

BIOL5803 Virology

Fall 2021 | Wednesdays 5:30 – 8:20pm, Bolin 209

Contact Information

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Office hours: MW 12:00 – 1:00pm; TR 11:00am – 1:00pm

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Course Description

This course is intended to provide students with foundational knowledge in the field of virology. Viruses are obligate parasites. They are extremely diverse, and yet all viruses share a common set of strategies for survival and propagation. Viruses are infectious, and their patterns of infection can strongly shape the genetics, behavior, and survival of the populations in which they are found. Because viruses are so diverse, it is really impossible to describe all of them; thus, we will use a few viruses as models for how viruses in general do the things they do.

Textbook & Instructional Materials

There will be **no required text** for this course. Rather, we will use the biology and chemistry literature to form our own textbook of sorts. Select journal articles from the literature are posted on D2L for you to download and read PRIOR to coming to class. If you really wish for a textbook, the following very affordable book is recommended: *Principles of Virology*, 5th Edition; Flint, Racaniello, Rall, Hatzioannou, Skalka; ISBN: 978-1-683-67358-3.

Additional Resources

There is a lot of information out there on viruses, but a few sites stand out as being particularly useful. They are:

1. [Virology](#) at Columbia with Vincent Racaniello: this is his course on viruses; complete with slides, study questions, and YouTube videos of his lectures. Since he wrote the recommended virology book, this is an excellent website for background information to supplement my lectures.
2. [Viral Zone](#): This is an encyclopedia of viruses (their structure, how they replicate, diseases, further resources).
3. “This Week in Virology” podcast: [TWiV](#), also available on iTunes. This is put out by VR Racaniello.
4. The [CDC](#) and [WHO](#) also publish a lot about viruses, including new and ongoing disease outbreaks.
5. The scientific literature is best searched for information on viruses through [PubMed](#), which gives you the option of searching FREE articles and downloading them directly to your computer.

Attendance

Students are expected to attend all meetings of the classes in which they are enrolled. This is especially true of graduate students in graduate courses that meet infrequently. If you absolutely MUST miss class (which would be for a significant reason), please inform me prior to the start of the class to be missed. Instructor’s records will stand as evidence of absences.

Student Handbook

Refer to: [Student Handbook-2018-19](#)

Academic Dishonesty: Cheating, collusion, and plagiarism (the act of using source material of other persons, either published or unpublished, without following the accepted techniques of crediting, or the submission for credit of

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work not the individual's to whom credit is given). Additional guidelines on procedures in these matters may be found through the [Dean of Students](#) office.

All forms of plagiarism are to be consciously and methodically avoided at all costs. Plagiarism is NEVER acceptable and there is no such thing as "accidental" plagiarism. Any assignment submitted in this class that is found to contain any form of plagiarism, no matter how minor an infraction, will receive a zero for a grade and you will receive no participation credit for that assignment. Plagiarism includes direct copying of the work of others without citation, paraphrasing without citation, improper or sloppy citation, citation without having actually read the source, and any or all other use of the work of others without proper vetting or reference.

Course Exam

There will be **one exam** (take-home) covering the lecture portion of the class. You will be given a set of questions to answer demonstrating that you understand how/why viruses do what they do. You will be allowed to use the scientific literature and other resources during the exam EXCEPT each other, other students, or other faculty.

Projects Required

- 1. Virology Book Club Report/Discussion (Book Report):** you will find a popular book about viruses, read it, and analyze it. An example could be something like *The Hot Zone*, by Richard Preston, which is about Ebola. You will analyze the book for the following elements and write about what you find:
 - a. Summary:** as with any book report, you first present a paragraph or two summarizing the book. Note: summarize does not mean blow-by-blow detail, but rather an overall synopsis (NOT taken from the dust jacket) of the book.
 - b. Purpose:** what was the intent of the author in writing the book?
 - c. Tone:** is the story of the virus "jazzed" up to make it exciting? Frightening? Or is it written in a factual manner that intends to inform rather than terrorize.
 - d. Science:** did the author do their homework and present the science of the virus – its life cycle, epidemiology, etc. and was the science presented correctly?
 - e. References:** does the author draw on the science literature to write the story, or is it historical, journalistic? Are there any references at all? Flip through the references and try to locate some of them—how easy would it be for someone to double-check the contents of the book?
 - f. Author:** who is the author and were they an appropriate author for the book that was written?
 - g. Assessment:** is it a good book (a "good read") and is it a good book for presenting a complex subject to the general public that does not have your education?
 - h. Book Club Discussion:** We will take one day towards the end of the course to talk about our books in class. This will be an informal round-table discussion (no formal presentation is required).
- 2. Virus Project (Review Paper):** you will select an individual virus to study this semester and write a mini-review of the current state of knowledge about that virus. You will specifically choose one of the primary papers you consult for your review paper to present to the class. Your written paper must discuss a **minimum of 10 primary research articles** on your chosen virus (note: you can choose any virus you want, but only one student will be allowed per virus. The virus you choose does not have to be the virus you do your book report on).
- 3. Major Presentation:** you will present one primary journal article from your review paper to the class (1 of the 10 minimum papers). This paper must be on the virus itself or its parts (it cannot be a paper primarily on cell biology, immunology, epidemiology, medical case reports, etc.). You will be required to email a copy of the paper to everyone in the class so that we may all read the paper prior to your presentation of it.

Late Work

No late work will be accepted. This is a non-negotiable policy. If I actually give you a deadline, I really do need your work at that time.

Problems with the Mechanics of Writing

You will be asked to write two (2) major papers in this course. If you require help with the basic mechanics of writing, you will need to work with the Writing Center. I will help you some, but I will not typically edit student work at the sentence level, so if you need that type of help you need to go to the Writing Center or work with another student/friend.

Desire-to-Learn (D2L)

Extensive use of the MSU D2L program is a part of this course. Each student is expected to be familiar with this program as it provides a primary source of communication regarding assignments, examination materials, and general course information. You can log into [D2L](#) through the MSU Homepage. If you experience difficulties, please contact the technicians listed for the program or contact your instructor.

Grading

Grades in the course will be broken down as follows. Straight percentages will be used to determine the overall grade in the course.

Table 1: Points allocated to each assignment

Assignments	Percentage
Exam	25%
Book Report	25%
Virus Project Review Paper	25%
Virus Project Presentation	25%

Instructor Class Policies

Please give your attention to the class and not your phones while class is in session. You may use a tablet or computer to take notes on, but please turn off the sound so we do not listen to your alarms and alerts.

Services for Students with Disabilities

In accordance with Section 504 of the Federal Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, Midwestern State University endeavors to make reasonable accommodations to ensure equal opportunity for qualified persons with disabilities. For more details, please go to [Disability Support Services](#).

Course Schedule

We will do everything possible to adhere to this schedule, but weather and other events may force changes to the schedule. You are responsible for going to D2L and downloading and reading all materials listed in the schedule. It is suggested that where multiple papers are listed, you read them in the order presented.

We will structure the course around SARS as a model virus; thus most papers will deal with SARS and how it provides a foundation upon which to explain most of virology.

Course Schedule

Date	Subject/Readings/Slide Packets (found on D2L)
Aug 25	<p>Course Introduction / What is a Virus? Baltimore D (1971) "Expression of Animal Virus Genomes" <i>Bacteriological Reviews</i> 35(3):235 – 241.</p>
Sept 1	<p>Where do viruses come from? The general problem of spillover. Johnson CK, Hitchens PL, Pandit PS, Rushmore J, Evans TS, Young CCW, Doyle MM. (2020) "Global shifts in mammalian population trends reveal key predictors of virus spillover risk." <i>Proceedings of the Royal Society B.</i> 287: 20192736.</p>
Sept 8	<p>Where do viruses come from? SARS and the problem of bats. Frutos R, Serra-Cobo J, Pinault L, Roig ML, Devaux CA. (2021) "Emergence of bat-related betacoronaviruses: Hazard and Risks." <i>Frontiers in Microbiology.</i> 12: 591535. Singh D and Yi SV. (2021) "On the origin and evolution of SARS-CoV-2." <i>Experimental & Molecular Medicine.</i> Doi:10.1038/s12276-021-00604-z.</p>
Sept 15	<p>How do viruses move? The very large problem of very small mosquitoes. Weaver SC, Forrester NL, Liu J, Vasilakis N. (2021) "Population bottlenecks and founder effects: implications for mosquito-borne arboviral emergence." <i>Nature Reviews: Microbiology.</i> Doi: 10.1038/s41579-020-00482-B.</p>
Sept 22	<p>How do viruses move? Shifting hosts. MacLean OA, Lytras S, Weaver S, Singer JB, Boni MF, Lemey P, P SLK, Robertson DL. (2021) "Natural selection in the evolution of SARS-CoV-2 in bats created a generalist virus and highly capable human pathogen." <i>PLoS Biology.</i> 19(3): e3001115. Pohl MO, Busnadiego I, Kufner V, Glas I, Karakus U, Schmutz S, Zaheri M, Abela I, Trkola A, Huber M, Stertz S, Hale BG. (2021) "SARS-CoV-2 variants reveal features critical for replication in primary human cells." <i>PLoS Biology.</i> 19(3): e3001006.</p>
Sept 29	<p>How does the virus get into the host? Any way it can, really.... Kim CH (2020) "SARS-CoV-2 evolutionary adaptation toward host entry and recognition of receptor O-acetyl sialylation in virus—host interaction." <i>International Journal of Molecular Sciences.</i> 21: 4549.</p>
Oct 6	<p>How do viruses replicate? The same way we do, but with caveats... V'kovski P, Kratzel A, Steiner S, Stalder H, Thiel V. (2021) "Coronavirus biology and replication: implications for SARS-CoV-2." <i>Nature Reviews: Microbiology</i> 19: 155-170. Satija N and Lal SK. (2007) "The molecular biology of SARS coronavirus." <i>Annals of the New York Academy of Sciences.</i> 1102: 26-38. Malone B, Chen J, Wang Q, Llewellyn E, Choi YJ, Olinares PDB, Cao X, Hernandez C, Eng ET, Chait BT, Shaw DE, Landick R, Dars SA, Campbell EA. (2021) "Structural basis for backtracking by the SARS-CoV-w replication—transcription complex." <i>Proceedings of the National Academy of Science.</i> 118(19): e21025167118.</p>
Oct 13	<p>Do all viruses replicate the same? No, not even when they begin with the same genome. Levene RE and Gaglia MM. (2018) "Host shutoff in influenza A virus: Many Manes to an End." <i>Viruses.</i> 10: 475. Piasecka J, Jarmolowicz A, Kierzek E. (2020) "Organization of the Influenza A virus genomic RNA in the viral replication cycle—structure, interactions, and implications for the emergence of new strains." <i>Pathogens.</i> 9: 951. Hu J, Zhang L, Liu X. (2020) "Role of post-translational modifications in influenza A virus life cycle and host innate immunity response." <i>Frontiers in Microbiology.</i> 11: 517461.</p>

Date	Subject/Readings/Slide Packets (found on D2L)
Oct 20	Why and how do viruses change? Restraint in an every changing host world. Iwasaki Y, Abe T, Ikemura T. (2021) "Human cell-dependent, direction, time-dependent changes in the mono- and oligonucleotide compositions of SARS-CoV-2 genomes." <i>BMC Microbiology</i> . 21: 89. Korber B, Fischer WM, Gnanakaran S, ..., LaBranche CC, Saphire EO, Montefiori DC. (2020) "Tracking changes in SARS-CoV-2 Spike: Evidence that D614G increases infectivity of the COVID-19 virus." <i>Cell</i> . 182: 812-827.
Oct 27	How do we combat viruses? It isn't as easy as it seems. Mengist HM, Dilnessa T, Jin T. (2021) "Structural basis of potential inhibitors targeting SARS-CoV-2 main protease." <i>Frontiers in Chemistry</i> . 9: 622898
Nov 3	The ethics of virology. What do we owe ourselves and our children? Forman R, Shah S, Jeurissen P, Jit M, Mossialos E. (2021) "COVID-19 vaccine challenges: What have we learned so far and what remains to be done?" <i>Health Policy</i> . 17: 13. Exam handed out. Exam is due December 1 at the latest.
Nov 10	VIROLOGY BOOK CLUB Bring your books for a roundtable discussion.
Nov 17	Student Presentations 1. 2. 3.
Nov 24	THANKSGIVING HOLIDAY—no class
Dec 1	Student Presentations 1. 2. 3.
Dec 8	FINALS WEEK: ALL PAPERS DUE NO LATER THAN 5:00PM

Review Paper (More Information)

Once your virus is selected, you need to choose some aspect of the virus' life cycle to investigate. For example, you may decide to study how the virus gets into the cell. You may need to do some more research on your virus to see what is out there before deciding what specifically you want to study. Note: START EARLY!!! You may have to inter-library loan some articles, so you can't wait until the last minute. I no longer hold subscriptions to the major virology journals, so I can't get the articles for you. The [PubMed](#) database is the easiest way to review papers before getting them because you can read all abstracts for free (and then many of the papers are open access, so you can download immediately).

Once your virus and life-cycle topic are chosen, you will need to find **10** peer-reviewed **primary** journal articles **published within the last 5 years** about the topic you have chosen. You may choose to include some review papers (secondary journal articles), but these are in addition to the 10 primary articles (not in place of). The 10 articles must all focus on your specific topic (as per the example, they would all have something to do with viral entry into the host cell). You will want to include background information on the virus (where it is found, how transmitted, diseases, etc.), but this can be obtained from Viral Zone, the CDC, etc. The 10 articles must then be analyzed and synthesized into a review article on the topic (e.g., you will use primary journal articles as the source material to write a secondary review article that describes the current state of research on the topic).

The review paper must be a minimum of 10 written pages (excluding cover page, reference list, etc.) in 12 point font, double-spaced, and 1 inch margins all the way around. Students will be held to high standards of grammatical accuracy, so make sure you proofread your writing. You may include figures, but they must be clear, well footnoted

as to source, have good figure legends, and be referred to in the text (figures can be inserted in the text or put on their own pages; they do not count as part of your written pages). Note: figures should be annotated to demonstrate you are not just using them for filler (for example, with notes or arrows to call attention to what you want me to see). The papers must be integrated to tell a cohesive story of the topic – you are NOT writing a paragraph summary of each paper strung together with no integration. If you write that type of paper, you will receive a failing grade.

Class Presentation (More Information)

From the 10 primary journal articles you gather for the mini-review paper, you will select **ONE paper** to present to the class. Your paper must be approved by me before presentation. We will set up an email list and you will email your paper to the class (one) 1 week before your presentation so that we can read it. We will run this like a journal club, which means that you will give no more than a 20-25 minute presentation on the paper and we will then discuss it (the audience can ask questions and/or we will talk about different aspects of the paper and what it means in context of the class). You will need to craft a **PowerPoint** presentation of your talk, which you will also turn in to me as part of your grade. You will be evaluated by me and your peers (peer review sheets will be handed out). Which paper you pick to present will ultimately be up to you (even though I want to approve it), but you will do best picking the most interesting paper of the 10 you are working with so as to convey that enthusiasm to us.

What goes into the presentation? Some sort of introduction (what the virus is, where it is found, does it cause human illness, etc.), an overview of the life cycle, where your focus is, the core of the paper (what was the research question, what was the hypothesis, what experiments were run and why, a focus on the results and what they mean), how the paper fits into the overall understanding of the life cycle, how your research fits into the context of the class, and future directions of the research (where do you think the research needs to go?). Note: you do NOT need to try and learn every technique in the paper in order to present it, but you do need to understand enough to explain the results of the paper to us. This may mean that you will need to consult other papers or encyclopedias, etc. to help you understand the techniques in general terms. You will want, therefore, to put your presentation together early and practice it at least a little so that you are comfortable talking about the results.

What does the audience do during the presentation? Listen, ask questions, and evaluate the presentation. You are expected to read the papers prior to the presentations so you can actively participate in the discussion.