, which is important for understanding the principles presented during the lecture.
- Students will therefore be quizzed on the essential paper** during the lecture. The quiz will occur just prior to the discussion of the paper.
- Each quiz will likely be three straightforward multiple-choice questions that test whether you have read the paper and recall the main points of the paper. Although I have recommended to the instructors that the questions be multiple-choice, each instructor is free to quiz how he or she wants.
- Students will be provided with paper to write their name, student number, and answers.
- There are 22 "content" lectures in which there will be a quiz. Everyone gets two free passes (i.e. their worst two marks will be given full value (1%), even if that is a mark of zero, on two quizzes (e.g. if they were absent)).

Exams

- The midterm exam will take place in class on **Thursday October 26**. It will be 50 minutes long and will consist of a roughly even mix of *multiple choice questions*,

short answer, and long answer questions. It will cover all the lectures up to the midterm.

- The final exam will be scheduled by A&S and will consist of a roughly even mix of *multiple choice, short answer, and long answer questions.* It will cover all of the lectures in the course; however, it will contain more questions about the material after the midterm. The proportion of points will be such that, when the scores from the midterm and the final are combined, each lecture receives approximately equal weight in the final grade.

Blackboard

MGY428 is using the “Blackboard Learn” system to disseminate course information. Blackboard can also be accessed via the University of Toronto’s home page. The program will ask you for your UTOR ID and password, which you all have.

Receiving MGY428-Related e-mails

Occasionally, MGY428 instructors will send out information to the entire class through the Blackboard system. However, Blackboard will only disseminate information through e-mail addresses that end in “@utoronto.ca”. To get these e-mails, please change your default e-mail on ROSI to your University of Toronto e-mail address.

2017-MGY 428 H1 Schedule

Section 1: Introductory Material and the Human Genome (Dr. Hughes)

Th Sep 7 - Lecture 1. **Introduction to course, genomics, and functional genomics**
 Tu Sep 12 - Lecture 2. **Molecular biology review, model systems, overview of genomics and proteomics techniques/approaches, gene classes/ontology**
 Th Sep 14 - Lecture 3. **The human genome: sequence, overview, and annotation**
 Tu Sep 19 - Lecture 4. **The human genome: genes, transcripts, and “functional elements”; introduction to sequencing technologies**
 Th Sep 21 – Lecture 5. **Human genetics - positional cloning to personal genomics**
****September 21: TA lecture - Molecular Genetics retreat**

Section 2: Invertebrates, Networks, and Comparative Genomics (Dr. Fraser)

Tu Sep 26 - Lecture 6. **Introduction to Yeast, Worms and Flies as Genomic Model Systems**
 Th Sep 28 - Lecture 7. **RNAi screening in worm and fly**
 Tu Oct 3 - Lecture 8. **High-content assays, cellular phenotyping, and CRISPR**
 Th Oct 5 – Lecture 9. **High resolution transcriptomics as a phenotyping tool**
 Tu Oct 10 - Lecture 10. **Biological networks**
 Th Oct 12 - Lecture 11. **Genetic interactions: significance and conservation**
 Tu Oct 17 - Lecture 12. **Predicting gene function**
 Th Oct 19 - Lecture 13. **Population genetics and comparative genomics**
 Tu Oct 24 - Lecture 14. **Other eukaryotes – emerging models and convergent evolution**
Th Oct 26 – Midterm (in class) (27%) (invigilated by Dr. Fraser) – scores returned by November 1

Section 3: Vertebrates and Cell Culture (Dr. Hughes)

Tu Oct 31 – Lecture 15. **Mouse and other vertebrate model systems; comparative genomics**
 Th Nov 2 - Lecture 16. **Cell culture: "in vitro" human functional genomics**

- **November 6-10 – Reading week**
- **November 6 (estimated) - Final day to drop the course without penalty**

Section 4: Gene regulation and “Epigenetics” (Dr. Hughes)

Tu Nov 14 - Lecture 17. **Measuring the “central dogma”; Noncoding RNA types and "cryptic" transcripts; possible roles of mobile DNA**
 Th Nov 16 - Lecture 18. **Transcription factors, chromatin, and epigenetics**
 Tu Nov 21 - Lecture 19. **Measuring regulatory sites in vivo and in vitro**
 Th Nov 23 - Lecture 20. **ENCODE and ongoing controversy about functional elements**

Section 5: Post-Transcriptional Gene Regulation (Dr. Hughes)

Tu Nov 28 – Lecture 21. **RNA-binding proteins and post-transcriptional gene regulation**
 Th Nov 30 - Lecture 22. **Splicing and alternative splicing: regulation and evolution**
 Tu Dec 5 - Lecture 23. **Proteomics, metabolomics, and mass spectrometry**

DECEMBER 5 – last day of class

****Final exam (51%) Dec 9 - Dec 20 (Scheduled by A&S)**

Information about Blackboard

Logging in to the Blackboard Course Website for MGY428

Like many other courses, MGY428 uses Blackboard for its course website. To access the MGY428 website, or any other Blackboard-based course website, go to the UofT portal login page at <http://portal.utoronto.ca> and log in using your UTOrid and password. Once you have logged in to the portal using your UTOrid and password, look for the **My Courses** module, where you'll find the link to the MGY428 course website along with the link to all your other Blackboard-based courses.

Activating your UTOrid and Password

If you need information on how to activate your UTOrid and set your password for the first time, please go to www.utorid.utoronto.ca. Under the "First Time Users" area, click on "activate your UTOrid" (if you are new to the university) or "create your UTOrid" (if you are a returning student), then follow the instructions. New students who use the link to "activate your UTOrid" will find reference to a "Secret Activation Key". This was originally issued to you when you picked up your Tcard at the library. If you have lost your Secret Activation Key you can call 416-978-HELP or visit the Help Desk at the Information Commons on the ground floor of Robarts Library to be issued a new one. **Course instructors will not be able to help you with this.** 416-978-HELP and the Help Desk at the Information Commons can also answer any other questions you may have about your UTOrid and password.

Email Communication with the Course Instructor

At times, MGY428 course Instructors may decide to send out important course information by email. To that end, all UofT students are required to have a valid UofT email address. You are responsible for ensuring that your UofT email address is set up AND properly entered in the ROSI system. You can do that by using the following instructions:

To submit the information to activate your UTOrid and password (see above), you will need to click the "Validate" button. Follow the instructions on the subsequent screens to receive your utoronto.ca address. Once you have your UofT email address, go to the ROSI system (www.rosi.utoronto.ca), log in and update the system with your new UofT email address.

You can **check your UofT email** account from

1. The UofT home page <http://www.utoronto.ca>: From the Quick Links menu on the top right, choose "my.utoronto.ca". Enter your UTOrid and password, and when the Welcome page opens, click "WEBMAIL".
2. Email software installed on your computer, for example Microsoft Outlook or Mozilla Thunderbird. Visit the Help Desk at the Information Commons or call 416-978-HELP for help with the set up.

Forwarding your utoronto.ca email to a Hotmail, Gmail, Yahoo or other type of email account **is not advisable**. In some cases, messages from utoronto.ca addresses sent to Hotmail, Gmail or Yahoo accounts are filtered as junk mail, which means that emails from your course instructor may end up in your spam or junk mail folder.

You are responsible for:

1. Ensuring you have a valid UofT email address that is properly entered in the ROSI system
2. Checking your UofT email account on a regular basis.

Accessibility Needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible:

disability.services@utoronto.ca

or

<http://www.accessibility.utoronto.ca>

Note regarding lecture materials and recordings of lectures

Lecturers will post their lecture materials (as ppt or pdf) on Blackboard, ahead of time if possible. Students should be aware that: (1) Faculty are not required to provide the postings and handouts; this is something we do to make the course easier to follow. (2) The lecture itself is the primary conduit of information. (3) The lecture may not follow the posted materials or the handouts exactly, and the lectures are likely to contain information that cannot be gained from the slides alone or the assigned reading material. (4) Exams are likely to include information that is not found on handouts and postings.

The individual lecturers can decide whether to allow recordings. Distribution of such recordings without permission constitutes an academic offence.

First Quiz on Tuesday, Sept 12, 2017

Be familiar with the following terms, and with the essential assigned paper (Watson and Crick, 1953):

- The difference between DNA and RNA
- mRNA
- cDNA
- EST
- Primer
- Microarray
- PCR
- Sanger Sequencing
- DNA polymerase
- Reverse transcriptase
- Ligase
- Restriction endonuclease
- Antibody
- Southern, northern and western blotting

Essential Reading:

Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid. 1953. Watson JD, Crick FH. *Nature*. 171(4356):737-8. PMID: 13054692

Recommended Reading:

Schena M, Shalon D, Davis RW, Brown PO. 1995. Quantitative monitoring of gene expression patterns with a complementary DNA microarray. *Science*. 270(5235):467-70. PMID: 7569999