New Undergraduate Course Approval Cover Form
Montana State University

This four-page form collects basic information about the proposed new course, provides information on the approval process, and includes all required approvals. Additional information (see INFO sheet) is also required as part of the New Course Packet.

Proposed New Course Information

Requested Rubric, Course Number, Core Designation (if needed):
Example: PHL 361 RH

Course Title:
Abbreviated Course Title (≤ 30 chars):
First Semester to be Offered:
Submitted by:
Submitter’s Contact Info: Phone, Email:
Instructor:
Department:
College:

New Course Review Process

Instructor completes the New Course Packet, with Core information if a Core designation is requested.

Instructor checks for “equivalent” course in the MUS system and recommends a common or unique course number.

Department Head’s signature indicates that course has been approved by the process used within the Department.

The Chair of the College Curriculum Committee signs to indicate College academic approval.

The College Dean signs to indicate that adequate resources are available to offer the course. Supporting information (Dean’s Statement) is typically required.

The New Course Packet (as PDF) is uploaded to the Provost’s Office server for distribution to other committees.

Course requests are sent to Curriculum and Program Committee (CPC). Core reviews are sent to appropriate Core subcommittee. Committees work in parallel when possible to speed approval process. Special topics courses (291,491) skip the CPC review (limited to two years.)

Provost’s Office reviews the new course request. New courses are submitted to MUS for Common Course Number (CCN) review. Dean and Department informed upon approval.

Approved new course sent to Registrar for inclusion in the Catalog and Schedule of Classes.

APPROVALS

Submitter * 
Date

Department Head * 
Date

Chair, College Curriculum Comm. 
Date

Dean * 
Date

Chair, Core Subcommittee (if app.) 
Date

Chair, CPC 
Date

Assoc. Provost * 
Date

Note: This diagram illustrates the typical flow path, but at any review step there can be a request for additional information or modifications. Careful review in early steps is the best way to speed the overall process. * Special topics courses (x91) require fewer signatures, but cannot be offered more than two times without committee review.
INFORMATION NEEDED FOR COMMON COURSE NUMBERING

The process for identifying a common course number for a new course is as follows:

1. Course learning outcomes are prepared for the new course.
2. The person submitting the new course request looks at the CCN website to see if a course with similar outcomes already exists in the MUS system. 
   
   www.mus.edu/Qtools/CCN/ccn_default.asp

   • If a course exists with at least 80% of the same outcomes, the course is considered “equivalent” to the proposed new course, and the new course should use the existing rubric and course number.
   
   • If no “equivalent” course is found, the person submitting the new course request should identify a unique course number that has not been used by any other course in the MUS system.

3. The requested rubric and course number are submitted as part of the new course packet.
4. The Provost’s Office submits the learning outcomes and the requested rubric and course number to the MUS to have a course number assigned to the course. (This will typically be the requested course number, but it could be changed.)
5. The assigned common course number is reported back to the person submitting the new course request.

<table>
<thead>
<tr>
<th>Requested Rubric, Course Number, Core Designation (if needed):</th>
<th>ANSCI 424 / BIOM 401 (co-listing)</th>
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</thead>
<tbody>
<tr>
<td>Course Title:</td>
<td>HOST-ASSOCIATED MICROBIAL ECOSYSTEMS</td>
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<tr>
<td>Abbrev. Course Title (≤ 30 char):</td>
<td>HOST-ASSOCIATED MICROBIOMES</td>
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<tr>
<td>Credits:</td>
<td>3</td>
</tr>
<tr>
<td>Department Offering Course:</td>
<td>Animal and Range Science / Microbiology</td>
</tr>
<tr>
<td>College:</td>
<td>Agriculture / Letters and Science (co-listing)</td>
</tr>
</tbody>
</table>

Is this course “equivalent” to a course in the MUS System?:

☐ Yes  ☐ No

Learning Outcomes for the Course:

• Introduce students to the importance of the microbial communities (microbiomes) that colonize animals, including humans, with respect to the host’s health, nutrition and development.

• Appreciate the genetic, functional, phenotypic, and antigenic diversity of microbes and the ecology that underscores host-associated microbiomes.

• Gain hands-on experience in current molecular research techniques to study microbial communities.

• Develop skills in critically evaluating literature.
INFORMATION REQUIRED BY THE REGISTRAR

The data needed to enter the new course into the MSU Catalog and Schedule of Classes is collected on this page. Once the new course has been approved, this page is automatically forwarded to the Registrar for data entry.

Assigned Rubric, Course Number, Core Designation (if needed):

Assigned Rubric

Course Title (for Catalog):

Course Title (for Schedule of Classes, 30 characters, max.):

First Semester to be Offered:

Restricted Entry/Consent of Instructor Required:

Instructor’s GID (last 4 digits only):

Department Offering Course:

College:

Is the requested course number available? (x4155 to check):

Yes  No

Frequency of course offering:

☑ Annually  ☐ Alternate Years, starting _______

Semester(s) offered (check all that apply):

☐ Summer  ☑ Fall  ☐ Spring

☐ First 6 weeks  ☐ Second 6 weeks  ☐ 12 weeks

Summer Options (check all that apply):

Credits by mode of instruction:

Lecture: _______

Seminar: _______

Independent Study: _______

Lab/Studio: _______

Recitation/Discussion: _______

TOTAL CREDITS: _______

Primary Mode(s) of Delivery:

☐ Face-to-face  ☐ Web-Enhanced (small on-line comp.)

☐ On-Line Only  ☐ Blended (significant on-line portion)

Time and Location – Call the Registrar’s Office at x4155 to find a time and location for the course.

Assigned Day(s):

☑ M  □ Tu  ☑ W  ☑ Th  □ F  □ Sa  □ Su

Assigned Time(s):

11:00 - 11:50 (M,W) 15:10 - 17:00 (T)

Assigned Building:

Animal Biosciences building

ABB 136 (M,W) ABB 338 (T)

65

Assigned Room:

Capacity (room capacity, or enrollment “cap”):

Co- and Pre-Requisites – Courses numbered 200 and above are normally expected to have prerequisites. When listing multiple prerequisites, please separate courses with “and” if both are required, or “or” if only one is required.

Prerequisite(s):

Co-Requisite(s):

Course Description – Provide a course description of 40 words or less for the MSU Catalog.

This course will introduce students to the microbial ecosystems that colonize human and animal hosts, detailing their essential roles in host nutrition, health and development. Students will also be exposed to modern molecular techniques used to study these systems.

ANSCI 424 / BIOM 401 (co-listing)
HOST-ASSOCIATED MICROBIAL ECOSYSTEMS
HOST-ASSOCIATED MICROBIOMES

Fall, 2013  6631

Animal and Range Science / Microbiology
Agriculture / Letters and Science (co-listing)

BIOB 160 and (CHMY 123 or BCH 380)

N/A

This course will introduce students to the microbial ecosystems that colonize human and animal hosts, detailing their essential roles in host nutrition, health and development. Students will also be exposed to modern molecular techniques used to study these systems.
DEAN’S STATEMENT

The reviewing committees are being asked to take a closer look at the resources required for each proposed new course. In many cases new courses will replace existing courses and the new course request is effectively resource neutral, however that is not always the case. For example, a new elective course that would result in distributing an existing student population across a larger number of courses would represent a significant increase in expenditures for the new course, and no increase in total student credit hours. A funding mechanism for such a course would need to be identified. The Dean’s Statement is the place to document how the costs of the proposed new course will be covered.

The Depts. of Animal and Range Sci. and Microbiology have experienced consistent growth over the past several years and economic forecasts would suggest this growth will continue. Rather than flooding the curriculum with courses we would suggest the current course will help to alleviate several overwhelmed courses. Further, the proposed course is important, topical and yet missing from curricula across the university. We believe the proposed course enhances MSU's content and may further enhance SCH growth.
New Undergraduate Course Narrative
Montana State University
Updated August 23, 2012

Please provide the following information in narrative format. Substantive responses to all criteria are required. Although not required, a draft syllabus can also be helpful to the committee in understanding the details of the proposed course.

General Course Information
1. Requested Rubric, Course Number, and Core Designation (if any)

> ANSCI 424 \ BIOM 401

2. Course Title

> HOST-ASSOCIATED MICROBIAL ECOSYSTEMS

3. Provide a general description of the course explaining the need for the course, its goals, and its overall structure. This is the most important part of the application and should offer a good sense of what students will experience by taking this class.

> MSU students currently lack an undergraduate level course focusing on host-associated microbial ecosystems (microbiomes), despite their critical importance to the health, nutrition and development of the host. Gastrointestinal microbial ecosystems make substantial contributions (up to 70%) to the host’s daily nutrition. These microbiomes also provide essential vitamins, degrade toxic compounds ingested with food and play a fundamental role in the maturation and homeostasis of our immune system. In addition, non-gut animal microbiomes are equally intriguing for their roles in host physiology. For example, urogenital microbiomes are important to reproductive performance and play important roles in neonatal health and development. Current research initiatives, including the human microbiome project (HMP) and the rumen microbial census have drawn substantial funding from major funding bodies and the associated research has led to a new level of understanding as to the roles of microbes in our every day well-being, along with our co-evolutionary association. Consequently the course is topical and expected to be very desirable across the many disciplines that coat this great MSU campus. The laboratory component of this course will also develop a new generation of students with skills desirable to the molecular biology field and with an intricate understanding of the practical application of theory.

4. Based on what types of student work (e.g., tests, homework assignments, papers, performances, etc.) will grades be determined?

> Grading:
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**Quizzes**  Students will be given short 5 min quizzes at the start of each class to assess their critical evaluation and understanding of the assigned literature

**Artistic Interpretation**  To enhance student learning they will each be assigned to groups that will be given one of the topics covered during the course. Each group will be required design an artistic interpretation (i.e. a song, mime etc.) of their assigned topic. We believe this will cause students to think about and discuss their topic in depth and in a fun way. The presentation of each groups AI at the end of the course will further reinforce the taught content.

**Topic Review**  Groups developed above will be assigned a second topic from the course. Each group will be responsible for presenting a 10 min review of the materials learnt in the topic prior to beginning the next topic. We believe this will enhance the educational outcomes by having students involved in their own learning.

**Literature Review**  As part of the lab work, students will be required to write a literature review
relating to the Class project that they will incorporate into their final paper

**Paper** Students will be required to write a manuscript using Cell Host and Microbe formatting, describing the methods, results and conclusions of the class lab project

**Peer Review** Students will be required to peer review the first draft of their classmates manuscripts. This process will be overseen by the course teachers. Peer review is a critical component of scientific research, we believe insight into the process will be beneficial to the students.

5. Provide a course content outline containing all major topics plus a brief description of the material to be covered under each major topic heading.

(For more information see the attached Syllabus)

1. **Obligate endosymbionts**

Some of the most amazing host-microbe symbioses have been described in insect systems. This topic is set first to capture the imaginations of students

2. **The gut & influence of anatomy**

This topic, critical to gut microbiome, will be augmented through a hands-in demonstration of a canulated cow rumen at the BART farm

3. **Who’s there**

The students will be introduced to the microbial diversity that occupies gut systems, introducing taxonomy and touching on the species concept. This will be augmented by a live microscope demonstration of microbial sample collected from the rumen earlier in the week

   a. **The viriome**

Bacteriophage and viruses play critical roles in maintaining balance within microbial ecosystems and this lecture will cover the local and national research that has shown this

4. **Microbial ecology**

This topic will cover current ecological theory, introduce key terminology and provide elaborated examples

5. **Diet & enterotypes**

These lectures (5 a-e) will cover the role of diet in affecting the microbiome and the interactions among diet, microbiome and host health. It will also cover the emerging work that is showing the gut microbiomes of humans can be classified into groups known as enterotypes that appear programmed by long-term dietary patterns
Probiotics (and prebiotics) have grown dramatically in popularity over the past century since they were first proposed by Metchnikoff. Today they are used in humans and livestock to support or improve health. There is some debate as to their actual efficacy and this will be examined in this topic.

6. The Gut-Brain axis

One of the most amazing emerging bodies of work is providing evidence that the gut microbiome can and does influence brain development and behavior. There is also some evidence to suggest the gut microbiome may be able to influence our dietary preferences.

7. Host genetic influences on the microbiome

This topic will examine the literature that is showing the influence of host genetic variation on the microbiome.

8. The urogenital tract microbiome and host health

Perhaps the second most well studied of host-associated microbiomes

   a. Niche-construction

   An important ecological feature that is seen in the human vaginal microbiome whereby *Lactobacillus spp.* exclude pathogenic microbes by altering the vaginal environment and making it inhospitable to most microbial life.

   b. Vaginal microbiome and reproduction

   Dysbiosis in the vaginal microbiome has been linked to reproductive failure, we will examine the literature surrounding this.

   c. Neonatal colonization and development

   Vaginal microbes are the primary colonists for conventionally born neonates. We will therefore follow on from our introduction to the reproductive microbiome and examine neonate colonization and development. Including the role of breast milk oligosaccharides.

9. Aging

   Physiological changes in aging populations has been shown to affect both gut and vaginal microbiomes, we will examine the links that have been shown.

10. The microbiome and immune-system maturation

    Several bodies of work have shown the development and maturation of the host immune system is critically
dependent on the gut microbiome

11. Environment and the hygiene hypothesis

In 1989 it was proposed that our increasing hygiene behaviors were causing the steady increases being observed in many diseases. We will examine this topic exploring evidence for and against this hypothesis.

12. Dysbiosis and disease

While our microbiomes are critical to health and development, some microbes are capable of causing diseases. Some evidence has shown dysbiosis of the microbiome may be enhance the ability of pathogenic microbes to cause disease, or conversely a healthy microbiome can preclude or eliminate disease.

13. Antibiotics

Antibiotics were a revelation in the 20th century following their discovery by Flemming in 1928 and have saved countless lives. Today the term antibiotic is often frowned upon, particularly in the livestock industry, due to the proliferation of antibiotic resistant pathogens. We will examine their role in medicine, in agriculture and their effect on the gut system.

6. List required texts or other required references.

> Our knowledge of host-associated microbiomes is rapidly evolving due to significant and widespread interest. Therefore textbooks are inadequately dated. Reading material will be assigned from journal articles and will be provided through desire2learn (D2L). Students will be expected to read the assigned materials beforehand and come to class ready to discuss the methods, results, and conclusions of these manuscripts.

7. What are the estimated enrollment and student credit hour (SCH) production?
   
   \[ \text{SCH} = (\text{enrollment} \times \text{credits}) \]

> Initially the estimated enrollment will be 40 students (25 AnSci and 15 micro), however the course will be moved to the front page of the course catalogs for Animal Science, Equine Science and Livestock Management and Industry in the next update making it a required elective. At this point the estimated enrollment will grow to an estimated 85 students (1/4 of total 220 enrollment for these courses + a doubling from Micro). The initial smaller class size will enable us to vet and refine the course.

Therefore the estimated SCH will be 120 initially and grow to 255 in 2016 (The time taken to list the course as required for the Animal Science, Equine Science and Livestock Management and Industry options and for those students to reach junior/senior level when prerequisites will allow them to take the course.

8. Will there be an enrollment cap that restricts enrollment below the level of student demand? If so, what is the enrollment cap and why is it necessary?
> Enrollment will be capped at classroom capacity, which initially will be 65 (ABB136). Given the anticipated growth, a new classroom venue will be sort in 2016.

9. Will course be a “restricted enrollment” course? If so, why is restricted enrollment necessary?

> No

10. Describe how the success of the course will be evaluated? (“End-of-semester student evaluations” is not the answer to this question. How will the instructor determine if the learning outcomes are being met, and how will the department determine if the course is fulfilling its intended purpose?)

> Learning outcomes will be evaluated weekly through in-class quizzes used to evaluate students critical understanding of each topic and the associated literature. Mid-year peer teaching evaluations will be conducted to determine adequacy of teaching methods.

11. Is the instructor a member of the regular faculty (i.e., tenured or tenure-track)? If no, please describe the instructor’s qualifications, attach a Vita, and provide a separate letter of support, signed by the department head (or appropriate unit director), addressing the instructor’s qualifications to teach this course.

> Yes both Yeoman and Walk are tenure-track faculty in Animal and Range Sciences and microbiology, respectively.

Level of Offering
12. Has the course been offered previously under 280/291 or 480/491? If so, when? Under what number? What was the enrollment? What level of students took the course?

> No

13. Justify the level of course offering.

> The course is targeted toward junior/senior level undergraduate students and graduate students. One of the primary objectives of this course is to encourage students into graduate level studies that consider the importance of host-associated microbiomes to their host’s physiology. A 400-level listing targets students approaching this transition, while additionally availing the course to graduate students who we believe will find the content useful to their own research. The hands-on practical experience in current molecular research techniques used to study microbial communities also makes the course more appropriate for 400-level students.

14. Does this course build on or interrelate with other courses in your curriculum or related curricula? If so, which ones?

> The proposed course will build on BIOB160 “Principals of living systems” and contextualize basic biochemistry. It will also augment ANSC320 Animal Nutrition and ANSC260 Functional anatomy. The course will provide an important link between basic understanding of host physiology and advanced topics, such as ANR521 “Advanced ruminant nutrition”.

15. Do the topics in the proposed course duplicate or reiterate those in other courses in this or any other department? If so, how do the coverage and educational experience differ and how is this duplication or reiteration justified? Also, what liaison (which is expected in cases of apparent overlap) has been conducted with other departments? Report reactions, both favorable and unfavorable.

> To the best of our knowledge the proposed course does not significantly duplicate any course currently available at MSU.

16. What programs (departments, colleges) will be impacted by the SCH production of this course? That is, where do you think the SCH in the proposed course are likely to come from? If the expected SCH production of the proposed course is greater than 1000, and the SCH are expected to come from other colleges, what steps have been taken to make the other units aware of the potential loss of SCH? Report reactions, both favorable and unfavorable.

> The proposed course will be co-listed through Animal and Range Sciences and Microbiology. It is expected that initially the majority of SCH will come from these two departments. However, the topic is of broad interest and applicability and is expected to draw SCH from BIOB, BIOE, BIOH, BIOM, BCH, CHBE, CTH, EBI, EQUS, F&WL, HDF, HDHL, HHD, HTH, IMID, MBSP, MEDS, NUTR, VTMB, and WILD.

17. If this proposed course has a significant interdisciplinary component, please explain briefly. Otherwise, indicate n/a.

> Host-associated microbial ecosystems are essential to the nutrition, health and development of all animal species (including humans). Therefore the content of this topic is applicable to all disciplines that study humans, domestic livestock, and wildlife. They are a comparatively well-elaborated ecosystem that makes them of interest to ecologically-focused disciplines. They interact with the host and each other through a complex process of biochemistry and host immunity making the course of interest to these disciplines.

Students Served

18. Does the proposed course serve majors only? Non-majors only? Both majors and non-majors? What other majors might be interested in this course? State areas or disciplines to be served and indicate the specific efforts that will be made to make the course material relevant to all disciplines served.

> The course will serve majors in the Science, Livestock management and Equine options of Animal and Range Science where it will be listed as a compulsory elective from 2014. The course is likely also to be of interest to BIOB, BIOE, BIOH, BIOM, F&WL, HDF, HDHL, HHD, HTH, IMID, MBSP, MEDS, NUTR, VTMB, and WILD majors. The course has been adapted to cover diverse host animals making it broadly applicable. The content will be refined to increase focus on the host species of interest to members of the class.

Resources

19. What additional resources (e.g., additional instructional FTE, required technologies), if any, will be required to offer this course? Are there any resource issues for the students who will take the course (e.g., required technologies, travel, on-line access requirements)? Will there be an additional fee charged to students taking this course? Please explain.
The practical component of this course will introduce students to cutting-edge molecular techniques. The labs of Yeoman and Walk are equipped with these technologies but a small additional fee will be charged to cover reagents associated with this work.

20. What existing information resources – print (books, journals, documents), audiovisual (videos, DVDs, CDs or other), and/or electronic (e-books, databases, electronic journals and web sites) – provided by the MSU Libraries will be used by students in this course? Provide examples as well as descriptive information. If additional information resources are necessary, please discuss those acquisitions with the library (x6549 Collection Development) at least three months prior to the beginning of the semester in which this course will be taught.

> Literature required for the course will be made available and distributed in PDF form through D2L. As part of the practical component students will be required to source and review literature from journals such as “Cell Host and Microbe”, “ISME Journal”, “Nature” and “Science” all available through the electronic journal subscriptions of the library.

Other Supporting Material

21. Include any additional information you feel is needed to support this request.

> Proposed course syllabus is attached
ANSCI 424 / BIOM 401 ANIMAL-ASSOCIATED MICROBIAL ECOSYSTEMS (MICROBIOMES)
FALL 2013

Class: 11:00 to 11:50am, Monday and Wednesday, ABB 136
Lab Thursday 3:10 to 5:00, ABB 338 (To be confirmed)

Teachers:
Carl J. Yeoman 321 ABB 994-7440 carl.yeoman@montana.edu
Seth T. Walk 219 Cooley TBD seth.walk@montana.edu

Goals:
• Introduce students to the importance of the microbial communities (microbiomes) that colonize animals, including humans, with respect to the host’s health, nutrition and development.
• Appreciate the genetic, functional, phenotypic, and antigenic diversity of microbes and the ecology that underscores host-associated microbiomes
• Gain hands-on experience in current molecular research techniques to study microbial communities.
• Develop skills in critically evaluating literature.

Motivation: MSU students currently lack an undergraduate level course focusing on host-associated microbial ecosystems (microbiomes), despite their critical importance to the health, nutrition and development of the host. Gastrointestinal microbial ecosystems make substantial contributions (up to 70%) to the host’s daily nutrition. These microbiomes also provide essential vitamins, degrade toxic compounds ingested with food and play a fundamental role in the maturation and homeostasis of our immune system. In addition, non-gut animal microbiomes are equally intriguing for their roles in host physiology. For example, urogenital microbiomes are important to reproductive performance and play important roles in neonatal health and development. Current research initiatives, including the human microbiome project (HMP) and the rumen microbial census have drawn substantial funding from major funding bodies and the associated research has led to a new level of understanding as to the roles of microbes in our every day well-being, along with our co-evolutionary association. Consequently the course is topical and expected to be very desirable across the many disciplines that coat this great MSU campus. The laboratory component of this course will also develop a new generation of students with skills desirable to the molecular biology field and with an intricate understanding of the practical application of theory.

Qualification of Teachers: Carl J. Yeoman is actively researching host-associated microbiomes. He has published several peer-reviewed manuscripts on gut and vaginal microbiomes of disparate host species, including humans, primates, mice and domestic livestock. He has been a participatory member of the human microbiome project (HMP) and the rumen microbial census have drawn substantial funding from major funding bodies and the associated research has led to a new level of understanding as to the roles of microbes in our every day well-being, along with our co-evolutionary association. Consequently the course is topical and expected to be very desirable across the many disciplines that coat this great MSU campus. The laboratory component of this course will also develop a new generation of students with skills desirable to the molecular biology field and with an intricate understanding of the practical application of theory.
derive from that objective. That specific paper was rated by the Faculty of 1000 as being in the top 2% of biomedical literature (http://f1000.com/prime/10923958).

Seth T. Walk is a microbiologist with interests in both basic and clinical research. Part of his research is focused on the ecology of the gastrointestinal tract and how the host immune system is regulated by bacterial and viral members of the microbiota. He has taken part in numerous studies related to microbiome-relevant diseases/disorders, including inflammatory bowel disease, *Clostridium difficile* infection, and human norovirus infection. He received postdoctoral training in an HMP-funded laboratory and collaborates with other investigators that develop and implement HMP-supported analytical tools and protocols.

**Proposed Readings:** Our knowledge of host-associated microbiomes is rapidly evolving due to significant and widespread interest. Therefore textbooks are inadequately dated. Reading material will be assigned from journal articles and will be provided through desire2learn (D2L). Students will be expected to read the assigned materials beforehand and come to class ready to discuss the methods, results, and conclusions of these manuscripts.

**Other materials:** In addition to reading materials, lecture notes, assignments, and questions will be provided online at D2L.

**Lectures:** Lecture sessions will be 50 minutes, twice a week and comprise a mixture of traditional lecture and discussion with hands-on concept reinforcement. The objective is to promote education in a fun and enjoyable way. Through lecture, discussion and visualized hands-on demonstration we hope to engage students of all learning styles. Questions will be encouraged and fostered through a friendly and inviting environment.

**Lab:** Labs will be 3 hours and will be designed to enhance concepts learnt in the classroom and provide students with the opportunities to perform molecular methods for microbiome characterization on cutting edge technologies available in the labs of professors Walk and Yeoman. A class project will take students from sample collection to data analysis and interpretation and will compare traditional and current-generation techniques. All lab topics will begin with a lecture describing the intricacies and theory surrounding the techniques to be covered. Each lab will conclude with an overview of what has been performed during that session and how it ties in to what we have learned from the lecture material. During this time students will be given a chance to discuss any challenges or points of confusion from the current lab class. Collectively this will reinforce material and ensure a critical understanding of the topic.
Grading:

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Other: The proposed course will be taught outside of major class hours meeting the provosts directive in this area.
## Proposed Lecture Schedule

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<th>Inst.</th>
<th>Date</th>
<th>Day</th>
<th>Topic</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJY + STW</td>
<td>Aug 27</td>
<td>Mon</td>
<td>Course Introduction</td>
<td>We will introduce the course, grading and the expectations</td>
</tr>
<tr>
<td>CJY</td>
<td>Aug 29</td>
<td>Wed</td>
<td>Obligate endosymbionts</td>
<td>Some of the most amazing host:mirobe symbioses have been described in insect systems. This topic is set first to capture the imaginations of students</td>
</tr>
<tr>
<td>CJY</td>
<td>Sept 3</td>
<td>Mon</td>
<td>The gut &amp; influence of anatomy</td>
<td>This topic, critical to gut microbiome, will be augmented through a hands-in demonstration of a canulated cow rumen at the BART farm</td>
</tr>
<tr>
<td>STW</td>
<td>Sept 5</td>
<td>Wed</td>
<td>Who’s there</td>
<td>The students will be introduced to the microbial diversity that occupies gut systems, introducing taxonomy and touching on the species concept. This will be augmented by a live microscope demonstration of microbial sample collected from the rumen earlier in the week.</td>
</tr>
<tr>
<td>STW</td>
<td>Sept 10</td>
<td>Mon</td>
<td>The virome</td>
<td>Bacteriophage and viruses play critical roles in maintaining balance within microbial ecosystems and this lecture will cover the local and national research that has shown this</td>
</tr>
<tr>
<td>STW</td>
<td>Sept 12</td>
<td>Wed</td>
<td>Microbial ecology</td>
<td>This topic will cover current ecological theory, introduce key terminology and provide elaborated examples</td>
</tr>
<tr>
<td>STW</td>
<td>Sept 17</td>
<td>Mon</td>
<td>Microbial ecology II</td>
<td></td>
</tr>
<tr>
<td>STW</td>
<td>Sept 19</td>
<td>Wed</td>
<td>Diet &amp; enterotypes</td>
<td>These lectures will cover the role of diet in affecting the microbiome and the interactions among diet, microbiome and host health. It will also cover the emerging work that is showing the gut microbiomes of humans can be classified into groups known as enterotypes that appear programmed by long-term dietary patterns</td>
</tr>
<tr>
<td>CJY</td>
<td>Sept 24</td>
<td>Mon</td>
<td>Butyrate &amp; gut development</td>
<td></td>
</tr>
<tr>
<td>CJY</td>
<td>Sept 26</td>
<td>Wed</td>
<td>Obesity &amp; the microbiome</td>
<td></td>
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<tr>
<td>CJY</td>
<td>Oct 1</td>
<td>Mon</td>
<td>Microbial nutritional interdependencies</td>
<td></td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 3</td>
<td>Wed</td>
<td>Gut microbes &amp; vitamins</td>
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<tr>
<td>CJY</td>
<td>Oct 8</td>
<td>Mon</td>
<td>Probiotics &amp; prebiotics</td>
<td>Probiotics (and prebiotics) have grown dramatically in popularity over the past century since they were first proposed by Metchnikoff. Today they are used in humans and livestock to support or improve health. There is some debate as to their actual efficacy and this will be examined in this topic.</td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 10</td>
<td>Wed</td>
<td>The Gut-Brain axis</td>
<td>One of the most amazing emerging bodies of work is providing evidence that the gut microbiome can and does influence brain development and behavior. There is also some evidence to suggest the gut microbiome may be able to influence our dietary preferences.</td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 15</td>
<td>Mon</td>
<td>Host genetic influences on the microbiome</td>
<td>This topic will examine the literature that is showing the influence of host genetic variation on the microbiome</td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 17</td>
<td>Wed</td>
<td>Host genetic influences on the microbiome II</td>
<td></td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 22</td>
<td>Mon</td>
<td>EXAM</td>
<td>Perhaps the second most well studied of host-associated microbiomes</td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 24</td>
<td>Wed</td>
<td>The urogenital tract microbiome and host health</td>
<td>An important ecological feature that is seen in the human vaginal microbiome whereby Lactobacillus spp. exclude pathogenic microbes by altering the vaginal environment and making it inhospitable to most microbial life</td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 29</td>
<td>Mon</td>
<td>Niche-construction</td>
<td></td>
</tr>
<tr>
<td>CJY</td>
<td>Oct 31</td>
<td>Wed</td>
<td>Vaginal microbiome and</td>
<td>Dysbiosis in the vaginal microbiome has been linked to</td>
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<tr>
<td>CYP</td>
<td>Nov 5</td>
<td>Mon</td>
<td>Neonatal colonization and development</td>
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<td></td>
<td>Vaginal microbes are the primary colonists for conventionally born neonates. We will therefore follow on from our introduction to the reproductive microbiome and examine neonate colonization and development. Including the role of breast milk oligosaccharides</td>
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<tr>
<td>STW</td>
<td>Nov 7</td>
<td>Wed</td>
<td>Aging</td>
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<td>Physiological changes in aging populations have been shown to affect both gut and vaginal microbiomes, we will examine the links that have been shown.</td>
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<tr>
<td>STW</td>
<td>Nov 12</td>
<td>Mon</td>
<td>The microbiome and immune-system maturation</td>
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<td>Several bodies of work have shown the development and maturation of the host immune system is critically dependent on the gut microbiome</td>
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<tr>
<td>STW</td>
<td>Nov 14</td>
<td>Wed</td>
<td>Environment and the hygiene hypothesis</td>
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<td>In 1989 it was proposed that our increasing hygiene behaviors were causing the steady increases being observed in many diseases. We will examine this topic exploring evidence for and against this hypothesis</td>
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<tr>
<td>STW</td>
<td>Nov 19</td>
<td>Mon</td>
<td>Dysbiosis and disease</td>
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<td>While our microbiomes are critical to health and development, some microbes are capable of causing diseases. Some evidence has shown dysbiosis of the microbiome may enhance the ability of pathogenic microbes to cause disease, or conversely a healthy microbiome can preclude or eliminate disease.</td>
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<tr>
<td>STW</td>
<td>Nov 21</td>
<td>Wed</td>
<td>Dysbiosis and disease II</td>
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<td>Antibiotics were a revelation in the 20th century following their discovery by Flemming in 1928 and have saved countless lives. Today the term antibiotic is often frowned upon, particularly in the livestock industry, due to the proliferation of antibiotic resistant pathogens. We will examine their role in medicine, in agriculture and their effect on the gut system</td>
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<tr>
<td>CYP</td>
<td>Nov 26</td>
<td>Mon</td>
<td>Antibiotics</td>
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<td></td>
<td></td>
<td>Artistic interpretation exams</td>
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<tr>
<td>CYP</td>
<td>Nov 28</td>
<td>Wed</td>
<td>Antibiotics II</td>
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<td></td>
<td></td>
<td>Artistic interpretation exams</td>
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<td>TBD</td>
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<td>EXAM</td>
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<tr>
<td>Date</td>
<td>Inst.</td>
<td>Lab</td>
<td>Notes</td>
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<tr>
<td>Aug 31</td>
<td>CJY</td>
<td><em>Generating Data I – Project design and molecular biology techniques</em></td>
<td>Students will be introduced to the considerations in designing an experiment and the molecular techniques we will use. Samples will also be collected for the class project.</td>
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<td></td>
<td></td>
<td>Class project – Sampling</td>
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<tr>
<td>Sept 7</td>
<td>CJY</td>
<td><em>Generating Data II – DNA/RNA extraction and purification, and PCR</em></td>
<td>This class will introduce students to the principals behind DNA/RNA extraction and PCR and give them experience in pipetting and handling of biological and reagents.</td>
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<td></td>
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<td>Class project – DNA extraction / purification</td>
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<tr>
<td>Sept 14</td>
<td>CJY</td>
<td>Class project – DNA extraction / purification</td>
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<tr>
<td>Sept 21</td>
<td>CJY</td>
<td>Class project - PCR</td>
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<tr>
<td>Sept 28</td>
<td>STW/CJY</td>
<td><em>Generating Data III – culturing and sequencing</em></td>
<td>The class will learn important aseptic techniques important for both molecular and culture based microbiome work. We will also set up and begin the sequencing run (this will run over the proceeding 24 h).</td>
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<td></td>
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<td>Class project - Sequencing</td>
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<tr>
<td>Oct 5</td>
<td>STW</td>
<td>Class project - Culturing</td>
<td>The class will prepare cultures of samples</td>
<td></td>
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<tr>
<td>Oct 12</td>
<td>STW</td>
<td>Class project – Culturing II</td>
<td></td>
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<tr>
<td>Oct 19</td>
<td>CJY</td>
<td><em>Data Analysis I – estimating diversity</em></td>
<td>The class will explore the techniques we will use to examine the microbiomes.</td>
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<tr>
<td>Oct 26</td>
<td>CJY</td>
<td><em>Data Analysis II – clustering and ordination</em></td>
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<tr>
<td>Nov 2</td>
<td>CJY</td>
<td>Class project - Data Analysis</td>
<td>The class will begin analyzing the data and, if time permits, explore a small shotgun metagenome to compare the different approaches.</td>
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<tr>
<td>Nov 9</td>
<td>STW</td>
<td>Class project – Data analysis II</td>
<td></td>
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<tr>
<td>Nov 16</td>
<td>CJY</td>
<td>Example – analysis of shotgun metagenome 16S dataset</td>
<td>Students will be provided time to interact with the teachers in the development of the manuscripts from the class project.</td>
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<tr>
<td>Nov 23</td>
<td>STW</td>
<td>Class project - Drafting the manuscript</td>
<td></td>
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<tr>
<td>Nov 30</td>
<td>CJY</td>
<td>Class project - Drafting the manuscript II</td>
<td></td>
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<tr>
<td>Dec 7</td>
<td>CJY/STW</td>
<td><em>Review</em></td>
<td>An overview will be provided of the lab component</td>
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