

# MOLECULAR VIROLOGY

MICR\*4330 Winter 2016

## DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY

Updated Course Outline Jan 13, 2016

### COURSE OBJECTIVES

This course will provide students with an in-depth understanding of viruses and their replication at the molecular level. The course will survey the diverse strategies that viruses use in their replication cycle as well as the molecular engagement of the virus with their cellular host. Examples of major viral families with different genomes (e.g. DNA vs RNA) will illustrate the extremely varied, and intricate complex interplay between viruses and their hosts, including various cellular responses (e.g. apoptosis) to prevent virus infection and the counteracting viral responses to them. The laboratory component of this course will give students hands-on experience in a molecular virology laboratory, and familiarize them with basic virology and cell biology laboratory techniques.

### TEACHING TEAM

**INSTRUCTOR:** Dr. Peter Krell SCIE 4252, ext. 53368, pkrell@uoguelph.ca  
**LAB INSTRUCTOR:** Debra Flett SCIE 3504, ext. 52533, dflett@uoguelph.ca  
**LAB TEACHING ASSISTANTS:** Julia Hooker SCIE 4254 (office) ext. 53264  
Mehdi Shabani SCIE 4442 (office) ext. 53264

**GUEST LECTURERS:** Dr Baozhong Meng, Dr Jondavid de Jong, Dr Juan Carlos Corredor

### COURSE STRUCTURE:

**LECTURES:** Monday/Wednesday in MCKN 225, 12:30 to 1:20 pm are slotted. Some lecture slots (Jan 25 and Mar 09) will be reserved for group work (e.g. preparations for UoG Virology Symposium). The student is responsible for all material covered during lectures, including guest lectures and is expected to follow announcements, e.g. regarding assignments and exams, on D2L.

**LABORATORY:** Wednesday/Thursday 2:30 – 5:20 pm in Science Complex 4111. Lab instructions will be posted to D2L in advance. It is mandatory for students to participate in the laboratory exercises. If you miss a scheduled laboratory you may be given a grade of 0 for that laboratory exercise. If you do happen to miss a laboratory session please inform your laboratory partner, the TA and Debra Flett, along with suitable documentation explaining your absence. Lab time slots will also provide extra time for library work and group discussions on presentations and organization of the Symposium.

The laboratory schedule is appended to this outline at the end (page 10)

## Learning Outcomes:

By the end of this course, students should be able to:

1. Describe the diversity of virus structures and the various molecular strategies viruses use to infect and replicate in the host cell and mature into infectious viruses
2. Understand how viruses interact with their multicellular host organisms, spread within the host and transmit infections within populations
3. Describe the basis of host specificity and how viruses evade host-mediated antiviral responses at the cell and organismal level
4. Describe the use of viruses in medicine (e.g. virotherapy) and in industrial foreign gene expression/gene therapy applications.
5. Use standard experimental approaches in a molecular virology laboratory
6. Develop critical thinking skills by analyzing their own data and by critically reading and evaluating original virus literature with suggestions for future studies
7. Organize and actively participate in a Symposium based on original virology literature
8. Hone their written and oral communication skills

## COURSE RESOURCES

**TEXTBOOK:** The highly recommended reference is Flint, Principles of Virology 4th Edition (2015). Fields Virology 6th Edition (Online version in library) (2013), Basic Virology 3rd Edition by Edward K. Wagner (2008), Fundamentals of Molecular Virology by Nicholas Acheson (Canadian) (2011), Introduction to Modern Virology by Nigel Dimmock (2016) and Virology Principles and Applications, 2<sup>nd</sup> Edition by John Carter and Venetia Saunders (2013) are helpful. These and other virology textbooks are available on a 2 hour reserve in the library. Encyclopedia of Virology and Ninth Report of the International Committee on Taxonomy of Viruses (Ed AMQ King) are also available online.

The web site <http://viralzone.expasy.org> is a good general source for virology and virus schematics.

**COURSE LINK:** Course materials, grades and announcements will be posted to our D2L Courselink at <https://courselink.uoguelph.ca>

## TENTATIVE LECTURES AND SCHEDULE (order might change; lecture numbers are approximate)

(Guest Lectures, TBA, for Jan 25, 27, Feb 1, tentative)

1. Overview of virus structure and replication cycle (1 lecture)
  - Virus morphologies and composition
  - Stages of replication
    - Attachment
    - Penetration
    - Uncoating
    - Biosynthetic phase (mRNA, protein, genome replication)
    - Assembly - Morphogenesis
    - Release
    - Maturation
2. Various strategies for virus replication (10 lectures).
  - Attachment/Penetration/Uncoating
  - Genome expression: transcription
    - dsDNA viruses

- ssDNA viruses
- ssRNA viruses (+ve and -ve strand)
- dsRNA viruses
- Genome expression: processing mRNAs
  - 5' capping, 3' polyadenylation
  - splicing
  - post transcriptional sequence changes
- Genome expression: translation
  - Translational regulation
  - Cis factors in viral mRNA (IRES, pseudoknots, shunting and frameshifts)
  - Posttranslational modifications
- Genome replication
  - Viral DNA (ds and ssDNA) replication
  - Viral RNA (-ve, +ve and dsRNA) replication
- Virion assembly, release and maturation:
  - Naked virions
  - Enveloped virions

### 3. Patterns of virus infection (1 lecture)

- Dynamics of host-cell interaction
- Acute infection
- Persistent infection
- Latent infection
- Others

### 4. Pathogenesis *in vivo* (i.e. in a multicellular host organism) (2 lectures)

- Entry
- Incubation period and spread within the host
- Multiplication
- Immune response
- Spread to other hosts
- Outcome of the infection to the host

### 5. Molecular basis of virus-host cell interactions (4 lectures)

- Cell and host specificity
- Cellular defences to virus infection (e.g. toll-like receptors, apoptosis)
- Host organism defences to virus infection (e.g. humoral and cellular immunity)
- Viral defences against host defences (e.g. inhibitors of apoptosis; decoys of and binding proteins to host defence proteins, RNA silencing)

## COURSE EVALUATION

The final grade will be based on the best combination (A or B) for the Grade Assessment above.

**Midterm Exam (20%):** Feb. 24, 2016, (12:30 to 1:20 in class)

The midterm exam will cover the material up to and including Feb 17.

**Final Exam (35%):** **Apr. 22, 2016, (7:00 to 9:00)** CHECK with Registrar's office to confirm! The final exam is comprehensive and covers lecture/lab/presentation.

**\* Students will get the best combination of:**

20% midterm exam plus 35% final exam for a total of 55%

**OR**

0% midterm exam plus 55% final exam for a total of 55%.

**Symposium Presentation (20%) (5% for abstract, 15% for presentation):**

The class will work in groups of 3 to review and present current research articles in the form of a Student Run Symposium. During the first two weeks of the course the class will decide the date/time/venue for the Annual UoG Virology Symposium and organize it all. The class will also need to fill positions for the Symposium Organization Committee. From this unique experience students will be able to add "symposium organization" to their list of skills in their CVs. The class will select the overall theme for the Symposium (though the instructor has veto power). A list of recent (e.g. 2014 to 2016) peer reviewed original scientific virology articles on that theme will be chosen by the students, with specific ones chosen by each group for evaluation and presentation. Each group is expected to critically read/understand the chosen article(s), as well as related articles, relevant reviews and publications on the topic. The students within each group are expected to collaborate equally with each other on the assignment and will share the same grade. The symposium format will include oral presentations by each group. Each group will write an abstract that will summarize the salient data in the selected paper(s) and discuss the strengths, weaknesses, possible future research and the abstract writer's conclusions in light of related publications. The student written abstracts will form part of the printed program for the Symposium. If provided enough lead time, abstracts will be sent for a "friendly review" to one other student group prior to submission.

Five marks will come from the abstract and 15 marks will be from the Symposium presentations and from the organization and participation of each student in the discussions during all presentations. Each student group will critically evaluate, provide constructive criticism and grade the abstract and presentation of one other group (to be assigned by the instructor).

More specific instructions on the paper evaluation and Symposium organization and oral presentations will be posted to the MICR\*4330 D2L site.

**Laboratory Exercises (25%):**

Students will work in groups of 2 with each expected to share equally in the research. The breakdown of marks follows.

- 2% protocol for baculovirus plaquing, isolation and analysis (from original literature)
- 13% individual reports of lab results (3% for phage experiments, 6% for specificity of insect virus infection, 4% for avian viruses labs).
- 10% baculovirus isolation/analysis research paper (one paper per pair)

The laboratory exercises will be posted to the MICR\*4330 D2L site

**Policy for regrading of midterm exams, laboratory reports and assignments**

Students who wish to have their midterm exam or assignments re-graded must submit that within 1 week of the return of the midterm exam or assignment. The entire midterm exam or assignment will be re-graded so the mark may go up, down or remain unchanged following the regrade.

## METHODS OF ASSESSMENT

### Overall Grade Assessment (the best of two combinations of marks)

	A	OR	B	Learning Outcomes
Midterm Exam	20%		0%	1 to 3
Presentation	20%		20%	6, 7 and 8
Lab	25%		25%	5 and 6
Final Exam	35%		55%	1 to 8
Total	100%		100%	

### Important Dates:

Midterm exam, Wednesday Feb 24 12:30 to 1:20 (in class)

40<sup>th</sup> class day, Friday March 11

Symposium Organization "Classes" Jan 25 and Mar 09

Final Examination, Tuesday April 22 7:00 to 9:00 pm (check with Exam Schedule to confirm)

Other dates for laboratory reports, as indicated in the laboratory schedule

**Absence, Exam Deferral and Academic Misconduct:** Students who are absent from class during the term will be expected to make up for classes missed through their own discussion with fellow students and independent reading. **No deferrals will be given for the midterm exam, regardless of the reasons (voluntary, medical, compassionate or others).** If a student misses the scheduled midterm exam, their final exam will automatically count for 55% of the final grade.

Please refer to the University of Guelph Undergraduate Calendar, Section VIII entitled Undergraduate Degree Regulations and Procedures at the link provided below for information on the University policies and procedures for examination, academic misconduct and deferred final examinations. **Pay specific attention to the definition of "Academic Misconduct" and the penalties that can be accrued as described in that section.**

[http://www.uoguelph.ca/undergrad\\_calendar/c08/index.shtml](http://www.uoguelph.ca/undergrad_calendar/c08/index.shtml)

The grading guidelines used in this course are those adopted by the University (Undergraduate Calendar under VIII. Undergraduate Degree Regulations and Procedures, Grades, Grading Procedures)

**80 - 100 (A) Excellent.** An outstanding performance in which the student demonstrates a superior grasp of the subject matter, and an ability to go beyond the given material in a critical and constructive manner. The student demonstrates a high degree of creative and/or logical thinking, a superior ability to organize, to analyze, and to integrate ideas, and a thorough familiarity with the appropriate literature and techniques.

**70 - 79 (B) Good.** A more than adequate performance in which the student demonstrates a thorough grasp of the subject matter, and an ability to organize and examine the material in a critical and constructive manner. The student demonstrates a good understanding of the relevant issues and a familiarity with the appropriate literature and techniques.

**60 - 69 (C) Acceptable.** An adequate performance in which the student demonstrates a generally adequate grasp of the subject matter and a moderate ability to examine the material in a critical and constructive manner. The student displays an adequate understanding of the relevant issues, and a general familiarity with the appropriate literature and techniques.

**50 - 59 (D)** Minimally Acceptable. A barely adequate performance in which the student demonstrates a familiarity with the subject matter, but whose attempts to examine the material in a critical and constructive manner are only partially successful. The student displays some understanding of the relevant issues, and some familiarity with the appropriate literature and techniques.

**0 - 49 (F) Fail.** An inadequate performance.

### **Absence and Illness:**

Students absent from class are expected to make up for classes missed through discussions with fellow students and independent reading. If a student does not write the midterm exam for any reason their final exam will count for 55% of the final grade. Any student wishing academic consideration must obtain supporting documentation as outlined under "Academic Consideration and Appeals" in the University Calendar. Your program counselor should be consulted about the procedures to be followed.

### **No alternate date for the final exam can or will be considered by the instructor.**

If the final exam is missed and the student requests academic consideration, the student must appeal to the Academic Review Subcommittee as outlined in the current calendar. Please consult your Program Counsellor for details. Academic consideration for the final examination is not the responsibility of the instructor. The Registrar's office sets the date and location of the final exam and deferred exam (if any).

## **I. Additional Course Information**

### Virology Affiliated Research Programs at University of Guelph

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Name of Faculty	Affiliation	Research Interest
Dr. Peter Krell	Mol Cell Biol	Baculovirus transcription/replication
Dr. Baozhong Meng	Mol Cell Biol	Plant virus replication/transmission
Dr. Ray Lu	Mol Cell Biol	Herpesvirus/host transcription
Dr. John Dawson	Mol Cell Biol	Use of viruses as expression vectors
Dr. Eva Nagy	Pathobiology	Adenovirus based vaccines/genomics
Dr. Dorothy Bienzle	Pathobiology	Feline leukemia virus
Dr. Sarah Wootton	Pathobiology	Retrovirus and cancer
Dr. Byram Bridle	Pathobiology	Oncolytic viruses
Dr. Leonardo Susta	Pathobiology	Avian Virology

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## **II. Course and University Policies (refer to the University Calendar)**

### Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: <http://www.uoguelph.ca/registrar/calendars/index.cfm?index>

### When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, ID#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Students in MICR\*4330 who do not complete and submit Laboratory Reports or Assignments on time will be assigned grades of zero in those reports/assignments unless extenuating circumstances are adequately documented within one week of the required submission date. Please inform the Laboratory Instructor of any absences, in advance.

As noted above, if a student does not sit the midterm examination for any reason, the final exam will count for 55% of the final grade (instead of 20% for the midterm exam and 35% for the final exams).

For the assignments and reports a late penalty of a loss of 10% of the assignment value per day (including weekends) will apply. As students are expected to be working on their assignments and reports throughout the semester, it is expected that students will submit their assignments in advance of the due date instead of at the last minute. As such, and for the group assignment, it is unlikely that any accommodation will be given for late submissions, except for longer term issues prior to the due date.

### Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students Accessibility Services (SAS) as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <https://www.uoguelph.ca/csd/>

### Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

**Plagiarism** is cheating and will be dealt with accordingly. Expulsion is one option. An example of plagiarism in this course is to re-use an assignment you have prepared for another course, including this one, or to use all or part of an assignment submitted or prepared by someone else.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor prior to submission.

### E-mail Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly. E-mail is the official route of communication between the University and its students. If the instructor wishes to communicate to the whole class, it will be through the course D2L and/or by email through their University of Guelph email address available on the D2L web site for the course.

The preferred (and often most efficient) route of communication between the student and instructor is to meet directly with the instructor. Nevertheless short questions with short yes or no answers can be done through email. Professional Email communication is not the same as texting. Thus in email communication with faculty and staff, professionalism and common courtesy applies and students are encouraged to be formal in their salutation and to use full sentences, proper Capitalization (I not i) punctuation and paragraph structures. The **subject line** should be informative and include MICR4330. This will allow the instructor to retrieve relevant emails easily and decrease the possibility of deletion without opening. Emails from only UoG accounts will be considered.

### Drop Date

The last date to drop one-semester courses, without academic penalty, is the 40<sup>th</sup> class day. To confirm the actual date, please see the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

### Copies of midterm exams and out-of-class assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments and examinations if returned to you: you may be asked to resubmit work at any time.

### Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material presented in class is considered as intellectual property. Permission may be granted under certain circumstances (e.g. for someone who is hearing challenged). Anything recorded with documented (e.g. by email) permission is restricted to use for that course and only that person unless further permission is granted. All recorded material should be deleted after the course is completed.

### Cell Phones and Laptops

Use of cell phones/tablets/phablets etc in a public space like the lecture hall, is intrusive and will distract you from learning and disturb those around you. If you have to bring them with you, turn them off while in class. Using your cell phone during lecture is not only counterproductive and intrusive, but will only distract you and your classmates from paying attention and learning. Do not try to text and learn during lecture.



There is little reason to use your laptop during lectures. For example you do not need to access the slides on your computer as these will be projected during class. While you may bring your laptop to lectures, again recognize that it is in a public space, visible by others and using the laptop can disturb those around you if used improperly. Please do not use your laptop during lecture for anything other than activities (e.g. taking notes) related directly to this virology course.

There is an expectation of professional conduct and courtesy on electronic discussion groups and email communications. The instructor will not monitor the discussion board as it is meant as a forum for free student exchange. However, if someone feels a particular posting is inappropriate you can inform the poster directly or bring it to the attention of the instructor.

**Grading:** As per Methods of Assessment page 3

### III. Campus Resources

If you are concerned about any aspect of your academic program:

- make an appointment with a program counsellor in your degree program.  
<http://www.bsc.uoguelph.ca/index.shtml> or  
<https://www.uoguelph.ca/uaic/programcounsellors>

If you are struggling to succeed academically:

- There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.  
<http://www.learningcommons.uoguelph.ca/>

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.  
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention.  
<https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations  
<http://www.uoguelph.ca/~ksomers/>

If you have a documented disability or think you may have a disability:

- The Centre for Student Accessibility Service (CAS) can provide confidential services and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability. For more information, including how to register with the centre please see: <https://www.uoguelph.ca/csd/>

## MICR\*4330 LAB SCHEDULE Winter 2016

WEEK	Activity	Summaries, Reports, Paper DUE DATE
<b>1</b> (Jan 13, 14)	Introduction and Working with Bacteriophage Baculovirus Protocol Report	Phage Notes <b>(3 marks)</b> Jan 20, 21 Protocol Report <b>(2 marks)</b>
<b>2</b> (Jan 20, 21)	Introduction to Cell Culture and Working with Insect Cells and Baculovirus – Cell Passage *	Baculovirus Research Mar 30, 31 <b>(10 marks)</b>
<b>3</b> (Jan 27, 28)	Insect Cell Culture and Cytopathic Effect of Insect Nucleopolyhedroviruses	Insect Virus Report Feb 24, 25 <b>(6 marks)</b>
<b>4</b> (Feb 3, 4)	Titration of AcMNPV	
<b>5</b> (Feb 10, 11)	Open Lab**	
(Feb 17, 18)	<b>BREAK WEEK</b>	
<b>6</b> (Feb 24, 25)	Embryonated Eggs as Viral Hosts	Avian Virus Report Mar 4, 5 (4 marks)
<b>7</b> (Mar 2, 3)	EM Harvest FPV infected eggs	
<b>8</b> (Mar 9, 10)	Viral Hemagglutination	
<b>9</b> (Mar 16, 17)	Open Lab	
<b>10</b> (Mar 23, 24)	Open Lab	
<b>11</b> (Mar 30, 31)	Open Lab	Baculovirus Research Report due
<b>12</b> (Apr 6, 7)	Open Lab	

\* This series of experiments will be ongoing during the semester with details to follow

\*\* Open Lab, laboratory is open to finish experiments and work on your Symposium and Presentations.

### Laboratory Grades:

Baculovirus research protocol	2 marks
Summary Reports of Results (phage, avian and insect viruses)	13 marks (3+4+6)
<u>Baculovirus Assignment</u>	<u>10 marks</u>
Total Laboratory Marks	25 marks