Syllabus: Principles of Virology

1. Course Information:
Title: Principles of Virology
Number: F494
Credits: 3
Prerequisites: Biol 261
Location: 201 Irving

2. Instructor contact information:
Karsten Hueffer
khueffer@alaska.edu
Tel: 474 6313
Office hour: flexible office hours by appointment
E-mail is the best way to contact me.

3. Course readings/materials:
The textbook for this course is:

Readings from this text as well as additional reading materials will be assigned by the instructor.

4. Course Description:
This course will cover the principles of virology. The main emphasis of this course is on the biology of human and animal viruses. Plant viruses, however will also be discussed in less detail. The course will focus on higher level of understanding of concepts governing the areas of virology covered in the course. Basic knowledge of cell biology is an absolute requirement of this course prior to enrolment. Biol 261 or equivalent courses at other institutions are prerequisites for this course. Knowledge about the basic concepts covered in this prerequisite course will be assumed by the instructor. Biol 342 is a recommended class to be taken prior to this course.

5. Course goals and outcomes:
The student will be able to evaluate problems in modern Virology including areas of virus biology, pathogenesis, and disease control. Successful completion of the course will give a solid understanding of basic concepts in the field of Virology and enable the students to apply these concepts to problems in the field of virology. At the end of the course the student will be able to describe the basic steps in virus replication and disease. The student will be able to predict the outcome of intervention measures both on the cellular as well as the population level. For more detailed description of learning goals and objectives see bottom of Syllabus.

6. Instructional methods:
The course is designed based on the scientific teaching method. This method includes active learning and group activities as well as formative assessments. The students are expected to read assigned material ahead of class so that class time can be spent on discussion of assigned reading, problem solving as well as other active learning activities. Assessment will be used throughout the course to help students judge their learning progress and help identify areas in need of focused attention.

7. Approximate schedule:

<table>
<thead>
<tr>
<th>Historic overview</th>
<th>week 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods in Virology</td>
<td>week 2</td>
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</table>
8 Course policies
You are expected to participate in discussion and other active learning activities. You are also expected to arrive at lecture on time.

9 Requirements
All students will be required to do reading assignments. I encourage students to work on assignments together.

The format of this assignment as well as the topic will be discussed with the instructor during the first three weeks of the semester and are due at the end of the semester

10 Evaluation/Grading
I will use plus minus grades in the class.

100%-97% A+
93%-96% A
89%-92% A-
85%-88% B+
81%-84% B
77%-80% B-
73%-76% C+
69%-72% C
65%-68% C-
61%-64% D+
57%-60% D
53%-56% D-
<53 F

Student performance will be evaluated with the following factors
Weekly quizzes 20% (end of each week)
Midterm oral exam 25% (end of week 7)
Final written exam 40% (as assigned during finals period)
Reading assessments 15% (beginning of each week)

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Total 100%
At the beginning of the week a short quiz will assess the knowledge of reading assignments to be completed prior to class. At the end of each week a short multiple-choice test will assess the knowledge of students about the topic discussed in class that week. The Midterm exam is an oral exam. The final is a written with multiple choice and short assay questions.

**11 Support Services**
If you require more assistance than can be provided in class, and office hours, you may want to contact Student Support Services (http://www.uaf.edu/sssp/).

**12 Disability Services**
If you have a disability, or think you may have a disability, please contact the Office of Disabilities Services (203 WHIT, 474-7043). We will work with this office to provide reasonable and appropriate accommodation to students with disabilities.
Learning Goals and Objectives

Overall Learning Goals:
Understanding of:
- general Virus life cycle
- fundamental differences between virus Groups
  - by genome composition
  - by structure
  - by genome size
  - by pathogenesis strategy
- Host-Virus interactions
- Methods and techniques used in virology

Overall Learning objectives:
Upon completion of the course the student will be able to:
- Describe general virus life cycle.
- Predict replication strategy of viruses based on genome composition
- Apply concepts of virus structure to replication cycle
- Evaluate different control measures of viral diseases
- compare possibilities and limits of methods and techniques used in virology
- Apply cell biological concepts to virological questions

Teachable units:

Historic overview:
Learning Goals:
Put milestones in Virology into context of engineering and general understanding of infectious disease over historical period.
Learning objectives:
List four milestones in virology
Describe development of virology as a science over time.
Connect the understanding of viruses to advances in engineering / technology

Methods in Virology:
Learning Goals:
Understand basic methods and techniques used in virology
Appreciate similarities and differences between diagnostic and research techniques
Learning objectives:
List basic techniques of cultivating viruses
Describe major diagnostic techniques in virology
Contrast the limitations of different methods
Propose a workflow to identify unknown viral agent

Genomes:
Learning goals:
Appreciate differences in genome structure of different viruses
Put virus genomes into evolutionary context
Learning objectives:
Describe basic viral genome structure:
Assemble viruses into taxonomic groups based on the Baltimore system

**Virus Structure:**
Learning Goals:
Understand components of virus particle
Understand concept of symmetry
Appreciate structural differences between enveloped and non-enveloped viruses
Learning objectives:
Describe basic components of virus particle
Explain the importance of symmetry in virus structures
Contrast structural elements of different viruses

**Virus Attachment and entry:**
Learning Goals:
Understand mechanism of viral attachment and entry
Understand differences based on viral structure
Learning objectives:
Describe three general mechanisms of viral entry
Predict the tissue tropism of viruses based on the receptor on the host cell
Contrast different trigger mechanism and their connection to entry mechanism
Evaluate the potential of entry inhibitor antivirals

**Genome replication (RNA viruses):**
Learning Goals:
Understand challenges faced by RNA viruses during their replication in the host cell
Understand fundamental differences between positive and negative strand RNA viruses
Learning objectives:
Name examples of RNA viruses
Explain different replication strategies for positive negative stand and retroviruses
Compare these replication strategies with genome replication strategy of host cells

**Genome replication (DNA viruses):**
Learning Goals:
Understand challenges faced by DNA viruses during their replication in the host cell
Learning objectives:
Name examples of DNA viruses
Describe replication strategies for DNA viruses
Compare these replication strategies with genome replication strategy of host cells
Predict differences between small and large genomes

**Viral Gene Expression:**
Learning Goals:
Understand how viruses subvert host cell gene expression mechanism
Appreciate differences between small and large viruses
Learning objectives:
Describe different mechanism of viral gene expression
Distinguish between acute and chronic viruses
**Virus assembly:**

**Learning Goals:**
- Understand basic steps in virus assembly
- Understand differences between DNA and RNA virus
- Understand differences between enveloped and non enveloped viruses

**Learning objectives:**
- Describe general methods of viral assembly
- Compare differences in assembly based on life cycle strategy

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**Host defenses meet viral biology:**

**Learning Goals:**
- Understand interplay between viral life cycle and host defenses
- Understand differences between acute and chronic viruses
- Understand immune evasion strategies of differences between viruses

**Learning objectives:**
- Describe basic components of the host immune system
- Predict level of immune modulation based on viral replication strategies
- Design potential immune evasion strategy for viruses

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**Patterns of infections:**

**Learning Goals:**
- Understand general course of infection
- Appreciate the differences between acute and chronic infections
- Understand importance of infection patterns on public health

**Learning objectives:**
- Describe basic course of infection
- Predict influence of infection pattern on disease prevention

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**Transformation and Oncogenesis:**

**Learning Goals:**
- Understand basic mechanism of oncogenes and viral transformation
- Appreciate the importance of viruses in cancer

**Learning objectives:**
- Describe mechanism of oncogenesis and viral transformation
- Predict ability of viruses to cause transformation

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**Viral Pathogenesis:**

**Learning Goals:**
- Putting Virus biology into organismal context
- Understand the importance of different cellular factors in disease

**Learning objectives:**
- Apply cellular concepts of virus biology to the organism level
- Distinguish steps in viral pathogenesis

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**Prevention and Control of Viral Diseases:**

**Learning Goals:**
- Understand different control measures available to veterinary and human medicine
- Understand the importance of vaccination for individual as well as public health

**Learning objectives:**
- Describe different control measures including vaccination, quarantine and culling
Evaluate the risks and benefits of vaccination on a personal as well population level

**Virus Evolution and Emergence of New Viruses:**

**Learning Goals:**
Understand factors leading to virus emergence and new viruses
Appreciate the role of viral emergence on human affairs

**Learning objectives:**
Describe reasons for viral emergence
Predict the potential for virus evolution and emergence
The students are expected to read the assigned material *ahead* of class starting with the second week of class. The lecture time will not cover all material in the reading but will rather focus on areas not clear after reading the assigned material as well applications of the material covered in the reading.

### Required reading for each week:

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<tr>
<th>Topic</th>
<th>Edition</th>
<th>pages in Principles of Virology</th>
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</thead>
<tbody>
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<td>Historic overview</td>
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<tr>
<td>Methods in Virology</td>
<td>week 2</td>
<td>27-62</td>
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<td>Viral Genomes</td>
<td>week 3</td>
<td>65-80</td>
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<tr>
<td>Virus Structure</td>
<td>week 4</td>
<td>83-125</td>
</tr>
<tr>
<td>Virus Attachment and entry</td>
<td>week 5</td>
<td>127-180</td>
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<tr>
<td>Genome replication (RNA viruses)</td>
<td>week 6</td>
<td>183-195, 199, 202-214, 217-221</td>
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<td>217-221, 230-235</td>
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<tr>
<td>Genome replication (DNA viruses)</td>
<td>week 7</td>
<td>299-339</td>
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<tr>
<td>Viral Gene Expression</td>
<td>week 8</td>
<td>253-279, 341-354, 362-368, 394-409</td>
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<td>356-362</td>
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<tr>
<td>Virus assembly</td>
<td>week 9</td>
<td>413-423, 451-491</td>
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<td>410-419, 452-498</td>
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<tr>
<td>Host defenses</td>
<td>week 10</td>
<td>531-569</td>
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<tr>
<td>Patterns of infections</td>
<td>week 11</td>
<td>597-621</td>
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<tr>
<td>Transformation and Oncogenesis</td>
<td>week 12</td>
<td>655-699</td>
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<tr>
<td>Prevention and Control of Viral Diseases</td>
<td>week 13</td>
<td>703-757</td>
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<tr>
<td>Virus Evolution and</td>
<td></td>
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<tr>
<td>Emergence of New Viruses</td>
<td>week 14</td>
<td>759-802</td>
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**VOLUME I**

**VOLUME II**