Spring 2-1-2022

BIOM 435.01: Virology

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Syllabus
BIOM 435: Virology

COURSE INFORMATION:

1. CRN: 30654
2. Credits: 3
3. Term: Sp 2022
4. Day/time: MWF; 2:00PM-2:50PM
5. Building/room: Health Science 207
6. Zoom link (UM login required): https://umontana.zoom.us/j/91421403378

INSTRUCTOR CONTACT INFORMATION:

1. Brent Ryckman
2. Department: Division of Biological Sciences
3. Office: Interdisciplinary Science Building (ISB) 215
4. Phone (Lab): 406-243-6948
5. Email (preferred): brent.ryckman@mso.umt.edu
6. Office hours: By appointment (probably via zoom)

COURSE SUMMARY

A. Course Description:

1. A "principles-based" discussion of virology, focusing on the molecular processes and events that must be completed by all viruses for successful replication within an individual host, and spread through host populations. The molecular basis of alternative replication strategies, the interactions of viruses with host organisms, and how these interactions lead to disease will be presented with examples drawn from a representative set of the more well studied viruses of human medical relevance.
2. Basic overview information for each unit topic will be given by the instructor in lecture format. The students will then elaborate on the material by formulating discussion questions, independently exploring these questions outside of class using internet or other resources, and then participating in in-class discussions.
3. Beyond familiarizing students with topics relating to molecular virology, this course will encourage students to practice critical and creative thinking skills with regard to modes of investigation, inquiry, questioning and the nature of scientific knowledge and so called "facts."
4. Only minority of students enrolled in BIOM435 will directly need detailed knowledge of virology in their future endeavors. Thus, while the course is designed to serve this minority of students, the broader, overarching goal is to provide all students with useful intellectual tools of scientific inquiry that will benefit them no matter what their future holds.

B. Prerequisite knowledge:

1. Formal prerequisite: BIOB 260 Cell and Molecular Biology

2. Virology can be thought of as a "secondary discipline." That is, virologists use a variety of approaches drawn from "primary" or "first-principle" disciplines to study the biology of viruses and viral diseases. Thus, understanding virology requires a solid background in molecular biology, biochemistry, genetics, cell biology and immunology. If you are concerned about your preparedness for this course, please make an appointment with the instructor.

C. Textbook and other informational resources:

1. No textbook required.
2. Students will be expected to regularly use the internet to access primary virology research articles
3. This course will generally follow the topic organization, and much of the lecture context content will be drawn from of Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses, S.J. Flint et al., Third Edition, ASM Press 2009.

D. Attendance:

1. Given the discussion nature of the course, will be almost impossible to do well without regular attendance. In the event of unavoidable, long-term absences, contact the instructor to find a solution.

E. Basic Course Design:

1. Overview unit lectures will be delivered by instructor.
2. Students will complete unit quizzes on their own time (administered on Moodle).
3. For each unit students will formulate their own "principles", questions derived from those principles, find one research article that addresses their "principle and question", and provide a short written analysis.
4. Student formulated Principles, Questions and analyses of research articles will also be discussed in class.
5. Note that this course design will result in overlap of units. I.e., while students are exploring principles, questions and research articles pertaining to one unit, lectures will move onto the next unit.

[redacted] ON SCIENTIFIC PRINCIPLES AND QUESTIONS (and COURSE PHILOSOPHY)

A. On inquiry, questions and the nature of advancing knowledge

1. On human resistance to new scientific ideas and questions.

a) *Max Plank (1853-1947; Scientific Autobiography and Other Papers.):* "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new generation grows up that is familiar with it."

b) *Enrico Fermi (1901-1954; quantum physicist; source unclear): "*Never underestimate the joy people derive from hearing something they already know."

2. On being open to new ideas and new questions

a) *Albert Einstein; (source unclear):* "It's not that I'm so smart, it's that I stay with problems longer"

b) *Rainer Maria Rilke (ca. 1905; Letters to a Young Poet):* "Be patient toward all that is unsolved in your heart and try to love the questions themselves…"

c) *Kwai Chang Caine (main character from 1972-75 TV series "Kung Fu"):* "I seek not to know all the answers, but to understand the questions."

3. On truth, facts, and advancing knowledge.

a) *Pierre Teilhard de Chardin; from "The Phenomenon of Man" (1955):* "….the history of the living world can be summarized as the elaboration of ever more perfect eyes within a cosmos in which there is always something more to be seen."

b) *Albert Einstein; (source unclear):* "Creating a new theory is not like destroying an old barn and erecting a skyscraper in its place. It is rather like climbing a mountain, gaining new and wider views, discovering unexpected connections between our starting points and its rich environment. But the point from which we started out still exists and can be seen, although it appears smaller and forms a tiny part of our broad view gained by the mastery of the obstacles on our adventurous way up."

c) *Immanuel Kant. 1783 "Prolegomena zu einer jeden künftigen Metaphysik, die als Wissenschaft wird auftreten können" ("Prolegomena to Any Future Metaphysics That Will Be Able to Present Itself as a Science":* "…every answer given on principles of experience begets a fresh question…"

d) *Common colloquialism:* "science just raises more questions than it answers."

B. On the nature of questions in science.

1. Discrete questions

a) Answer seeking

b) Can bring clarity to a subject

c) Generally narrows the askers viewpoint and therefore can restrict creativity

d) Generally constricted by the asker's viewpoint (assumptions and beliefs)

e) Types of discrete questions.

(1) Clarification

(2) Informational/factual

(3) Logical next step

(4) More detail or depth

2. Abstract questions

a) Not intended to elicit a clear answer

b) Can expand the asker's viewpoint and promote creativity

c) Can move beyond the askers preexisting viewpoint (assumptions and beliefs).

d) Types of abstract questions.

(1) Rhetorical

(2) Exploratory

(3) Leading

(4) Heretical (I.e., challenging the current paradigms and beliefs)

3. No "hard line" between types of questions.

a) What may begin as a discrete question might proliferate towards abstraction as the investigation proceeds.

b) To be of practical use, abstract questions must precipitate discrete questions that can be more directly investigated

c) Continuous flow back and forth between types of questions

d) *Example.*

(1) Discrete question: "How many strains of SARS -CoV2 are there?"

(2) Abstract questions: "How do we define 'strains'?"

(3) Many possible discrete questions:

(a) "How many SNPs among the CoV2 genomes sampled from:

(i) One person?"

(ii) A cohort of people from one community?"

(iii) Cohorts of people from different geographic regions?"

(b) "Do any of the detected SNP's "meaningfully affect the virus biology/disease?"

(4) Abstract question: "What kinds of effects on virus biology would be "meaningful?"

C. On the nature of "scientific truths."

1. Terms we give to our "scientific truths".
   a) Principle
   b) Law
   c) Theory
   d) Model
   e) Fact
2. The varying foundations of what we hold as scientific principles.
   a) Based on observations and empirical data
      (1) Example: "…The smaller creatures are, the more they swarm." (de Chardin; The Phenomena of Man.)
      (2) May be clearly observed in some instances, but does this mean such principles are universally "true"? (do all "small creatures" swarm? Do no "large creatures" swarm?)
   b) Based purely on abstract thought.
      (1) Example: Newton's First Law of Motion; " "Objects at rest tend to stay at rest, and bodies in motion stay in motion in a straight line unless acted on by an external force."
      (2) May not be observable anywhere in the universe, but does this mean such principles are not really "true"?
3. If not universally "true", of what use are scientific principles, laws, theories, models etc.?
   a) Tools for making predictions (e.g., engineering applications).
   b) Tools for the formulation of new questions
   c) Tools for making new observations, and making sense of them.
      (1) Charles Darwin_ from; The Life and Letters of Charles Darwin, 1898
         (a) "…without the making of theories, I am convinced there would be no observation"
      (2) *Ca. 1660: Ruben de la Vialle* "graffiti'ed" his name over prehistoric cave paintings in a Pyrenees mountains cave now called "Niaux".
         (a) In the 1600's there was no coherent, widely accepted concept of the existence of prehistoric hominids, much less that they might paint images of animals on the walls of caves.

(b) Perhaps de la Vialle, believing himself to be the only human ever to access that cave, he was not intellectually open to actually "seeing" the prehistoric paintings for what they really were..

ASSIGNMENTS, ASSESSMENTS AND GRADING:

A. Unit quizzes (11 units, approximately 10 points each)

1. Following each lecture unit, a quiz will be activated on Moodle for students to complete on their own time.
2. Students may consult any resource while completing quizzes, but note that there will time limits imposed, so it will be best if students attend and are engaged in lecture times.

B. Unit Assignments: "Principles to Questions to Analysis of Research Articles." (11 units, 5 points each)

1. For each lecture unit, students will independently
   a) Formulate **TWO** distinct "principles" relevant to that unit's lecture material.
   b) Formulate **TWO** questions based on **ONE** of the principles.
   c) Select a research article that addresses or somehow relates to the selected principle and question and provide a brief written analysis.
      (1) Article selected must be an original, published research article, not a "review" "commentary", "news" article etc., etc. If you an unsure what this means, ask the instructor.
      (2) While the selected research article must clearly relate to the student's principle and question, it is not expected that it will offer any specific, conclusive "answer". (See section IV, above)
   d) For full credit
      (1) Assignments must be uploaded by due date indicated on Moodle assignment module.
      (2) Formatted clearly with subheadings
         (a) Two Principles
            (i) Must be clearly distinct, not just different ways of stating the same idea or contingent or dependent on each other.
            (ii) Must be "principle" as described in Section IV.C. above. I.e., not a specific, detailed "fact
         (b) Questions addressing selected principle
            (i) Indicate which of your two principles informs your questions
            (ii) Link between selected principle and questions must be clear and logical.
         (c) Summary analysis of research article must include
            (i) Citation in the format: "**Author1 [Last name, first initials], Author2[Last name, first initials], etc. Publication Year. Article Title. Journal Name. Vol:page numbers."**

(ii) Statement of the authors' research question(s) (this almost certainly will be different and more specific than your question and it may not be clearly stated by the authors.

(iii) A summary of the research approaches and strategies used by the authors to address their question.

(iv) A summary of the authors' conclusions.

(v) Recommended length 300-750 words (not including student's Principles and Questions).

C. Participation in class discussions (10 points total)

1. Each student will orally report on their Principles assignment for one unit during the semester.
2. Instructor will randomly assign groups of 3-4 students to a specific unit.
   a) Students will briefly summarize their assignment followed by open class discussion. Approximately 5 minutes per student. ***The focus should be on the essence of how the selected paper relates to your principle and question. NOT to give an analysis of the technical detail. Think "forest" not "trees".***
   b) Acceptable absences may be made up on another class period. Students must contact instructor.

D. Learning Outcomes

1. Develop the art of summary (i.e. summarize the essence of how research articles relate to virology principles as oppose to analyzing the technical details of a paper)
2. Independently formulate "principles" of virology.
3. Formulate discrete and abstract questions based on individually formulated "principles".
4. Perform independent research of information sources such as the internet to explore individually formulated questions.
5. Fill in the blank-labels on a diagram of the Baltimore virus classification scheme.
6. Cite at least two examples of molecular biology "principles" that were discovered by studying viruses.
7. Distinguish the terms "susceptible", "resistant" and "permissive" with respect to potential host cells.
8. Explain the term "cytopathic effects" in the context of viral replication.
9. List at least two distinct ways of quantifying viruses as physical entities, and two distinct ways of measuring viruses as replicating entities.
10. Calculate multiplicity of infection using given information/data.
11. Identify the, eclipse, latent/lag, exponential and plateau phases of a viral replication curve
12. Match the terms icosahedral, helical, naked and enveloped to diagrams of representative viral particles.
13. Distinguish the terms "affinity" and "avidity" with respect to viral receptor interactions.
14. Explain the fundamental differences in entry mechanisms between enveloped and naked viruses.
15. Identify what types of *purified* viral genomic nucleic acids are infectious when delivered into cells by transfection methods.
16. Explain why RNA viruses are generally more prone to mutations than DNA viruses

17. Distinguish reassortment from recombination as mechanisms of RNA virus evolution.
18. Explain at least one mechanism by which RNA viruses switch from mRNA production to genome replication.
19. Compare and contrast the autoregulatory and temporal cascade mechanisms of DNA virus gene expression regulation.
20. Explain the relationship between alternative RNA splicing mechanisms of HIV and nuclear export of viral RNA molecules.
21. Explain at least one mechanism of how viruses inhibit or suppress host gene expression.
22. Explain at least one mechanism by which viruses expand their genetic coding capacity at the level of mRNA translation.
23. Explain the term "concatamer" as it relates to viral DNA replication.
24. Describe three priming mechanisms for viral DNA replication.
25. Explain the concept of "self-assembly" of viral particles.
26. Compare and contrast cell-to-cell viral spread and cell-free viral spread.
27. Match a list of general events in viral pathogenesis with a list of viral, host and environmental factors that influence the event.
28. Distinguish intrinsic host defenses, innate immunity and adaptive immunity.
29. Distinguish acute and persistent infections using given data.
30. Explain at least one mechanism of viral immune evasion.
31. Explain why DNA viruses often affect the regulation of the cell cycle, and how this relates to the development of cancer.
32. Obtain primary research articles from internet sources such as PubMed
33. Critically evaluate the strengths and weaknesses of primary research articles.

E. Grading (approximate, subject to change)

	Semester total per assessment tool	**Percent of final grade**
Unit Quizzes	**110**	**60**
Unit Principles, questions, research articles; written assignments	**55**	**30**
Participation	**10**	**10**
Semester Total	**175**	**100**

Final grade	Final Score		Percentage
A	162	175	93-100
A-	225	161	90-92
B+	152	156	87-89
B	145	151	83-86
B-	140	144	80-82
C+	135	138	77-79
C	128	134	73-76
C-	122	127	70-72
D+	117	121	67-69
D	110	116	63-66
D-	105	109	60-62
F		104	< 60

[redacted]ACCESSIBILITY, DISABILITIES, AND SPECIAL ACCOMMODATIONS:

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and the Office for Disability Equity (ODE). If you anticipate or experience barriers based on disability, please contact the ODE at: (406) 243-2243, ode@umontana.edu, or visit www.umt.edu/disability for more information. Retroactive accommodation requests will not be honored, so please, do not delay. As your instructor, I will work with you and the ODE to implement an effective accommodation, and you are welcome to contact me privately if you wish.

[redacted]UM CULTURAL LEAVE POLICY

Cultural or ceremonial leave allows excused absences for cultural, religious, and ceremonial purposes to meet the student's customs and traditions or to participate in related activities. To receive an authorized absence for a cultural, religious or ceremonial event the student or their advisor (proxy) must submit a formal written request to the instructor. This must include a brief description (with inclusive dates) of the cultural event or ceremony and the importance of the student's attendance or participation. Authorization for the absence is subject to approval by the instructor. Appeals may be made to the Chair, Dean or Provost. The excused absence or leave may not exceed five academic calendar days (not including weekends or holidays). Students remain responsible for completion or make-up of assignments as defined in the syllabus, at the discretion of the instructor.