# Washington State University

## MAJOR CURRICULAR CHANGE FORM - - NEW/RESTORE COURSE

- Please attach rationale for your request, a complete syllabus, and explain how this impacts other units in Pullman and other campuses (if applicable).
- Obtain all required signatures with dates.
- Provide original stapled packet of signed form/rationale statement/syllabus PLUS 10 stapled copies of complete packet to the Registrar's Office, campus mail code 1035.
- Submit one electronic copy of complete packet to wsu.curriculum@wsu.edu.

### Requested Future Effective Date:

<table>
<thead>
<tr>
<th>Term/Year</th>
<th>Course Typically Offered:</th>
<th>Fall</th>
</tr>
</thead>
</table>

**DEADLINES:** For fall term effective date: October 1st; for spring or summer term effective date: February 1st. See instructions.

**NOTE:** Items received after deadlines may be put to the back of the line or forwarded to the following year. Please submit on time.

### New Course

**Topics in Biomedical Experimentation**

- **Course Subject/Crosslist:** NEUROSCI, GLANHLTH, MBIOS, VET_MCR, VET_PATH, VET_PH
- **Course No.:** 564
- **Credit Hrs:** 1
- **Lecture Hrs:** 1
- **Lab or Studio Hrs:** 0
- **Prerequisite:**

The course examines the philosophy of experimental design and practical application and analysis of various experimental approaches in biomedical research.

### Additional Attributes: Check all that apply.

- ✔ Crosslisting (between WSU departments)*
- □ Conjoint listing (400/500):
- □ Variable credit:
- □ Repeat credit (cum. max. hrs.):

Special Grading:

- □ S, F; □ A, S, F (PEACT only);
- □ S, M, F (VET MED only);
- □ H, S, F (PHARMACY, PHARDSCI only)

- □ Cooperative with UI
- □ Other (please list request):

### The following items require prior submission to other committees/depts. (SEE INSTRUCTIONS.)

- □ Request to meet Writing in the Major [M] requirement (Must have All-University Writing Committee Approval.)
- □ Request to meet UCORE in _____________ (Must have UCORE Committee Approval)  See instructions.
- □ Special Course Fee _____________ (Must submit request to University Receivables.)

---

### Contact:

**Kay Brothers**

**Phone number:** (509) 335-9376  **Campus mail code:** 7520

**Email:** brathers@vetmed.wsu.edu  **Instructor, if different:** Steve Simasko simasko@vetmed.wsu.edu

---

**Chair/date**

**Dean/date**

**All-University Writing Com / date**

**Chair (if crosslisted/interdisciplinary)**

**Dean (if crosslisted/interdisciplinary)**

**UCORE Committee Approval Date**

---

**Catalog Subcommittee Approval Date**

**GSC or AAC Approval Date**

**Faculty Senate Approval Date**

*If the proposed change impacts or involves collaboration with other units, use the additional signature lines provided for each impacted unit and college.
I wish to express my support for the submission of NEUROSCI; GLANHLTH;MBIOS; VET_MCR/V MIC; VET_PATH/V PA; VET_PH/V PH 564: Topics in Biomedical Experimentation. Sincerely, Douglas Call

Douglas R. Call, Professor
Interim Director, Paul G. Allen School for Global Animal Health
Fellow, American Association for the Advancement of Science
Adjunct Professor, The Nelson Mandela African Institution of Science and Technology, Arusha, Tanzania
240 SE Ott Road, Room 331, Washington State University, Pullman, WA 99164-7090
+1 509-335-6313, drcall@wsu.edu
New Course Proposal: *Topics in Biomedical Experimentation*

**Proposed Course:** Cross listed: NEUROSCI 564; GLANHLTH 564; MBIOS 564; VET_MICR 564; VET_PATH 564; VET_PH 564

**Title:** Topics in Biomedical Experimentation

**Course Description for Catalog:** This course examines the philosophy of experimental design and the application and analysis of various experimental approaches used in biomedical research.

**Enrollment Pre-Requisites:** Graduate student status within a biomedical based program at WSU. An advance undergraduate or graduate statistics course. Students should check with the iPBS Academic Coordinator to obtain a list of planned topics each year.

**Rationale:** We are proposing this new course, *Topics in Biomedical Experimentation*, to better meet the needs of the PhD-granting programs in the College of Veterinary Medicine. As a college, we are striving to transition our PhD programs from course-intensive to training-intensive with more emphasis on how to do science, including how to think about a scientific research program and how to learn what is needed when needed (i.e., to become independent learners). *Topics in Biomedical Experimentation* is based on the premise that because the effective design and analysis of experiments is critical to professional success, PhD candidates will benefit from formal instruction in the effective design and analysis of experiments in biosciences. The modular design of the course is intended to provide both flexibility and focus. Students can select those experimental approaches appropriate to their projects and goals (which often cross specific programmatic boundaries), and the modular design enables faculty to quickly develop new modules as new techniques and approaches are developed in biomedical experimentation. The course has both philosophical and practical (applied) goals. All program directors in the College have agreed to this plan.

**Course Structure:** This course consists of independent modules (or sections), each 5 weeks in duration. Within each module the class will meet the equivalent of 3 classroom hours per week, thus each module is equivalent to 15 hours of instruction and is valued at 1 semester hour of credit. Modules are independent of one another - they do not assume students have taken prior modules, and they are independently graded. Depending on demand for particular topics, at times more than one module may be offered within a 5-week block. The course can be repeated for credit (up to 6 total) if each module taken has a unique topic. Participating programs will keep track of student progress to make sure identical topics are not repeated. The participating programs will also keep a list of current and planned future module topics so that students in the programs can anticipate when they will be able to take a topic they desire. At registration, particular modules will be designated Section 1, Section 2, Section 3, etc., and students register for the appropriate section number. Program Advisors will make sure that a student does not register for modules that have time conflicts.

In the first block (weeks 1-5) the only module offered will be *Philosophy of Experimental Design* (always Section 1). This module is required of all graduate students in programs participating in the iPBS umbrella (Molecular Biosciences, Neuroscience, and Immunology and Infectious Disease). Subsequent modules offered in the second block (weeks 6-10) and third block (weeks 11-15) are focused on specific experimental and analytical approaches. These are elective and students may choose to enroll in those they deem useful to their research plans. Multiple elective modules are (and will continue to be) developed, and depending on the demand, may be offered annually or every other year.

**Module I: Philosophy of Experimental Design.** This module is based on the text book *Experimental Design and Analysis for Biologists* by David J. Glass. It covers the central philosophical goal of the course and provides necessary structure to help students understand basic experimental design, such as 1) experimental framework, 2) components of the experimental system, 3) experimental design including use of correct sets of controls, and 4) the experimental model used to represent the data.
Module II and beyond: These modules are electives for the students. In these modules the focus moves from a philosophical stance of experimental design to exploring particular experimental approaches including strengths and weaknesses of techniques and proper analysis of data structures. Students select the elective modules that are applicable to their field and research questions. The elective modules will be offered on a rotating basis, such that the modules of interest to the most students may be offered every year and the modules with fewer or more specific interest offered every other year. Currently we have two elective modules completed (see attached syllabi):

1) Analysis of Biomedical Experiments. This modules introduces students to elements in the design of biomedical experiments that optimize outcomes and avoid common errors. A significant focus is placed on the application of statistical tests to actual experimental designs with an emphasis on practical design and limits to interpretation. The course assumes students have had a statistics course in the past through analysis of variance.

2) Imaging and Image Analysis. This module introduces theory and application of light and fluorescent microscopy. The module primarily focuses on different types of confocal microscopy and the advantages and limitations of each approach. Techniques for analysis and quantification of results from images are emphasized. Includes hands-on training on confocal microscopes.

Two planned future modules are:

1) ‘Omics’. Genomics and proteomics have become central to many biomedical applications. The course covers technical approaches but the emphasis is on analysis of data structures and limitations to the interpretation.

2) Transgenic Experimental Design and Analysis. Focus is on techniques to generate and maintain transgenic cells, cell lines, and experimental organisms.

Learning Outcomes: Because each module has a unique goal and focus, at this level of rationale learning outcomes can only be addressed in a general manner. Further, each module will have a unique blend of theoretical, practical, and project based activities such that the assessment process within the modules are unique to that module.

General learning outcomes - Students will understand:

1) the technical basis for an experimental or analytical approach and be able to apply the approach to new applications of their own design or requested by the instructors.

2) the weaknesses and limitations of different experimental or analytical approaches and apply their insight into these limitations to both their own work and the work of others.

In general there will be three types of assessment activities within each module, but with different emphases for each module. These include:

1) Class participation – student contribution to class discussions and presentations. This activity will enable the instructor to assess whether the student can explain a theoretical or experimental point and the ability of the student to then apply that knowledge to the topic of discussion.

2) Homework assignments – students may be asked to do a quantitative analysis, design an experiment, or write responses to study questions. These will be used to keep the students on track with the pace of the course and to assess their understanding at intermediate points in the course. This information can then be used by the instructor to re-emphasize essential concepts that have not been grasped by the students. Assignments are unique to each module.

3) Final exam/project – Some modules may expect students to develop a project of their interest which will be graded. For those modules in which a project is not central to the course, a final exam will be used to assess student learning. These projects/exams will typically ask the student to apply knowledge of process to a new situation, and then discuss the expected outcomes and limitations.
General syllabus for Topics in Biomedical Experimentation

**Course:** Topics in Biomedical Experimentation

**Course Number (cross listed):** NEUROSCI 564; GLANHLTH 564; MBIOS 564; VET_MICR 564; VET_PATH 564; VET_PH 564

**Instructor:** Steve Simasko (primary); VBR 205F; Phone: 5-6624; Email: simasko@vetmed.wsu.edu

**Office Hours:** TBD  

**Course limit:** 30 students

**Prerequisites:** Graduate student status within a biomedical based program at WSU. An advance undergraduate or graduate statistics course. Students should check with the iPBS Academic Coordinator to obtain a list of planned topics each year.

**Meeting Schedule:** Taught in Fall semester. Arranged when needed; but generally targeted to Tuesday/Thursday, 9:10 -10:25 AM in VBR 201.

**Credits:** Each section is 1 semester credit hour and meets over 5 weeks for 15 hours of instruction. Students register for independent section numbers that indicate which modules they plan to take. Students should verify with advisors/instructors that particular sections do not have a time conflict.

**Course Description:** This course examines the philosophy of experimental design and practical application and analysis of various experimental approaches in biomedical research.

**Course Structure:** Each section (module) is independent of other sections and is taught within a 5 week block and ends with a completed set of graded activities. There are three consecutive blocks per semester. The first 5 week block is always *Philosophy of Experimental Design* and is required of students from programs participating in the iPBS umbrella. Students may enroll in additional elective modules that are offered during the second and/or the third blocks. Students may enroll in multiple sections of the course within one term and may repeat the course if new module(s) have not previously been taken. Students are encouraged to visit the iPBS website for a list of current and planned modules.

**Course Activities:** Each module will have a unique set of activities depending on the specific nature of the module, but generally they will consist of readings from review articles or textbooks that cover basic information, lectures that cover theoretical concepts, discussions of papers from the literature to examine application of concepts or critique of concepts or applications, hands-on activities in which experimental approaches are used by the students, and homework and take home tests that assess the ability of the student to apply course materials to new situations. For every hour of in-class instruction, or equivalent online instruction, students should expect at least 2 hours of outside class course preparation in the form of reading, course assignments, and review of previous lectures. See the syllabi for specific modules for details.

**Student Learning Outcomes and Assessment:** Because each module has a unique goal and focus, at this level of rationale learning outcomes at this point are addressed in a general manner. Further, each module will have a unique blend of theoretical, practical, and project based activities such that the assessment process within the modules are unique to that module. See specific syllabi for more details of activities within the module.

General learning outcomes – Students will understand:

1) the technical basis for an experimental or analytical approach and be able to apply the approach to new applications of their own design or requested by the instructors.

2) the weaknesses and limitations of different experimental or analytical approaches and apply their insight into these limitations to both their own work and the work of others.
In general there will be three types of assessment activities within each module, but with different emphases for each module. These include:

1) Class participation – student contribution to class discussions and presentations. This activity will enable the instructor to assess whether the student can explain a theoretical or experimental point and the ability of the student to then apply that knowledge to the topic of discussion.

2) Homework assignments – students may be asked to do a quantitative analysis, design an experiment, or write responses to study questions. These will be used to keep the students on track with the pace of the course and to assess their understanding at intermediate points in the course. This information can then be used by the instructor to re-emphasize essential concepts that have not been grasped by the students. Assignments are unique to each module.

3) Final exam/project – Some modules may expect students to develop a project of their interest which will be graded. For those modules in which a project is not central to the course, a final exam will be used to assess student learning. These projects/exams will typically ask the student to apply knowledge of process to a new situation, and then discuss the expected outcomes and limitations.

Grading Policy: This is a graded course. In order to earn a passing grade, students must participate actively in class, complete assigned work and complete written exams. See individual module syllabi for relative weight of activities within a module. Unless excused (preferably prior to being late), late assignments are discounted 5% per day. Grades assigned (percentage scores):

A = 100-90%; A- = 89-85%; B+ = 84-80%; B = 79-75%; B- = 74-70%; C = 69-60%; D = 59-50%;
F = 49 & below

Attendance Policy: Students are expected to attend class on-time and participate fully. If you have a necessary planned conflict with a scheduled class, contact Dr. Simasko. Exams missed due to illness or other unforeseen events may be eligible for a make-up exam. This requires that you contact Dr. Simasko before the exam or no later than 48 hours after the exam. Written documentation is required and must be submitted to Dr. Simasko before a make-up exam can be administered.

Statement on Academic Integrity: Academic integrity will be strongly enforced in this course. Any student caught cheating on any assignment will be given an F grade for the course and will be reported to the Office Student Conduct. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3). It is strongly suggested that you read and understand these definitions.

Safety and Emergency Notification: WSU is committed to enhancing the safety of the students, faculty, staff, and visitors. It is highly recommended that you review the Campus Safety Plan (http://safetyplan.wsu.edu/) and visit the Office of Emergency Management website (http://oem.wsu.edu/) for a comprehensive listing of university policies, procedures, statistics, and information.

Reasonable Accommodation: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information visit:

Pullman or WSU Online: http://accesscenter.wsu.edu, Access.Center@wsu.edu
Spokane: https://spokane.wsu.edu/studentaffairs/disability-resources/
Tri-Cities: http://www.tricity.wsu.edu/disability/
Vancouver: http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services
Module: Philosophy of Experimental Design

Instructor: John Nilson;  BLS 235  Phone: 509-335-8645  Email: jhn@vetmed.wsu.edu

Scheduled: First 5 weeks of the spring semester (Jan 11 through Feb 12)


Module Description: This course will help graduate students develop an understanding and the habits of mind regarding acquisition of new knowledge through examining the principles of experimental design and analysis. Materials are presented based on the following questions:

1. How do we know?
2. What is the evidence?
3. What is the argument that interprets the evidence?
4. Are there alternative explanations or better ways of solving the problem?

The assigned textbook for this module provides important discussion points in an easily accessible form. Additionally we will rely on selected peer-reviewed papers to provide both background and new information. The papers will be used to illustrate, apply, and expand the challenges of experimental design and analysis of research relevant to biomedical sciences. These articles will serve as homework and as discussion items for each class period.

Assessment:

- Class Participation (15% of grade) - does the student contribute to discussions in class
- Homework (15% of grade) – does the student presentation demonstrate an understanding
- Final Module Exam (70% of grade) – typically, a broad question asking for an interpretation of results or propose an alternative explanation or better way of solving the problem

Student Learning Outcomes: Students will:

1. summarize principles of experimental design and explain the difference between deductive and inductive reasoning.
2. understand the NIH mandated principals and guidelines for reporting preclinical research.
3. identify the most common statistical errors that appear in published articles.

Topics to address the outcomes: 1) reading and in-class discussions based on textbook and primary literature; and 2) lectures.

Outcomes assessed by: 1) in-class discussion of textbook and primary literature; and 2) final exam.
Class schedule:

<table>
<thead>
<tr>
<th>Dates</th>
<th>Readings</th>
</tr>
</thead>
</table>
2. Uri Alon: Why truly innovative science demands a leap into the unknown: https://www.youtube.com/watch?v=F1U26PLiXjM  
| 1/14/16 | 1. NIH-- Proposed Principles and Guidelines for Reporting Preclinical Research: http://www.nih.gov/about/reporting-preclinical-research.htm  
| 1/19/16 | Philosophy of Experimentation: *Glass*, Chapters 1 - 6 (pp 1 - 28) |
| 1/21/16 | Philosophy of Experimentation: *Glass*, Chapters 7 - 12 (pp 29 - 76) |
| 1/26/16 | System Validation: *Glass*, Chapters 13 - 21 (pp 77 - 128) |
| 1/28/16 | The Experiment: *Glass*, Chapters 22 - 26 (pp 129 - 198) |
| 2/2/16  | The Experiment: *Glass*, Chapters 27 - 30 (pp 199 - 228) |
| 2/4/16  | The Model: *Glass*, Chapters 31 - 34 (pp 229 - 250) |
| 2/9/16  | 1. What is "n" in cell culture experiments? http://labstats.net/articles/cell_culture_n.html  
2. Combining results across experiments. http://labstats.net/articles/combining_experiments.html  
3. Randomization I: spatial arrangement of samples: http://labstats.net/articles/randomise_spatial.html  
4. Randomization II: order of sample collection and processing: http://labstats.net/articles/randomise_order.html  
| 2/11/16 | Recap and Exam (due before class on 2/16/16) |
Module: Analysis of Biomedical Experiments

Instructor: Bryan Slinker; 509-335-3064; slinker@vetmed.wsu.edu

Scheduled: Second 5 weeks of the spring semester (Feb 15 through Mar 25)


Module Description: This course will inform the student of common misapplications of statistics in biomedical experimentation. Emphasis is on selecting the correct statistical approach and once selected, what are the pitfalls.

The assigned textbook provides important discussion points in an easily accessible form. Additionally we will rely on selected peer-reviewed papers to provide both background and new information. The papers will be used to illustrate, apply, and expand the challenges of experimental design and analysis of research relevant to biomedical sciences. These articles will serve as homework and as discussion items for each class period.

Assessment:

- Class participation: 15% -- does the student contribute to discussions in class
- Homework: 15% - does the student work demonstrate an understanding
- Written exam: 70% - questions asking for the design of an experimental program, justification of the observational unit, and critique of methods. The written exam format: short answer.

Student Learning Outcomes: Students will:

1. be able to select, with justification, the most appropriate statistical test for a particular experimental design, or alternatively, be able to adjust the design of their experiment so that it conforms to the assumptions of their chosen statistical approach.

2. understand the limits to the conclusions from a statistical analysis and use this understanding to effectively construct arguments regarding the interpretation of their experimental results.

3. use sound statistical principles in the design of an experimental program, from justifying the observational unit, to establishing the number of replicates, to methods that help remove bias in making observations.

Topics to address the outcomes: 1) reading and in-class discussions; and 2) lectures.

Outcomes assessed by: 1) class participation during in-class discussions; 2) periodic homework assignments; and 3) final written exam for the module.
Class schedule:

<table>
<thead>
<tr>
<th>Dates</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/16/16</td>
<td><strong>Vickers A.</strong> <em>What is a P-value Anyway? 34 Stories to Help You Actually Understand Statistics</em> Addison-Wesley Longman; 2010. Chapters 1-12</td>
</tr>
<tr>
<td>2/23/16</td>
<td><strong>Vickers A.</strong> Chapters 24-34</td>
</tr>
<tr>
<td></td>
<td>Power Calculations for animal models</td>
</tr>
<tr>
<td></td>
<td>2. <strong>Lazic SE.</strong> Why we should use simpler models if the data allow this: relevance for ANOVA designs in experimental biology. <em>BMC Physiol.</em> 2008;8(1):16.</td>
</tr>
<tr>
<td></td>
<td>Multiple Comparisons</td>
</tr>
<tr>
<td>3/15/16</td>
<td>Spring Break – no class</td>
</tr>
<tr>
<td>3/22/16</td>
<td>Applied discussions of possible ways to analyze a real data set (different types of statistical tests that may be applicable), given the questions or groups, or outcomes of the data. Why a couple different tests may be appropriate to different groups of experimental data that goes into a paper.</td>
</tr>
<tr>
<td>3/24/16</td>
<td>Recap and Final Exam (due before class on 3/29/16)</td>
</tr>
</tbody>
</table>
Module: Imaging and Image Analysis

Instructors: Gary Wayman: 509-335-8211; waymang@vetmed.wsu.edu
Eric Shelden: 509-335-2368; eshelden@vetmed.wsu.edu
David DeWitt: 509-355-0659; david.dewitt@vetmed.wsu.edu

Scheduled: Third 5 weeks of the spring semester (Mar 28 through Apr 29)

Module Description: This course will guide students in the selection of optimal imaging techniques for the particular question they seek to answer, provide hands on experience with collecting results from a sample of their interest (or a provided sample), and then once the image is collected, the optimal means to extract data from the image.

Assessment:

- Class participation: 15% - does the student contribute to discussions in class
- Homework: 15% - does the student work and technique demonstrate an understanding
- Written exam: 70% - questions regarding collection of images; critique of technique used, and evaluation of the approaches to quantify results. The written exam format: 50% essay; 50% multiple choice.

Student Learning Outcomes: Students will:

1. understand the technical nature of fluorescent microscopic measurements and how different confocal techniques enables one to address different types of experimental questions.
2. collect an actual confocal image so as to understand in detail the needs for proper sample handling and the limitations sample preparation has on the quality of the images obtained.
3. suggest alternative microscopic techniques that could be applied when fluorescent microscopy is unable to address the experimental question.
4. select the proper approach to quantifying results from a set of images.

Topics to address the outcomes: 1) readings and in-class discussions of papers from research literature; 2) lectures; and 3) hands on use of a confocal microscope.

Outcomes assessed by: 1) participation in in-class discussions; 2) a final exam/report related to both their sample data as well as general questions.
Class Schedule:

<table>
<thead>
<tr>
<th>Dates</th>
<th>Topics and Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/29/16</td>
<td>Widefield resolution, numerical aperture, image formation, contrast, signals</td>
</tr>
<tr>
<td>3/31/16</td>
<td>Fluorescent probes, spectra, filters, illumination sources, fluorescent microscopes</td>
</tr>
<tr>
<td>4/5/16</td>
<td>Cameras, photomultipliers</td>
</tr>
<tr>
<td>4/7/16</td>
<td>Confocal microscopy, TIRF, FLIM, FRET, multiphoton illumination</td>
</tr>
<tr>
<td>4/12/16</td>
<td>Super resolutions imaging</td>
</tr>
<tr>
<td>4/14/16</td>
<td>Digital image, image processing</td>
</tr>
<tr>
<td>4/19/16</td>
<td>Quantitative analysis of images, three dimensional reconstruction</td>
</tr>
<tr>
<td>4/21/16</td>
<td>Hands on imaging I</td>
</tr>
<tr>
<td>4/26/16</td>
<td>Hand on imaging II</td>
</tr>
<tr>
<td>4/28/16</td>
<td>Exam</td>
</tr>
</tbody>
</table>