

Veterinary Virology: Molecular and Evolutionary Biology of Animal Viruses

Course #: VME 6508

Class #: 25480

Class periods: Monday and Thursday, 4:00 p.m. – 5:15 p.m.

Class location: Veterinary Academic Building (VAB) Room V1-100A

Academic Term: Spring 2024

Instructor:

Andrew Allison, Ph.D.

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Office hours: Contact instructor through e-mail to set up an appointment

Teaching Assistants:

NA

Course Description:

Veterinary Virology is a 3-credit (3 hours of lecture/week) graduate-level course focused on understanding the common, fundamental molecular and evolutionary mechanisms used by animal viruses to infect hosts.

The course is structured in three parts:

- Part I will cover fundamental concepts in animal virology as well as contemporary molecular, proteomic, structural, microscopy, and computational research techniques used to study viruses. Topics covered will include reverse genetics, single particle tracking, protein chromatography, cryo-electron microscopy, X-ray crystallography, and RNA-Seq, among others.
- Part II is structured to follow the systematic step-by-step processes of viral infection within animal hosts, starting at cellular entry and ending in cellular exit, using important animal pathogens as examples. Topics covered will include host cell receptor recognition and binding; fusion and penetration with host membranes; mRNA transcription and genome replication; unique protein production strategies used by viruses and post-translational modifications of viral proteins; intracellular trafficking, packaging, assembly, and maturation of virus particles; and virus transmissibility within and between hosts.
- Part III will cover the ecology and evolution of animal viruses, as well as their epidemiology and clinical aspects of infection. Topics will include mechanisms of virus evolution and emergence; spillover and zoonotic transmission; reverse zoonoses; and virus-host interactions on a molecular/atomic level, among others.

Course Prerequisites:

Previous introductory coursework in molecular biology and/or general microbiology/virology is recommended, although not required, prior to taking this course. A companion course, *Wildlife Virology: Emerging Wildlife Viruses of Veterinary and Zoonotic Importance*, is also offered and provides an all-inclusive and up-to-date synopsis on emerging viruses of wildlife. These two courses do not have to be taken in any particular order and may be taken independently of each other if desired.

Student Learning Objectives:

Having successfully completed this course, each student should be able to:

- Apply various contemporary research techniques for characterizing viruses on a genetic, evolutionary, structural, and functional level into their graduate and/or future post-doctoral studies

- Diagram in detail the sequential process of virus infection from entry to exit and subsequently design research experiments that could be used to specifically investigate various components of the viral life cycle
- Evaluate the various mechanisms used by viruses for translation of mRNAs in order to increase their coding capacity or modulate gene expression
- Analyze the processes by which viral proteins and genomes are transported intracellularly and propose potential mechanisms used by viruses to selectively package their genomes into capsids in order to develop theoretical models for packaging
- Debate current evolutionary relationships among animal viruses and the major drivers of viral evolution
- Assess the importance of various evolutionary and ecological mechanisms in facilitating virus emergence and epizootics of animal disease
- Formulate concepts on how viruses may manipulate the vertebrate immune system in order to cause disease and the interplay between host- and viral-mediated pathogenesis
- Compare and contrast the mechanisms by which RNA and DNA viruses replicate and evolve within hosts

Materials and Supply Fees:

NA

Required Textbooks and Software:

There are no required textbooks or software. Test material will be derived directly from lectures.

Recommended Materials:

A number of recommended virology textbooks for those interested in additional reading are outlined below:

- ***Fields' Virology***
David M. Knipe and Peter M. Howley (editors-in-chief)
Two volume set, 6th edition (2013)
Volume I: Chapters 1-42 / Volume II: Chapters 43-76
Lippincott Williams and Wilkins, Philadelphia, PA
This is the most authoritative textbook on virology available, with individual chapters on specific virus families and general virology topics written by the top experts in their respective fields. A very useful reference for anyone studying virology. Newer (more specific) volumes (1-4) are also now available.
- ***Principles of Virology***
Jane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatzioannou, and Anna Marie Skalka
Two volume set, 5th edition (2020)
Volume I: Molecular Virology / Volume II: Pathogenesis and Control
ASM Press, Washington, D.C.
This textbook covers the fundamental principles and processes used by all viruses during infection. There are also older versions (1999, 2004, 2009, 2015) of the textbook available, although slightly outdated. More information on specific virus families, if warranted, may be found in *Fenner's Veterinary Virology* or *Fields' Virology*.
- ***Fenner's Veterinary Virology***
N. James Maclachlan and Edward J. Dubovi (editors)
5th edition (2016)
Elsevier Academic Press, San Diego, CA
This textbook specifically outlines the major viral pathogens of veterinary importance and their associated clinical disease in domestic animals. *Veterinary Virology* also covers zoonotic viruses that are maintained in both domestic animals and wildlife.

Course Schedule:

Lectures will consist of PowerPoint presentations along with short videos. Additionally, at the start of select lectures, an image (e.g., virus structure, cellular diagram, graphical data) will be shown with an accompanying question. The image will demonstrate an interesting or fundamental concept in virology that will aid in understanding the course material. Within a week of the lecture, each student will be required to write (i.e., a two to three paragraph) summary of the image/concept in their own words. Interpretations will be discussed together in class before lecture. Additional details will be given in class. Class will meet twice a week for 1 hour 15 minutes/lecture for a total of 2.5 hours of lecture/week.

Week 1

Animal viruses: An introduction

Week 2

Viral nucleic acids, proteins, and lipids

Week 3

Classical techniques in virology: methods for isolation, propagation, purification, visualization, quantification, and antigenic classification of viruses

Week 4

EXAM 1

Contemporary molecular techniques in virology: Reverse genetics and deep sequencing technologies

Week 5

Contemporary proteomic techniques in virology: Protein chromatography and purification, mass spectrometry, and biomolecular interaction techniques (surface plasmon resonance and bilayer interferometry)

Contemporary structural techniques in virology: X-ray crystallography, cryo-electron microscopy, and nuclear magnetic resonance spectroscopy

Week 6

Contemporary microscopy and microfluidic techniques in virology: Single particle tracking, flow virometry, and other microfluidic platforms; basic and high-resolution fluorescent microscopy

What is the virosphere and how has it changed dramatically in the last 10 years?

Week 7

Viral receptor proteins: structure-function and membrane fusion

EXAM 2

Week 8

RNA viruses: RNA synthesis I

RNA viruses: RNA synthesis II

Week 9

DNA viruses: RNA and DNA synthesis

Processing and splicing of viral mRNAs

Week 10

Viral translational strategies

Post-translational modifications of viral proteins and intracellular trafficking

Week 11

EXAM 3

Viral assembly and the obscure mechanisms of genome packaging

Week 12

Manipulation and evasion of immune responses and pathogenesis

Recombination and reassortment in the evolution of animal viruses

Week 13

Virus mutation and adaptation to new hosts

Zoonoses and reverse zoonoses

Week 14

Virus emergence

Week 15

Overview and recap of fundamental concepts

FINAL EXAM (EXAM 4)

Attendance Policy, Class Expectations, and Make-Up Policy:

Class attendance is required. Absences from class must be arranged with as much advance notice as possible with the course instructor through e-mail (aallison1@ufl.edu) or in person. Excused absences must be consistent with UF Graduate policies (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation. Additional information on attendance regulations can be found at the following link: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Evaluation of Grades:

There will be four non-cumulative exams, each worth 20% of the final grade. Exams will consist of multiple choice, matching, short answer, and essay questions. Completion of the image summaries (5 total) will constitute 20% of the final grade.

Assignment	Points	Percentage of Final Grade
Exam 1	100	20%
Exam 2	100	20%
Exam 3	100	20%
Exam 4	100	20%
Image Summaries	100	20%
Total	500	100%

Grading Policy:

A final letter grade for the course will be assigned according to the UF Grading System as shown below.

Percent	Grade	Grade Points
100.00 – 94.00	A	4.00
93.99 – 90.00	A-	3.67
89.99 – 87.00	B+	3.33
86.99 – 84.00	B	3.00
83.99 – 80.00	B-	2.67
79.99 – 77.00	C+	2.33
76.99 – 74.00	C	2.00
73.99 – 70.00	C-	1.67
69.99 – 67.00	D+	1.33
66.99 – 64.00	D	1.00
63.99 – 60.00	D-	0.67
59.99 – 0	F	0.00

Students Requiring Accommodations:

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://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.

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/evals>. 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/>.

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 TA 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. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy:

There are federal laws protecting your privacy to grades earned in courses and on individual assignments. For more information, please see <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>.

Campus Resources:

The following resources are available to all UF students:

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> and 352-392-1575; and the University Police Department: 352-392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 352-392-1161.

University Police Department at 352-392-1111 (or 9-1-1 for emergencies), or <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 or view at <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center: Reitz Union, 352-392-1601. <https://www.crc.ufl.edu/>. Career assistance and counseling.

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, 352-392-2010 or 392-6420. <https://teachingcenter.ufl.edu/>. General study skills and tutoring.

Writing Studio: 302 Tigert Hall, 352-846-1138. <https://writing.ufl.edu/writing-studio/>. Help brainstorming, formatting, and writing papers.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.