

**Wildlife Virology:
Emerging Wildlife Viruses of Veterinary and Zoonotic Importance**

Course #: VME 6195/4906

Class periods: MWF 4:05-4:55 p.m.

Class location: Veterinary Academic Building (VAB) Room V3-114 and/or Zoom

Academic Term: Spring 2021

Instructor:

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

Teaching Assistants:

NA

Course description:

The emergence of viruses that cause disease in animals and humans is a constant threat to veterinary and public health and will continue to be for years to come. The vast majority of recently emerging viruses that have led to explosive outbreaks in humans are naturally maintained in wildlife species, such as influenza A virus (ducks and shorebirds), Ebola virus (bats), Zika virus (non-human primates), and severe acute respiratory syndrome (SARS) coronaviruses (bats). Such epidemics can have severe psychosocial impacts due to widespread morbidity and mortality in humans (and/or domestic animals in the case of epizootics), long-term regional and global economic repercussions costing billions of dollars, in addition to having adverse impacts on vulnerable wildlife populations.

Wildlife Virology is a 3-credit (3 hours of lecture/week) undergraduate/graduate-level course focusing on pathogenic viruses that are naturally maintained in wildlife species which are transmissible to humans, domestic animals, and other wildlife/zoological species. In this course, we will cover a comprehensive and diverse set of RNA and DNA viruses that naturally infect free-ranging mammals, birds, reptiles, amphibians, and fish. We will also address the newly described diversity of viruses found within marine and terrestrial invertebrates/arthropods and its significance to the taxonomy and origins of animal and human viral pathogens.

This course will give a preparatory overview on general virology as it relates to wildlife populations, followed by an extensive family-based approach to emerging and re-emerging viruses of wildlife. The majority of lectures will cover a specific virus family and will include (although not limited to) the following points, allowing the student to directly compare and contrast different virus families:

- Virus species within the family that are of veterinary and/or public health importance and basic information on their molecular biology
- The geographical distributions of wildlife viruses, emphasizing viruses found in North America, but also exotic viruses that are of concern for introduction into the USA
- The ecology and epizootiology of wildlife viruses, including the reservoir and amplifying hosts - along with vectors where applicable - involved in normal transmission cycle(s)
- How cross-species transmission occurs into aberrant, non-target hosts such as domestic animals or humans and the epizootiological/epidemiological significance of such events
- The clinical signs and symptoms of viral infection in target (wildlife reservoir and amplifying hosts) and non-target (humans, domestic animals, or other wildlife) species, where known

Course Prerequisites:

Specific introductory coursework is not required prior to taking this course, although a basic background in general microbiology is recommended. A companion course, *Veterinary Virology: Molecular and Evolutionary*

Biology of Animal Viruses, is also offered and provides a comprehensive foundation on core concepts in veterinary virology. 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:

- Formulate scenarios on how the ecological and epizootiological parameters of the normal transmission cycle(s) of wildlife viruses, including the hosts and/or vectors involved and routes of infection, may affect virus emergence
- Estimate the potential risk that specific endemic and exotic wildlife viruses pose to humans and domestic/zoological animals
- Design biosecurity strategies that could be implemented to minimize risk of disease transmission for pathogenic wildlife viruses
- Differentiate common clinical signs of disease or lesions in animals and/or humans associated with infection by different viruses that would facilitate diagnosis/identification
- Compare and contrast different viral families and their phylogenetic relationships to each other
- Analyze the mechanisms by which wildlife viruses spread to domestic animals and/or humans and the factors that facilitate (or impede) their successful sustained transmission in new hosts
- Conduct a detailed and comprehensive literature search in order to write a succinct scientific review paper for potential submission to a peer-reviewed journal

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:

- *Virus Taxonomy*
Andrew M. Q. King, Michael J. Adams, Eric B. Carstens, Elliot J. Lefkowitz (editors)
9th Report of the International Committee on Taxonomy of Viruses (ICTV) (2012)
Elsevier Academic Press, San Diego, CA
ISBN: 978-0-12384-684-6
This is the most recently published hard copy report of the ICTV, the governing body for viral taxonomy, which is published approximately every five years. It is the most comprehensive description of viral orders, families, genera, and species available. Like *Fenner's* and *Fields'*, a very useful reference for anyone in the virology field, although the state of viral taxonomy is very rapidly changing due to advances in next generation sequencing technologies. The most recent report (2018) has been published on-line.
- *Fenner's Veterinary Virology*
N. James Maclachlan and Edward J. Dubovi (editors)
5th edition (2016)
Elsevier Academic Press, San Diego, CA
ISBN: 978-0-12800-946-8
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.
- *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

ISBN: 978-1-45110-563-6

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.

Course schedule:

Lectures will consist of Powerpoint presentations along with select short videos and their discussion. Class will meet three times a week (1 hour/lecture) for a total of 3 hours of lecture/week.

Week 1: Jan 11th – 15th

INTRODUCTION

Lecture 1: Wildlife viruses: An overview

Lecture 2: The wildlife – domestic animal – human interface

Assignment: Write a short review paper (for an example, see *Current Opinion in Virology*) on a virus or group of viruses that you are currently studying (or would like to study) with the ultimate aim of publishing the manuscript in a peer-reviewed journal. The review may cover any topic related to virus biology, ecology, or epidemiology, etc. and should include current knowledge gaps and future research directions that would allow for a better understanding of the topic you are addressing. Depending upon the journal to which you may want to submit your review article, specific guidelines outlined in the author's instructions for that journal will be adhered to, as well as additional guidelines set forth in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria and/or the PICOS approach for developing research questions (please see <https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000100> and <http://prisma-statement.org> for more information), where applicable. A manuscript will be due at the end of the semester (Lecture 44). Further details will be provided in class.

RNA VIRUSES

Lecture 3: Arenaviruses (Family *Arenaviridae*; (+/-) ssRNA)
○ Viruses within the *Mammarenavirus* and *Reptarenavirus* genera

Week 2: Jan 20th - 22nd (no class on 18th)

Lecture 4: Hantaviruses (Family *Hantaviridae*; (-) ssRNA)
○ Viruses within the *Orthohantavirus*, *Mobatvirus*, and *Thottimvirus* genera

Lecture 5: Bunyaviruses (Family *Peribunyaviridae*; (-) ssRNA)
○ Viruses in the *Orthobunyavirus* genus

Week 3: Jan 25th -29th

Lecture 6: Nairoviruses (Family *Nairoviridae*; (-) ssRNA)
○ Viruses within the *Orthonairovirus* genus

Lecture 7: Phleboviruses (Family *Phenuiviridae*; (+/-) ssRNA)
○ Viruses within the *Phlebovirus* genus

Lecture 8: Filoviruses (Family *Filoviridae*; (-) ssRNA)
○ Viruses within the *Ebolavirus*, *Marburgvirus*, *Cuevavirus*, *Striavirus*, and *Thamnovirus* genera

Week 4: Feb 1st-5th

- Lecture 9: Bornaviruses (Family *Bornaviridae*; (-) ssRNA)
- Viruses within the *Orthobornavirus* and *Carbovirus* genera
- Lecture 10: Nyaviruses (Family *Nyaminiviridae*; (-) ssRNA)
- Viruses within the *Nyavirus* genus
- Lecture 11: Paramyxoviruses (Family *Paramyxoviridae*; (-) ssRNA)
- Viruses within the *Morbillivirus*, *Henipavirus*, *Orthoavulavirus*, *Ferlavirus*, *Respirovirus*, and *Rubulavirus* genera + *Sunviridae* (a new family related to paramyxoviruses)

Week 5: Feb 8th-12th

- Lecture 12: Pneumoviruses (Family *Pneumoviridae*; (-) ssRNA)
- Viruses within the *Metapneumovirus* genus
- Lecture 13: Rhabdoviruses (Family *Rhabdoviridae*; (-) ssRNA)
- Viruses within the *Lyssavirus*, *Ledantevirus*, *Ephemerovirus*, *Hapavirus*, and *Vesiculovirus* genera
- Lecture 14: **EXAM 1** (25%)

Week 6: Feb. 15th-19th

- Lecture 15: Orthomyxoviruses (Family *Orthomyxoviridae*; (-) ssRNA)
- Influenza A viruses of birds and bats; viruses within the *Quaranjavirus* and *Thogotovirus* genera
- Lecture 16: Reoviruses (Family *Reoviridae*; dsRNA)
- Viruses within the *Orthoreovirus*, *Coltivirus*, and *Orbivirus* genera
- Lecture 17: Picobirnaviruses (Family *Picobirnaviridae*; dsRNA)
- Viruses within the *Picobirnavirus* genus

Week 7: Feb. 22nd-26th

- Lecture 18: Alphaviruses (Family *Togaviridae*; (+) ssRNA)
- Viruses within the *Alphavirus* genus
- Lecture 19: Flaviviruses (Family *Flaviviridae*; (+) ssRNA)
- Viruses within the *Flavivirus*, *Pestivirus*, *Pegivirus*, and *Hepacivirus* genera
- Lecture 20: Arteriviruses (Family *Arteriviridae*; (+) ssRNA)
- Viruses within the *Deltarterivirus* and *Epsilonarterivirus* genera

Week 8: March 1st-5th

- Lecture 21: Picornaviruses (Family *Picornaviridae*; (+) ssRNA)
- Viruses within the *Aphthovirus*, *Cardiovirus*, and *Senecavirus* genera
- Lecture 22: Caliciviruses (Family *Caliciviridae*; (+) ssRNA)
- Viruses within the *Lagovirus* and *Vesivirus* genera
- Lecture 23: Coronaviruses (Family *Coronaviridae*; (+) ssRNA)
- Viruses within the *Alphacoronavirus*, *Betacoronavirus*, *Deltacoronavirus*, and *Gammacoronavirus* genera

Week 9: March 8th-12th (no Spring Break)

- Lecture 24: Astroviruses (Family *Astroviridae* (+) ssRNA)
○ Viruses in the *Mamastrovirus* and *Avastrovirus* genera
- Lecture 25: Tobaniviruses (Family *Tobaniviridae*; (+) ssRNA)
○ Viruses in the *Torovirus*, *Pregotorovirus*, and *Bostovirus* genera
- Lecture 26: Hepeviruses (Family *Hepeviridae*; (+) ssRNA)
○ Viruses in the *Orthohepevirus* genus

Week 10: March 15th-19th

- Lecture 27: Retroviruses (Family *Retroviridae*; (+) ssRNA-RT)
○ Viruses in the *Alpharetrovirus*, *Betaretrovirus*, *Gammaretrovirus*, and *Lentivirus* genera
- Lecture 28: **EXAM 2** (25%)

DNA VIRUSES

- Lecture 29: Poxviruses (Family *Poxviridae*, dsDNA)
○ Viruses in the *Orthopoxvirus* and *Parapoxvirus* genera

Week 11: March 22nd-26th

- Lecture 30: Asfarviruses (Family *Asfarviridae*, dsDNA)
○ Viruses in the *Asfivirus* genus
- Lecture 31: Iridoviruses (Family *Iridoviridae*, dsDNA)
○ Viruses in the *Ranavirus*, *Megalocytivirus*, and *Lymphocystivirus* genera
- Lecture 32: Herpesviruses (Family *Herpesviridae*, dsDNA)
○ Viruses in the *Proboscivirus*, *Macavirus*, *Varicellovirus*, and *Mardivirus* genera

Week 12: March 29th-April 2nd

- Lecture 33: Adenoviruses (Family *Adenoviridae*, dsDNA)
○ Viruses in the *Atadenovirus*, *Aviadenovirus*, *Mastadenovirus*, and *Siadenovirus* genera
- Lecture 34: Polyomaviruses (Family *Polyomaviridae*, dsDNA)
○ Viruses in the *Alphapolyomavirus*, *Betapolyomavirus*, and *Gammapolyomavirus* genera
- Lecture 35: Papillomaviruses (Family *Papillomaviridae*, dsDNA)
○ Viruses in the *Deltapapillomavirus*, *Thetapapillomavirus*, and *Omikronpapillomavirus* genera

Week 13: April 5th-9th

- Lecture 36: Parvoviruses (Family *Parvoviridae*, ssDNA)
○ Viruses in the *Amdoparvovirus* and *Protoparvovirus* genera
- Lecture 37: Circoviruses (Family *Circoviridae*, ssDNA)
○ Viruses in the *Circovirus* and *Cyclovirus* genera
- Lecture 38: Hepadnaviruses (Family *Hepadnaviridae*, dsDNA-RT)
○ Viruses in the *Avihepadnavirus* and *Orthohepadnavirus* genera

VIRUS ECOLOGY

Lecture 39: Virus-host ecology: Emerging bat-borne viruses

Lecture 40: Virus-host ecology: Emerging reptilian viruses

Lecture 41: Virus-host ecology: Emerging viruses of cetaceans

Lecture 42: Virus-vector ecology: Emerging tick-borne wildlife viruses

Lecture 43: Virus geography: Emerging viruses endemic to Florida + review papers are due (40%)

Lecture 44: Wildlife virology: A recap

FINAL EXAM (EXAM 3) (25%)

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 policies (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) in the Graduate Catalog 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:

Grades will be based on a review paper (25%) and three non-cumulative exams, each worth 25% of the final grade. Exams will consist of multiple choice, matching, short answer, and essay questions.

Assignment	Points	Percentage of Final Grade
Exam 1	100	25%
Exam 2	100	25%
Exam 3	100	25%
Review paper	100	25%
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 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. 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>.