

JEPSON FELLOW PROPOSAL COVER SHEET

Academic Year 2012 — 2013 Application for Funding in Fiscal Year 2013 — 2014

Due Monday, September 10, 2012

Project Title: _____ Characterizing New Nematodes and Extending Opportunities for UMW Students to Experience Science and Find New Species _____

Name of Applicant: _____ Theresa M. Grana, Ph.D _____

Department: _____ Biological Sciences _____

Project Summary (50-75 words, insert in the box below):

This proposal describes a research project that extends my current research program. My students and I have discovered new species of nematodes and I propose here to formally describe one new species for publication. I also propose to further develop a semester long introductory biology laboratory that I am implementing in preliminary form this semester. In this lab, students partake in an original research project where they find and characterize nematodes.

Required Attachments:

1. Description of a Research/Creative Project (following required format, no longer than five pages)
2. Copy of the Applicant's *Curriculum Vitae*
3. One-page Teaching Statement (describing oneself as a teacher and relating the teaching statement to the proposed project)
4. One syllabus from a course taught within the last two years; if desired, one example of supplementary material from that course (such as an assignment description) that is relevant to the project being proposed may be included

Applicant Signature: _____

Date: _____

Chair Signature: _____

Date: _____

A. Project Description

Problem Statement: Nematodes (roundworms) are a diverse and abundant group of organisms that play important ecological roles. One nematode, *Caenorhabditis elegans* is an important model for human diseases (1). In the fall of 2010, my research students and I discovered a new species of nematode. Few people know that this new species was discovered at the University of Mary Washington or that the worm lives on our campus. How many more nematodes are in our own back yards that no scientist has documented?

Before others have a chance to document this species and claim discovery, I propose to spend a year describing this species for publication. Gaining expertise in species descriptions and establishing additional collaborative relationships will allow me to guide future research students through the species description and documentation process. In the following years, we will continue to discover and characterize new species, properly keeping records, communicating with scientific collaborators, and contributing to the larger body of nematode research. As part of this fellowship, I also plan to develop a new semester-long laboratory during which students authentically participate in a research project. Initial species discovery and characterization projects will be integrated into my *Biological Concepts I* course (the first course in UMW's introductory biology sequence which fulfills general education natural science requirement). Based on evidence presented below, participating in research will be more effective than traditional labs, and the students will have contributed to understanding the diversity of nematodes by the end of the semester.

Why involve a class in an original research project? First, the current literature on undergraduate science education vehemently urges science educators to change the traditional undergraduate laboratory experience into more authentic research experiences (2–4). Second, mere recipe or protocol-based laboratories tend to be tedious and lose the attention of today's students. Moreover, such laboratories are not representative of how science is truly practiced. Based on my own experiences as a student, only when I participated in a summer research program did I realize that science is a creative process¹ involving problem solving, experimental design, exploration of the unknown, teamwork, and communication. Third, as an instructor, I find many of the current labs have little to do with the true nature of scientific research. Finally, Howard Hughes Medical Institute's Science Education Alliance designed a course called *Phage Hunters*. In this course, first year students participate in a year long research project (5). Across the country, instructors have found that students who are part of the *Phage Hunters* course are more engaged and understand the scientific process better (6) than in their previous offerings of the course with labs featuring predetermined outcomes.

Why study nematodes? Despite their ecological roles regulating decomposition and nutrient cycling, and usefulness for genetic, neurobiology, cell biology and developmental biology research, greater than 90% of nematodes remain undescribed (1). In the past three years, my students and I have isolated about 100 strains of nematodes (roundworms). Some of these strains are new species. Others are representatives of known species, which are useful for two reasons: 1. no one may yet know that this species exists where we found it; 2. these representatives may be genetically divergent from other representatives and so may be useful for comparative genomics (such as finding genes that lead to adaptive phenotypes) (7).

¹ (Note on science as a creative process: to understand how a cell works for example, you must imagine how it works, then you must design an experiment to test what you imagined, then you must interpret your results, and then try again.)

B. Goals and Specific Objectives

Finding new nematodes is a major goal of my research program. In the projects described below I seek to find new nematodes, describe new nematodes, and improve the *Biological Concepts* laboratory experience.

Specific Aim/Project 1: *Develop straightforward protocols (executable by undergraduates) for Scanning Electron Microscopy (SEM) imaging of nematodes.*

Though I have imaging experience with other equipment, I have never used a SEM. For this project, I will learn how to prepare nematode samples for SEM, and I will master and practice using the SEM during the summer 2013. Examples of SEM images taken and published by Dr. Karin Kiontke, my collaborator, are shown in Figure 1 in Appendix I. In summer 2013 and early fall 2013, I will develop and refine student friendly procedures to be used with my students in *Biological Concepts* and my research group. The procedures will help them to prepare samples and take images on the SEM.

Specific Aim/Project 2: *Formally describe a new nematode species for publication.*

From fall 2013 to spring 2014, I will work with my collaborators Drs. Karin Kiontke and David Fitch of New York University to formally describe one new species of nematode. The SEM technique that I learn in project 1 will aid in this description. The description will be ready for publication by the end of summer 2014.

Roles and Responsibilities: For this collaboration, I will prepare the nematode samples, take all the images and measurements, create the drawings, and analyze the images. Dr. Kiontke's role will be as a consultant to guide my descriptive work and to review the manuscript I write before submission for publication. Dr. Fitch will recommend which species are the most useful to describe. Dr. Kiontke have significant experience describing new species and will advise me on taking the series of measurements and physical descriptions necessary for this task. We currently communicate often, sometimes several times per week, and I am certain they will continue supporting and advising me in my work. A letter of support from Drs. Fitch and Kiontke is provided at the end of this document.

Specific Aim/Project 3: *Fully develop a semester-long, research-based Biological Concepts laboratory involving nematodes. (Wormfinding)*

In summer 2013 and during the fall semester 2013, I will implement a semester-long undergraduate research project in my *Biological Concepts* course. The overall goal of the laboratory is to allow students who would not normally have the opportunity to participate in research, including non-science majors, to participate in a genuine research project during a class laboratory. This goal aligns directly with the American Association for the Advancement of Science's *Vision and Change Final Report* that encourages educators to "Introduce research experiences as an integral component of biology education for all students, regardless of their major"(8). The research project I propose will potentially increase long-term understanding of the material, lead to better understanding of the research process, and greater ownership and interest in the laboratory activity (9).

In summary, the projects will continue beyond the fellowship year. The course release will allow me to devote consistent time to each of the projects so that they can all be successful.

C. Potential Impact and Significance

For specific aim 1 (*develop SEM protocols*), I will practice SEM techniques on new species of nematodes. Images from this will be used in the publication that I expect to generate from specific aim 2. Once I perfect the technique, I plan to incorporate it into the work that students perform as part of specific aim 3 in *Biological Concepts*. UMW has an SEM, which is rare for an undergraduate institution. Generally, SEM microscopes are run by core facilities at select universities and are heavily used. My collaborators in the Fitch lab at NYU pay hundreds of dollars per hour to take images at Albert Einstein College of Medicine. Thus, my URES and BIOL491 research students could be involved in projects performing SEM imaging for our collaborators, and benefit from the scientific communication they partake in as part of that collaboration. Both my students and I would be co-authors on our collaborators' research papers because we would be contributing to their characterization of nematodes.

For specific aim 2, I plan to fully describe a new species of nematode during the 2013-2014 school year. Once I have worked through this process once, numerous students over subsequent years would be able to describe new species under my direction. Our new descriptions would be published to the benefit of the nematode research community, and our work would contribute to understanding of nematode diversity and evolution (10, 11).

For specific aim 3, I will fully develop a semester-long teaching lab based research project for undergraduates. This project will have several levels of impact for me and for students. A few potential differences in learning from a research project vs. a prepared lab are listed in Table 1 in Appendix I. Also,

Learning Outcomes:

- *Biological Concepts* students will be more engaged, more interested in, and better understand the scientific process (5)
- students will develop research record keeping and communication skills
- this project will enhance the inquiry aspect of the laboratory – where students develop hypotheses and test the hypothesis as part of the laboratory

Teaching Project Outcomes:

- develop lab guide materials, instructional videos, presentations
- learning objectives and assessments will be developed for each module of the laboratory.
- activities will be better tied to lecture concepts than they are in the pilot project

Research Outcomes:

- with guidance, undergraduates are eager and able to contribute to knowledge in the field.

Dissemination Outcomes:

- development of modular research-based teaching laboratory materials that can be applied by others to large classes
- reportable learning gains/areas that still need improvement
- present this *Wormfinding* as feasible for other worm researchers at national meetings and/or in peer-reviewed science education journals

Significance to the Mission of UMW: to give students opportunities to perform undergraduate research as in the UMW Mission statement, the Biology Program mission statement, and as recommended by the UMW CAS Taskforce on Undergraduate Research. To remain competitive,

UMW must align with national trends in terms of undergraduate research. Additional examples of research-based classroom labs and their benefits are discussed in (12).

D. Procedures and Methods

Specific Aim/ Project	Title	Timeline for accomplishing project work
1	Master Scanning Electron Microscopy SEM	Early Summer 2013
1	Develop, write, and refine SEM procedures for students	Summer through early fall 2013
3	Develop the <i>Wormfinding</i> lab manual	Summer and Fall 2013
3	Implement semester-long undergraduate research project in the <i>Biological Concepts</i> course	Fall 2013
2	Work with collaborators to formally describe on new species of nematode for publication submission	Fall 2013 through the Spring 2014

Specific Aim 1: My collaborators, Drs. Kiontke and Fitch will send me protocols for nematode sample fixation and advise me as I work on my SEM technique. In addition, Kathy Loesser-Casey, the local SEM expert, will show me the specifics of using our fixation and imaging equipment. Thus, I will learn to perform the fixation steps to prepare samples for SEM. Then, I will use our SEM microscope to take images of a new nematode species.

Specific Aim 2: I will learn which measurements need to be taken and how to take them. I have a high power Normarski video microscope in my laboratory that is fully capable of taking high quality images for use in measurements of features used in species descriptions (see Figure 2). I plan to initially perform some measurements on a described species to ensure that my equipment is properly calibrated. For the new species, I will use my strong Adobe Photoshop and Illustrator skills to produce the traces/drawings needed for formal species descriptions.

Specific Aim 3: This semester, I am piloting *Wormfinding*, a laboratory which lays the foundation for this aim. This preliminary nematode work will only take about 10 hours total spread out over the course of the semester, with the rest of the time dedicated to traditional labs (see Appendix III and course syllabus). For the fellowship project, I aim to develop additional worm characterization and experimentation modules that will be used to address specific concepts. Many researchers at small universities choose to study nematodes, particularly *C. elegans*, because nematodes are easy and inexpensive to take care of, and many interesting laboratory activities have been developed that utilize *C. elegans*. The teaching load reduction provided by this grant will provide me with time to review the teaching literature involving worm research and to develop additional modular laboratory components based on that research. These modules will fit with my broad plan of discovering and characterizing new nematodes, and involve inquiry aspects. A lab manual will be developed, and the *Wormfinding* activities will be better integrated with the course material. Supplies for this lab will cost no more than the materials used in the traditional lab.

As the laboratory proposed in aim 3 is developed, I will examine my learning goals and make decisions as to what to include, and may choose to retain some of the current inquiry labs in the

curriculum. I also will further develop the learning goals and means of assessment for lab. Assessments will be implemented during the module, by using the established Council on Undergraduate Research (CUR) survey, and assessments that I develop.

I have the necessary experience in nematode research, along with collaborative support, to carry out my proposed research aims. In addition, I have experience developing laboratory exercises for undergraduates, both in my time here at UMW while I have worked with Dr. Debbie Zies to improve the General Genetics laboratories (adding background, learning objectives, illustrations, and improving post-lab assignments) and in my published Cell Biology laboratory and assessments (13), which I began developing as a post-doctoral fellow in 2006. As you can see in my CV, during my career I have capably switched research fields multiple times (yeast protein interaction, fly gene regulation, cell-based radiation biology research, and nematode cell adhesion research). Thus, I am prepared to study nematode diversity, learn species description, and extend my imaging skills during this project.

I do not have other research commitments during the grant period and expect to have a reduced teaching load to accomplish the aims of this grant. I would teach fewer sections of my usual courses: *Biological Concepts I* in the fall and *General Genetics* in the spring.

E. Anticipated Results

Project 2 will result in a publication in the journal *Nematology* or the *Journal of Nematology* as a formal species description. Project 1 could result in a publication in a similar journal as a co-author on one of my collaborators' research articles. Project 3 will result in an improved Biological Concepts learning experience and new laboratory curriculum for the students. For me, project 3 will result in a research presentation and/or research publication describing the newly developed research-based laboratory project. Criteria for success include publication of my description within two years, mastery of the SEM technique and developments of further collaborations utilizing SEM, and improved learning outcomes in *Biological Concepts*. See Appendix II, Connection between Teaching and Research Outcomes for a diagram illustrating the Anticipated Results.

F. Dissemination of Results

I plan to share my work at national and international meetings. Barcode sequences of nematodes we discover will be deposited in GenBank and descriptions will be recorded in Dr. Fitch's Rhabditina database. The results of my projects will be disseminated to the UMW community through a research presentation, such as the STEM colloquium, which I hope will encourage and my local colleagues to find ways to bring research into the classroom. Students will also be involved in dissemination of the results. Students in my class have already contributed to the blog (<http://wormfinding1.umwblogs.org/>). With past support of UMW undergraduate research funds and the summer science institute, my research students have given presentations at local and international research conferences (see my CV), and Research and Creativity Day. Expanding my skills would further enable my students to participate in important research and to present their work in various venues.

Undergraduates can discover and describe new species. Lets do it!

Appendix I

Images removed due to possible copyright concerns.

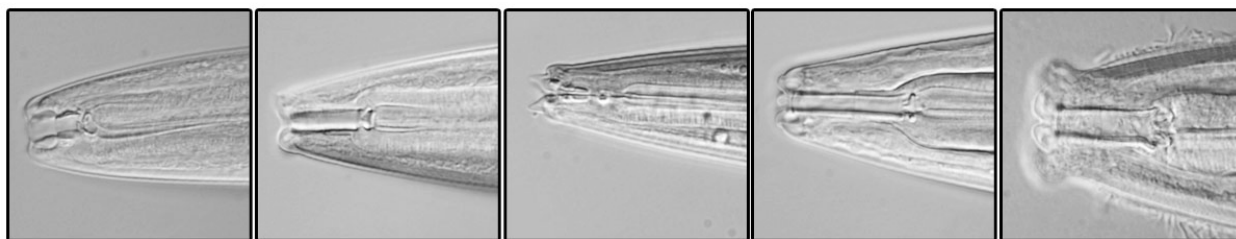


Figure 2: Examples of nematode mouthparts from various nematode strains found in my research program at UMW. Worms were imaged with Normarski microscopy in my laboratory (some images by me, others by students).

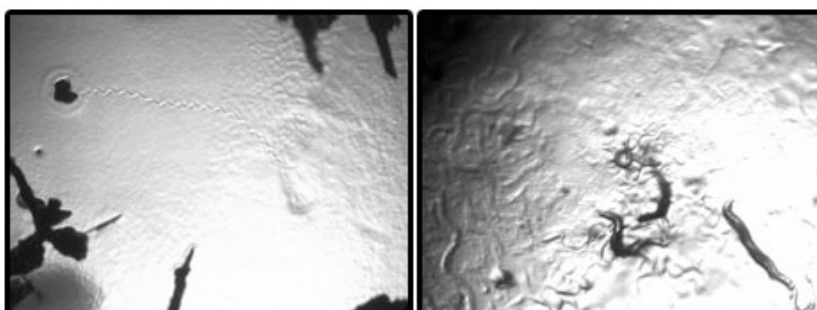
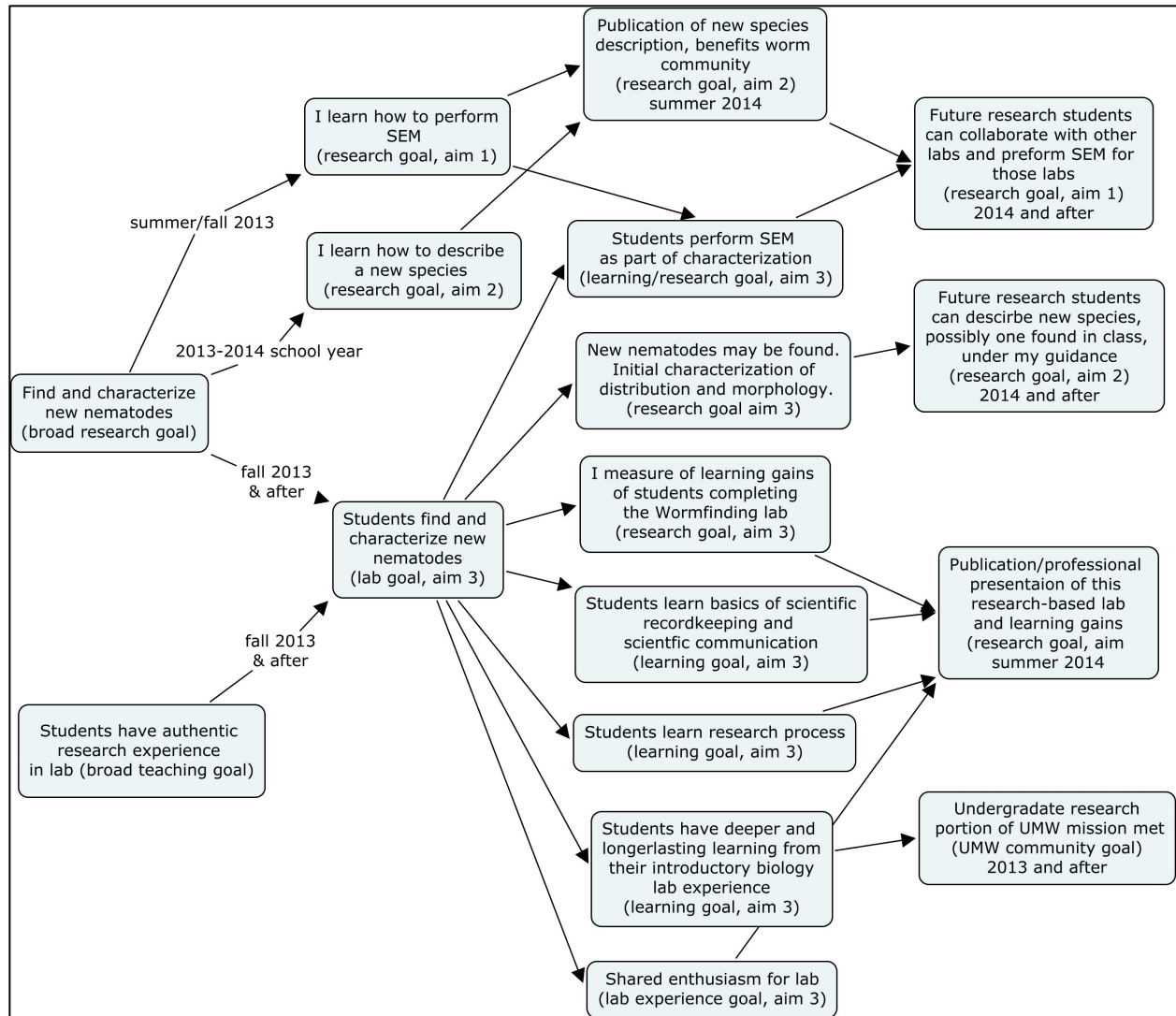


Figure 3: What *Biological Concepts* students first see as nematodes emerge from their samples.

Table 1: Basic Comparison of the Traditional Cookbook-like laboratory vs. Research-based laboratory	Cookbook laboratory (Traditional)	Research-based laboratory (My proposal)
Students learn to follow directions.	Yes	Yes
Students have a chance to follow protocols that demonstrate concepts connected with the lecture material. The experiments are one-time, have an expected outcome, and if they fail there are no consequences.	Yes	No
Students have a chance to follow some protocols associated with the lecture material. Some of these are Traditional with a known outcome. Many of these protocols have an unknown outcome and will result in new data that could be published. If the procedure does not work, the student will have the flexibility to troubleshoot (problem solve) and repeat the work.	No	Yes
Students have to think about what they are doing to be successful.	Not always	Yes
Student lab results contribute to the body of scientific knowledge.	No	Yes

Appendix II. Connections between Teaching and Research Outcomes for the Projects Proposed in this Fellowship Application. Timeline included.



Appendix III: Pilot-project, *Wormfinding*, description and timeline of class activities for finding worms in *Biological Concepts* this fall, 2012.

This fall, my *Wormfinding* laboratory lays the initial groundwork for aim 3. I am learning where the students make mistakes in their initial worm work and seeing just how excited they are to be doing a meaningful lab project (See Figure 3 for an example of students see in the first hours after sampling for nematodes as they begin the nematode isolation process). The pilot project will help me understand the limitations of worm finding with a larger group of students, to develop preliminary protocols, and gauge student abilities. I have already realized that we need to use microscopes from an advanced course because the ones in the lab are insufficient.

Several of the traditional labs at UMW have already been modified to include scientific inquiry experiments where the students design and execute their own experiments with the materials at hand. This is a good development, but the outcome is still known and the lab does not contribute to the field of biology. An improvement I would like to make to the *Wormfinding* lab is to include inquiry modules, because in its pilot state, it is a characterization of the worms rather than any true experimentation investigating biological questions.

Week 1: Introduce students to collecting worms, including photographing the site, Google Earth for GPS readings, and field safety. Students make observations of example nematodes with distinct behaviors and phenotypes, including species with males, species of different sizes, and different coloration. (90 minutes). Give students bags with labels.

Week 2: Students bring samples to lab. Students plate soil and wait for nematodes to emerge (while another lab exercise is going on) (30 minutes). Students have UMW Blogs training. (45 minutes). Friday: go down to the lab and look at worms during the last 20 minutes class.

Week 3: New nematode stocks will have been established. Students will observe, name, photograph, and draw their nematodes. Students will continue to record the data they generate on the class blog (<http://wormfinding1.umwblogs.org/>). Their blog is a lab notebook and will help them prepare their final poster lab report. *Everyone look at plates from other groups. Emphasize the diversity of organisms.* (1 hour or more)

Week 5: Nematodes will be washed into a lysis buffer to expose the genomic DNA for PCR. Students will freeze worms at -80C. [talk about osmosis & diffusion]. (15 minutes)

Week 6: Lysis completed by incubation reaction (90 minutes).

Week 9: PCR set up and run. (60 minutes)

Week 10: Gel electrophoresis. (2 hours). Photograph gels, compare amplified region to control.

Week 11: preliminary poster design

Week 12: DNA sequences will have been obtained from the student's gels. They will be introduced to DNA sequence results and my research students will build a phylogenetic tree for the students.

Week 14: Final poster, including the placement of each nematode on a phylogenetic tree as provided by my research students. Comparison of the discovered species to known closest relative will be part of the final poster.

Week 15: Final survey/assessment

As modules are developed in 2013-2014, student research activities that span each week of the semester will be added.

Appendix IV: References

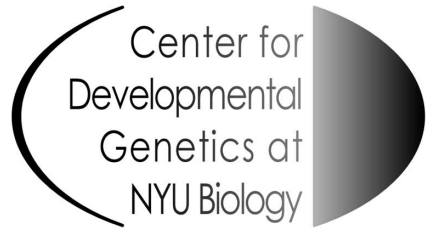
1. Holm B, Carter VC, Woodin T (2011) Vision and change in biology undergraduate education: Vision and change from the funding front. *Biochemistry and Molecular Biology Education* 39:87–90.
2. National Research Council. (2003) *BIO2010: Transforming Undergraduate Education for Future Research Biologists* (Washington, DC: National Academies Press).
3. Woodin T, Carter VC, Fletcher L (2010) Vision and change in biology undergraduate education, a call for action--initial responses. *CBE Life Sci Educ* 9:71–73.
4. Caruso SM, Sandoz J, Kelsey J (2009) Non-STEM undergraduates become enthusiastic phage-hunters. *CBE Life Sci Educ* 8:278–282.
5. Harrison M, Dunbar D, Ratmanskyy L, Boyd K, Lopatto D (2011) Classroom-based science research at the introductory level: changes in career choices and attitude. *CBE Life Sci Educ* 10:279–286.
6. Blaxter M (2011) Nematodes: the worm and its relatives. *PLoS Biol* 9:e1001050.
7. Ross JA et al. (2011) *Caenorhabditis briggsae* recombinant inbred line genotypes reveal inter-strain incompatibility and the evolution of recombination. *PLoS Genet* 7:e1002174.
8. Vision and Change in Undergraduate Biology Education Initiative (2009) (American Association for the Advancement of Science, Washington, D.C.) Available at: <http://www.visionandchange.org/finalreport>.
9. Witherow DS, Carson S (2011) A laboratory-intensive course on the experimental study of protein-protein interactions. *Biochem Mol Biol Educ* 39:300–308.
10. Cutter AD (2010) Molecular evolution inferences from the *C. elegans* genome. *WormBook*:1–14.
11. Kiontke KC et al. (2011) A phylogeny and molecular barcodes for *Caenorhabditis*, with numerous new species from rotting fruits. *BMC Evol Biol* 11:339.
12. Wei CA, Woodin T (2011) Undergraduate research experiences in biology: alternatives to the apprenticeship model. *CBE Life Sci Educ* 10:123–131.
13. Cox-Paulson EA, Grana TM, Harris MA, Batzli JM (2012) Studying human disease genes in *Caenorhabditis elegans*: a molecular genetics laboratory project. *CBE Life Sci Educ* 11:165–179.
14. Karin Kiontke, Mantaro Hironaka, Walter Sudhaus (2002) Description of *Caenorhabditis japonica* n. sp. (Nematoda: Rhabditida) associated with the burrower bug *Parastrachia japonensis* (Heteroptera: Cydnidae) in Japan. *Nematology* 4:933–941.



New York University

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Dr. Karin Kiontke; Senior Research Scientist
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Web: <http://wwormtails.bio.nyu.edu/>



Dear Theresa,

We write to offer our support and collaboration to your proposal to develop a research/teaching plan that will not only be important for enriching undergraduate education, but will also contribute important work to nematode systematics.

Regarding our collaboration, we are very happy to contribute the following:

- (1) Consultation regarding SEM imaging of nematodes. One of us, Dr. Kiontke, has extensive experience using SEM for imaging nematode features not otherwise observable. Such images greatly enhance species descriptions.
- (2) Consultation and help with writing species descriptions for publication. Dr. Kiontke especially has extensive experience with publishing nematode species descriptions, and has been a member of a Society of Nematologists committee to establish rules for such descriptions.
- (3) Suggestions for which taxa would be the best to describe. Because of the phylogenetic and systematic work from our lab, we have a good idea of which taxa are in greatest need of morphological/molecular description. We can thus help to ensure that your species description publications will have the greatest impact on rhabditid systematics.
- (4) Finally, we will set up a BLAST server to allow you to use rRNA gene sequences to identify the closest relatives of species that you and your students isolate from the field.

We look forward to helping you in your important research/education endeavors.

Sincerely, Prof. David H. A. Fitch and Dr. Karin Kiontke

Theresa M. Grana, Ph.D.

September 2012

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EDUCATION

Ph.D., Genetics and Molecular Biology, University of North Carolina, Chapel Hill, NC, 1998-2003
B.S., Molecular Biology, Magna cum laude, Grove City College, Grove City, PA, 1994-1998

PROFESSIONAL EXPERIENCE

Assistant Professor, Department of Biological Sciences, University of Mary Washington,
Fredericksburg, VA, 2008-present

Postdoctoral Fellow, Department of Zoology, University of Wisconsin, Madison, WI, 2005-2008

Research Associate, Department of Zoology, University of Wisconsin, Madison, WI, 2004-2005

Adjunct Assistant Professor (temporary, full time), Department of Biology, Westmont College,
Santa Barbara, CA, Spring, 2004

Microbiology Lab Assistant, Grove City College, Grove City, PA, 1997

Carolina Summer Fellow, Department of Pharmacology, University of North Carolina, Chapel Hill,
NC, 1997

Research Experiences for Undergraduates, Biomedical Sciences, Wadsworth Center for Research
and Laboratories, Albany, NY, 1996

TEACHING EXPERIENCE

As a faculty member at the University of Mary Washington, 2008-present

Introductory Biology with Laboratory
General Genetics with Laboratory
Bioinformatics
Developmental Biology with Laboratory

Senior Seminar
Special Problems in Biology
Readings in Biology
Undergraduate Research

As a post-doctoral fellow at the University of Wisconsin

Laboratory exercise developer, Cell Biology, 2007-2008

Guest lecturer, Introduction to Animal Development, 2005, 2007

As a teaching adjunct at Westmont College, Spring 2004

Genetics with Laboratory
Biology Senior Seminar

As a graduate student at the University of North Carolina

Coinstructor, Scientific Inquiry, 2000, 2001

Teaching Assistant, Cell and Developmental Biology, 1999

Education conference and workshop participation (selected)

- Genome Solver Annotation Workshop, J. Craig Venter Institute, Rockville, MD, 2012
- Undergraduate Biology in the 21st Century Workshop, BioQUEST Curriculum Consortium, Beloit, WI, 2011
- Undergraduate Faculty Genetics Education Workshop, American Society for Human Genetics, Washington, DC, 2010
- New Faculty Boot Camp, Society for Developmental Biology, Albuquerque, NM, 2010
- Synthetic Biology Workshop, Davidson College, Davidson, NC, 2010
- First RECOMB Satellite Conference in Bioinformatics Education, San Diego, CA, 2009
- Enriching Learning for All, Madison, WI, 2007
- Reconsidering Learning Styles and Strategies, Madison, WI, 2006
- The Engaged Classroom: Strategies for Teaching Today's Students, Madison, WI, 2005

RESEARCH EXPERIENCE*My research program: August 2008-present*

- Collecting and identifying nematodes found in Virginia and elsewhere by using imaging and phylogenetic methods. Characterizing nematode life history, anatomy, suitability for use to understand development, and mechanisms of evolution.
- Characterizing the sexual determination and natural environment of *Rhabditis* species related to SB347 to understand the evolution of sexual differentiation.

Postdoctoral work under the supervision of Jeff Hardin, UW-Madison, July 2004-2008

- Identified regulators of cadherin-mediated adhesion during epithelial morphogenesis in an RNAi-based genome-wide screen in *C. elegans*.
- Explored the interaction of L1 cell adhesion molecules and cadherins in early *C. elegans* development via a fusion of modern techniques and classical embryology.

Graduate research under the supervision of Adrienne Cox, UNC-Chapel Hill, Spring 1999-Dec. 2003

- Dissertation title: "Mechanisms of Ras-mediated Radioresistance."
- Determined the signaling mechanisms used by the Ras oncogene to cause tumor cells to survive to ionizing radiation, as may occur in cancer radiotherapy.
- Characterized transformation and signaling properties of the small GTPase Rit via standard assays used to study oncogenic transformation.

Graduate rotation under the supervision of Bob Duronio, UNC-Chapel Hill, Fall 1998

- Showed that the dDP subunit of the heterodimeric transcription factor DP/E2F is epistatic to dE2F with regard to the expression the helicase subunit *mcm3*.

Undergraduate research under the supervision of Adrienne Cox, UNC-Chapel Hill, Summer 1997

- Tested various combinations of inhibitors of H-Ras and NF- κ B signaling for their ability to sensitize tumor cells transformed by oncogenic K-Ras to ionizing radiation.

Undergraduate research under the supervision of Steve Hanes, Wadsworth Center, Albany, NY, Summer 1996

- Attempted to establish a yeast model of *Drosophila* Bicoid repression of *caudal* mRNA translation to screen for other interactors.

COMMITTEE AND COMMUNITY SERVICE

Professional service

Poster Judge, Society for Developmental Biology 69th Annual Meeting, Albuquerque, NM 2010

Session Moderator, Biology with Microbiology section, Virginia Academy of Science, Virginia Commonwealth University, 2009, 2010

UMW service: College & University

College of Arts & Sciences Curriculum Committee, Fall 2009-Spring 2012; Secretary 2011-2012

Invited Panelist, "Step Ahead: Students with Disabilities Orientation", 2010

UMW Biology Department service

Biology Outcomes Committee Chair, Fall 2010-present

Outcomes Assessment Coordinator for Biological Sciences, Fall 2009-present

Biological Concepts Committee, Spring 2009-present

Panelist, Preparing for Graduate School, Biology Career Workshop, 2009, 2010

Community service

Volunteer, Society for Developmental Biology Expo, USA Science and Engineering Festival, October 23, 2010. Explained developmental biology to children and families in attendance at the event.

Service before UMW employment

UW Relay for Life invited speaker, "Research funded by the American Cancer Society", Madison, WI, 2008

Founding member and key organizer, UW Post-Doc Association, UW-Madison, 2004-2006

Invited panelist, "Choosing a Postdoctoral Position at a University", graduate student professional development series, UW-Madison, 2005

Co-organizer of annual symposia, Cell and Molecular Biology Program graduate student group, UNC-Chapel Hill, 1999-2003; decided on topics, invited speakers from around the US, designed website and advertisements for the symposium each year.

HONORS, GRANTS, and AWARDS

Grants from outside UMW

J. Craig Venter Institute Travel Grant, Summer 2012 \$116 & two nights in a hotel

Society for Developmental Biology Teaching Faculty Travel Grant, Summer 2010 \$600

Society for Developmental Biology New Faculty Boot Camp Expenses, Summer 2010 \$314

UMW grants

College of Arts and Sciences Curricular Innovation Grant, to carry out the project "Open Ended and Problem Based Learning for Freshman Biology" (Project aims to improve lecture portion of Biological Concepts I), Summer 2012 \$2500

Supplemental Faculty Development Grant to present research at the "Evolution of *Caenorhabditis* and other Nematodes" meeting, Spring 2012 \$1151

Teaching Center Grant, to carry out the project "Does Writing a Condensed Laboratory Report Improve Student Critical Thinking Skills in Genetics Laboratory?" (Project aims to examine the utility of laboratory reports vs. worksheet-like post labs), shared with Deborah Zies, Spring – Summer 2012 \$1750

Teaching Center Open Travel Grant, to attend the BioQUEST Curriculum Consortium "Undergraduate Biology in the 21st Century" workshop, Spring 2011 \$500

Supplemental Faculty Development Grant, to attend the BioQUEST Curriculum Consortium "Undergraduate Biology in the 21st Century" workshop, Spring 2011 \$700

Supplemental Faculty Development Grant, to attend the Society for Developmental Biology conference, Spring 2010 \$1250

Faculty Research Grant for project expenses to carry out the project entitled "Comparative Analysis of Key Developmental Events in Two Species of Nematode", Spring 2010 \$3500

Teaching Center Open Travel Grant, to attend RECOMB Satellite Conference in Bioinformatics Education, Spring 2009 \$500

Supplemental Faculty Development Grant, to attend RECOMB Satellite Conference in Bioinformatics Education, Spring 2009 \$600

Grants to my research students (\$5275)

Virginia Academy of Science, Undergraduate Research Grant, Fall 2010

Undergraduate Research Grants, Spring 2010, Fall 2010, Spring 2011, Fall 2011-Spring 2012

Grants before my employment at UMW

American Cancer Society Postdoctoral Fellowship, 2005-2008; I wrote this grant to fund my position as a postdoctoral fellow. \$138,000 (salary, benefits, travel)

Cell and Molecular Biology Training Program Travel Award, UNC-Chapel Hill, 2003 \$300

Gordon Research Conference Young Investigator Award, 2003 \$690

Sarah Graham Kenan Dissertation Award, 2002-2003 \$2000

Graduate Mentor Award for Smallwood Summer Undergraduate Research Fellow, UNC-Chapel Hill, 2002 \$1000

Graduate School Transportation Grant Fund, UNC-Chapel Hill 2002 \$308.50

Young Investigator/Student Travel Award, Radiation Research Society, 2001, 2002 \$500, \$500

NIH/NCI Cancer Cell Biology Training Grant Predoctoral Fellowship, 2000-2002 \$29,748 (salary)

SOCIETY MEMBERSHIPS

Society of Nematologists, 2012-present

Society for Developmental Biology, 2010-present

Association for Biology Laboratory Education, 2012-present

Virginia Academy of Science, 2009-present

Genetics Society of America, 2007-present

American Society for Cell Biology, 2006-2010

Radiation Research Society, 2001-2003

PEER-REVIEWED JOURNAL ARTICLES (+ shows joint first authorship)

Lynch, AM, **TM Grana**, EA Cox-Paulson, A Couthier, M Cameron, I Chin-Sang, J Pettitt, J Hardin. A genome-wide functional screen identifies MAGI-1 as an L1CAM-dependent stabilizer of apical junctions in *C. elegans*, *Current Biology*. 2012. 22:1-9.

This was initially my research project. AM Lynch joined the project as she began her graduate work at the University of Wisconsin and I trained her in the techniques involved. A genetic screen is a large undertaking and we worked together on the project for several years. When I moved to UMW, I did not have access to the equipment necessary to complete this project. AM Lynch completed the project; this paper describes our research.

Cox-Paulson, EA⁺, **TM Grana**⁺, MA Harris, JM Batzli. Studying human disease genes in *C. elegans*: a molecular genetics laboratory project. *CBE-Life Science Education*. 2012. 11:165-179.

I co-designed this lab exercise and accompanying assignments, the lab manual, the pre- and post-surveys, helped teach the lab, and analyzed the data. For the paper, I prepared about a quarter of the text and aided in revisions of the text. Cox-Paulson prepared most of the text, but was less involved in data collection and teaching the laboratory.

Wolyniak, MJ, CJ Alvarez, V Chandrasekaran, **TM Grana**, A Holgado, CJ Jones, RW Morris, AL Pereira, J Stamm, TM Washington, Y Yang. Building better scientists through cross-disciplinary collaboration with synthetic biology: a meeting report from the Genome Consortium for Active Teaching (GCAT) Workshop 2010. *CBE-Life Sciences Education*. 2010. 9:399-404.

I helped design the survey instrument, interpret the results, and was the sole preparer of all images and graphs for this publication.

Grana, TM, EA Cox, AM Lynch, J Hardin. SAX-7/L1CAM and HMR-1/cadherin function redundantly in blastomere compaction and non-muscle myosin accumulation during *Caenorhabditis elegans* gastrulation. *Developmental Biology*. 2010. 344(2):731-44.

I performed more than ninety percent of the experiments and writing for this paper. Co-author Hardin communicated with the journal and advised me as I started the project.

Grana, TM, CI Sartor, AD Cox. EGFR autocrine signaling in RIE-1 cells transformed by the Ras oncogene enhances radiation resistance. *Cancer Research*. 2003. 63:7807-14.

Bivona, TG, I Perez de Castro, IM Ahearn, **TM Grana**, VK Chiu, PJ Lockyer, PJ Cullen, A Pellicer, AD Cox, MR Philips. PLCgamma activates Ras on Golgi via RasGRP1. *Nature*. 2003. 424(6949):694-8.

Grana, TM, EV Rusyn, H Zhou, CI Sartor, AD Cox. Ras mediates radioresistance through both PI3-K-dependent and Raf-dependent but MEK-independent signaling pathways. *Cancer Research*. 2002. 62:4142-50.

Rusyn, EV, ER Reynolds, H Shao, **TM Grana**, TO Chan, DA Andres, and AD Cox. Rit, a non-lipid-modified Ras-related protein, transforms NIH 3T3 cells without activating the ERK, JNK, p38 MAPK or PI3K/Akt pathways. 2000. *Oncogene*. 19(41): 4685-94.

PUBLISHED ABSTRACTS (* shows work completed by undergraduates)

Peer-reviewed

Wang, BA*, EA Haynes* and **TM Grana**. Comparative developmental and evolutionary studies of new *Caenorhabditis* species in Virginia. The Journal of Federation of American Societies for Experimental Biology, 2011. 25:535.3.

Grana TM, J Hardin. Polarity defects resulting from weakened cell-cell adhesion: lost signal? *Developmental Biology*. 2010. 344(1):470.

Non-peer-reviewed

Wang BA*, EA Haynes*, M Mukhtarzada*, **TM Grana**. Comparative developmental and evolutionary studies of new *Caenorhabditis* species in Virginia, The Virginia Journal of Science. 2011. Volume 62 No. 1&2 Spring/Summer.

Baardsen, EM*, B Wang*, and **TM Grana**. The isolation and identification of a new *Caenorhabditis* species to be used in comparative genomics. The Virginia Journal of Science. 2010. Volume 61 No. 1&2 Spring/Summer.

ORAL PRESENTATIONS AT CONFERENCES

International Conferences

Grana TM, PC Eskridge*, M Mukhtarzada*. Discovering nematodes in an undergraduate setting: another can of worms. Evolution of *Caenorhabditis* & Other Nematodes, Cold Spring Harbor Lab, NY, April 3-6, 2012.

National Meetings

Grana TM, T Dewey. Why *not knowing* is important in teaching science. BioQUEST Curriculum Consortium "Undergraduate Biology in the 21st Century" workshop white paper session, June 14, 2011.

Presentations by Student Co-Authors

-National and State

Eskridge PC*, **TM Grana**. Phylogenetic analysis and diversity of free-living terrestrial nematodes in Virginia, Research and Creativity Day, Chi Beta Phi 64th National Conference, West Liberty, WV, October 22, 2011.

-On Campus

Mukhtarzada M*, **TM Grana**. Anatomical and developmental differences among *Caenorhabditis* species. UMW Summer Science Research Symposium, July 20, 2011.

Wang, BA*, E Baardsen*, **TM Grana**. Identifying *hmp-1(fe4)* enhancers using RNAi screening. UMW Summer Science Research Symposium, July 22, 2009.

Oral Presentations Before my Employment at UMW

Grana, TM. Cell-cell adhesion systems in cell ingression. UW Wormgroup, Madison, WI, March 24, 2008.

Grana, TM, EA Cox, J Hardin. Cell-cell adhesion in gastrulation. UW Wormgroup, Madison, WI, February 19, 2007.

Grana, TM, EA Cox, J Hardin. Hammering out the roles of HMR-1/cadherin and SAX-7/L1-CAM in cell-cell adhesion and gastrulation. Zoology Research Show and Tell, Madison, Wisconsin, September 21, 2006.

Grana, TM, EA Cox, J Hardin. Cadherin interactors during morphogenesis of *C. elegans*. Cell Biology Study Group, Madison, Wisconsin, November 18, 2005.

Grana, TM, EA Cox, J Hardin. Cadherin and L1-CAM in *C. elegans* gastrulation. UW Wormgroup, Madison, WI, October 17, 2005.

Grana, TM, EA Cox, J Hardin. Cadherin interactors during development. Triangle Wormgroup, Chapel Hill, NC, October 6, 2005.

Grana, TM, H Zhou, CI Sartor, AD Cox. Oncogenic Ras induces radioresistance in part via increased TGF- α ; and abrogation of EGFR signaling by GW572016 causes radiosensitization. Gordon Research Conference in Radiation Oncology, Ventura, CA, January 26-30, 2003.

Grana, TM, H Zhou, CI Sartor, AD Cox. Ras upregulation of EGFR ligands increases EGFR activity and cell survival following radiation. Curriculum in Genetics and Molecular Biology Seminar, Chapel Hill, NC, October 29, 2002.

Grana, TM, H Zhou, CI Sartor, AD Cox. Ras-mediated radioresistance via autocrine pathways. 49th Annual Meeting of the Radiation Research Society, Reno, Nevada, April 20-24, 2002.

Grana, TM, EV Rusyn, H Zhou, CI Sartor, AD Cox. Ras upregulation of the PI3-K/Akt pathways, but not of MEK/ERK or p38, increases post-radiation survival in Ras-transformed RIE-1 cells. 17th Annual Meeting on Oncogenes, Frederick, MD, June 20-23, 2001.

Grana, TM, EV Rusyn, H Zhou, CI Sartor, AD Cox. Mechanisms of Ras-mediated radioresistance. 48th Annual Meeting of the Radiation Research Society, San Juan, Puerto Rico, April 21-25, 2001.

Grana, TM, H Zhou, CI Sartor, AD Cox. Mechanisms of Ras-mediated radioresistance. Curriculum in Genetics and Molecular Biology Seminar, Chapel Hill, NC, February 20, 2001.

POSTER PRESENTATIONS

International Conferences

Grana, TM, J Hardin. Polarity defects resulting from weakened cell-cell adhesion: lost signal? Society for Developmental Biology 69th Annual Meeting, Albuquerque, NM, August 6, 2010.

Poster Presentations by Student Co-Authors

-International

Wang, BA*, EA Haynes* and **TM Grana**. Comparative developmental and evolutionary studies of new *Caenorhabditis* species in Virginia. American Society for Biochemistry and Molecular Biology/Experimental Biology Annual Meeting, Washington, D.C., April 9-10, 2011.

Wang, BA*, E Baardsen*, **TM Grana**. Isolation and identification of a new nematode species. American Association of Cancer Research Undergraduate Student Caucus and Poster Competition, Washington, D.C., April 17, 2010.

-National and State

Eskridge, PC*, **TM Grana**. Phylogenetic analysis and diversity of free-living terrestrial nematodes in Virginia, Virginia Academy of Sciences Fall Meeting, Richmond, VA, October 15, 2011.

Wang, BA*, EA Haynes*, M Mukhtarzada*, **TM Grana**. Comparative developmental and evolutionary studies of new *Caenorhabditis* species in Virginia, Virginia Academy of Sciences Annual Meeting, Richmond, VA, May 26, 2011.

Wang, BA*, E Baardsen*, **TM Grana**. The isolation and identification of a new *Caenorhabditis* species to be used in comparative genomics. Virginia Academy of Sciences Annual Meeting, Harrisonburg, VA, May 21, 2010.

Wang, BA*, E Baardsen*, **TM Grana**. Identifying a new model organism for developmental and genomic studies. Virginia Academy of Science Fall Meeting, Richmond, VA, October 24, 2009.

Freeman, SA*, **TM Grana**. Discovery of an unknown gene that overlaps in function between *sax-7(eq1)* and the *sym* genes in *Caenorhabditis elegans*. Virginia Academy of Science Fall Meeting, Richmond, VA, October 24, 2009.

-On Campus

Eskridge, PC*, **TM Grana**. Phylogenetic analysis and diversity of free-living terrestrial nematodes in Virginia, Research and Creativity Day, University of Mary Washington, April 17, 2012.

Eskridge, PC*, **TM Grana**. Phylogenetic analysis and diversity of free-living terrestrial nematodes in Virginia, UMW Summer Science Research Symposium, July 20, 2011.

Mukhtarzada, M*, BA Wang*, EA Haynes*, **TM Grana**. Anatomical comparison of *Caenorhabditis* species. Research and Creativity Day, University of Mary Washington, April 19, 2011.

Wang, BA*, E Baardsen*, **TM Grana**. The isolation and identification of a new *Caenorhabditis* species to be used in comparative genomics. Research and Creativity Day, University of Mary Washington, April 12, 2010.

Freeman, SA*, **TM Grana**. Determination of synthetic phenotypes in *hmp-1* and *sax-7* *C. elegans* mutants by RNA Interference. UMW Summer Science Research Symposium, July 22, 2009.

Poster presentations before my employment at UMW

Grana, TM, EA Cox, MA Harris, J Hardin, JC Batzli. Using *C. elegans* to demonstrate central concepts of gene expression. 16th International *C. elegans* Meeting, Los Angeles, CA, June 27-July 1, 2007.

Grana, TM, EA Cox, J Hardin. Cell-cell adhesion molecules regulate gastrulation in *C. elegans*. 16th International *C. elegans* Meeting, Los Angeles, CA, June 27-July 1, 2007.

Grana, TM, EA Cox, T Walston, J Hardin. HMR-1/cadherin and SAX-7/L1CAM function redundantly to regulate cell-cell adhesion and gastrulation in *C. elegans*. 46th annual American Society for Cell Biology Meeting, San Diego, CA, December 9-13, 2006.

Grana, TM, EA Cox, T Walston, J Hardin. HMR-1/cadherin and SAX-7/L1CAM function redundantly to regulate cell-cell adhesion and gastrulation in *C. elegans*. American Cancer Society Postdoctoral Fellows Meeting, Santa Anna Pueblo, NM, November 1-3, 2006.

Grana, TM, EA Cox, T Walston, J Hardin. HMR-1/cadherin and SAX-7/L1CAM function redundantly to regulate cell-cell adhesion and gastrulation in *C. elegans*. *C. elegans* Development & Evolution Meeting, Madison, WI, June 22-25, 2006.

Couthier, A, **TM Grana**, A Flett, J Hardin, J Pettitt. Making the HuMPback bridge: a genome-wide screen for molecules that contribute to cadherin-catenin complex function. 15th International *C. elegans* Meeting, Los Angeles, CA, June 25-29, 2005.

Grana, TM, EA Cox, J Hardin. HMR-1/cadherin and LAD-1/L1-CAM act cooperatively to regulate cell-cell adhesion during gastrulation in *C. elegans*. 15th International *C. elegans* Meeting, Los Angeles, CA, June 25-29, 2005.

Grana, TM, TG Bivona, MR Philips, AD Cox. Spatio-temporal control of radioresistance by oncogenic Ras. 12th International Congress of Radiation Research, Brisbane, Australia, August 17-22, 2003.

*Litterer, RL, **TM Grana**, AD Cox. TC-21, a Ras-related oncoprotein, as a target for geranylgeranyltransferase inhibitors in anticancer treatment. UNC-CH Annual Celebration of Undergraduate Research, Chapel Hill, NC, April 25, 2003.

Grana, TM, EV Rusyn, AD Cox. Mechanisms of Ras-mediated radioresistance. UNC-CH Curriculum in Genetics and Molecular Biology Retreat, Chapel Hill, NC, September 6, 2000.

Grana, TM, H Shao, DA Andres, AD Cox. What properties of Ras-related proteins, Rit and Rin are important for signaling and transformation? UNC-CH Curriculum in Genetics and Molecular Biology Retreat, Chapel Hill, NC, August 24, 1999.

***Grana, TM**, AD Cox. Combination FTase inhibitor and I- κ B treatment for radiosensitization of epithelial cells. 45th Annual Meeting of the Radiation Research Society, Louisville, KY, April 25-29, 1998.

References by request: Andrew Dolby, Deborah O'Dell.
September 2012

Teaching Statement

In my teaching, I focus on *providing a foundation* upon which students can build. Students enter my classes with varied levels of preparation, goals, and needs. Throughout the semester, I seek to establish a solid foundation which is essential to students' understanding of more advanced concepts. This involves relating the material to the students' interests and experiences. I stress that my role is as a guide and that the role of each student is to build their own framework through practice and working with the concepts. By providing credit for assignments and class activities, I emphasize that practice matters. Along with understanding of the foundational concepts, I teach the language of science, and provide group worksheets and group laboratory activities. This gives students the opportunity to work with the concepts and practice using the language of biology. Because exams are only part of what demonstrate learning, these activities occur prior to exams so that students have a chance to learn and own the material.

Another emphasis of my teaching is *removing obstacles*. Misconceptions are the primary obstacle I can address to improve student learning. Misconceptions about basic biology are plentiful. Because additional concepts are built upon the basics, addressing misconceptions is a major aspect of my teaching. I have kept records of student misconceptions as revealed by answers they provide on homework and exams. These records have allowed me in subsequent years to teach material from a different angle, ask clarifying questions during lectures, and design class activities that address the misconceptions. When I walk around the room during group worksheet activities, I talk to students in small groups or one-on-one to lead them to more accurate understanding. Once misconceptions are addressed, the students can better piece together new concepts and build up a solid understanding.

I also *emphasize thinking and understanding over facts*. Knowledge of biology is expanding rapidly in this information age, and how students should be trained is changing. Our students need to develop logical and reasoning skills, to understand cause and effect, to identify and disregard red herrings, and to be able to develop a rational argument. By asking students to explain evidence, to design and interpret experiments, and to read and critique popular articles related to the class material, I emphasize development of these intellectual skills. Multi-week projects and laboratories give my students opportunities for deeper understanding and questioning: more chances to fit material together, to relate it to the class concepts, and to communicate what they are learning. Projects, not lectures, help students improve in the skills they need to make sense of the world and to perform well in their careers.

The project I propose for the Jepson Fellowship relates directly to *providing a foundation*, *removing obstacles*, and *emphasizing thinking and understanding over facts*, because doing science is a vehicle for students to really learn. Seeing science as just a collection of facts that they can memorize and not contribute to is an obstacle to learning. By working through problems students encounter in their expanded *Wormfinding* project, students will develop intellectually. This project will involve background reading of primary literature, exploration and synthesis of information from various sources, integration of the students' experimental results with the wider scientific knowledge, and communication. Furthermore, students learn best when what they are learning really matters. In this project, they will be adding to the body of scientific knowledge, so what they are learning and doing matters. Students will experience responsibility, teamwork, the excitement of discovery, and that their contributions are important. That is what is most essential for them to learn in a general education course that aims to introduce students to laboratory science.

Professor: Dr. Theresa Grana
Office: 436 Jepson (x1196)
Email: tgrana@umw.edu

Office Hours: Mon. 11:30-1, Tues. 12:15-2,
Wed. 11:30-1, Fri. 2-3 *or by appointment*

Lecture: Mon., Wed., Fri. 3:00 - 3:50 Jepson 219
Lab: Thurs. 2:00 - 4:45 Jepson 110

Materials to Purchase for the course:

Textbook: 1) Campbell Biology: Concepts & Connections, 7/E, Jane B. Reece, Martha R. Taylor, Eric J. Simon, Jean L. Dickey, published by Benjamin Cummings, 2012.

Online Learning Platform: 2) MasteringBiology®

Information on variously priced options for purchasing/renting the text and MasteringBiology® are posted on Canvas. Register for our section via the Course ID: MBGRANA95224

Lab Manual: 3) Experiments in Biological Concepts, Vol. 1. 2012. Dept. of Biological Sciences, UMW. 5th edition, McGraw-Hill, Inc. ISBN-13: 978-0-07-804593-6 ISBN-10: 0-07-804593-2. *You must have the current edition. It can only be purchased through the UMW bookstore.*

Student Learning Objectives:

1. To acquire a knowledge of biology that will enable meaningful intellectual engagement within the discipline. The main areas of study for Biological Concepts 121 are:
 - a. basic chemistry and the functions of biological molecules
 - b. the functioning of living things on a cellular level
 - c. the mechanisms of genetics that explain how cells reproduce and how characteristics are inherited
 - d. the evolutionary mechanisms that explain how organisms have changed during Earth's history
 - e. the principles of ecology within the studies of behavior, population dynamics, community and ecosystem dynamics, biogeochemical cycles, biomes, and conservation biology
2. To describe the major theories and principles of biology including:
 - a. the evidence supporting these ideas
 - b. how these theories and principles have changed over time
 - c. the role of the scientific mode of inquiry in developing these scientific understandings
3. To use the scientific method to seek answers to scientific questions, including:
 - a. the use of the scientific method to design, carry out, and interpret results of experiments
 - b. the use of the scientific way of thinking in order to understand, interpret, and evaluate scientific information as a means of solving real-world problems
4. To acquire the background and skills to become scientifically literate, specifically:
 - a. to be able to understand and critically evaluate current and future developments, discoveries, and controversies in biology, for example genetic testing, natural resource management, and climate change
 - b. to understand how biological information impacts one's everyday life, including the choices one makes regarding various personal and societal issues
5. To describe how the progress of biological knowledge has created new social, political, philosophical, and technical dilemmas for individuals and society
6. To demonstrate fundamental laboratory techniques and the use of scientific equipment

MasteringBiology®: your course resource

- PowerPoint slides used in for each week's lectures will be available on MasteringBiology® the Sunday before the lecture. For most students, it is useful to print out these notes and take additional notes on them during class.
- Course assignments, quizzes, grades, documents and announcements will be posted on MasteringBiology®. We will not use the Canvas site, but a link to Mastering has been posted on Canvas.

Nematode Worm Research

By being in my 121 Biology lab, you have joined my research team for the semester. As a researcher, you will discover new species of worms, and participate in their characterization throughout the semester. You will meet the ongoing members of my research team and learn from them. You are expected to be completely honest about the locations where you find worms, the dates you sampled, etc. Throughout the semester you will learn more about the research you are participating in. Because the other 121 labs do not participate in this research we will shorten and skip some of the lab activities in the lab manual, but appropriate related activities using worms will be added. Also, because we are doing original research with live organisms, the schedule of lab activities may change based on their life cycles.

Honor Code

- You are expected to abide by the UMW Honor Code.
- All tests, quizzes, and other assignments **must be completed independently (unless indicated otherwise)** and pledged.
- Cell phones and all other electronic devices must be put away during lecture and lab tests. Any calculations performed must be done on a *calculator dedicated for that purpose*.
- You are encouraged to work together and discuss concepts in post-lab assignments and during your group class activities, but you should represent your own thoughts on your turned in assignments.
- Plagiarism is copying another individual's work and representing it as your own, even when you change the wording. I want to see your work so I can help you learn, not someone else's work.
- You must write out the complete pledge as posted in your classroom.
- The consequences for cheating are severe, no matter how big or 'minor' the violation. Your instructor will turn you in.

Lecture: Attendance, conduct and requirements

- Please help create a positive, low stress, learning environment:
 - be professional
 - make sure your phone is turned off
- Lecture will begin promptly at 3:00 PM.
- Attendance is not mandatory but is highly recommended. If you miss class you will miss out on critical announcements and will also miss information not in the text or online.
- As with most things in life, you will get out of this class what you put into it.

Lab: Conduct, attendance and requirements

- **Your Responsibilities:** Come to lab prepared. *Bring the lab manual to lab, every time.*
- Come to lab on time and do not leave before the instructor reviews your results.
- Follow safety instructions.

Biology Department lab attendance policy: Because Biological Concepts 121 is a laboratory course it is imperative that students participate in the laboratory exercises.

One lab missed: no penalty

Two labs missed: 20 point deduction from final lab participation grade.

Three labs missed: full letter grade deduction for course, for example, a B+ would be reduced to a C+. This is in addition to 20 point penalty noted above for the second lab missed.

Four labs missed: grade assigned is “F” or withdraw from the course

If will miss a lab for a valid reason (e.g. illness, college-sponsored activity), you plan to attend another section. You can only make up a lab during the same week of the lab. Contact both me and the instructor of another section as soon as you know about your need to change.

Note that lab attendance also affects class participation because your lab group depends on you.

Grading

Final Grade = $100 \times \text{total points earned} \div \text{points possible}$ (~743 total for course)

Exams	4 x 100 points	400
Pre-class mastering assignments (on Mastering site)	10 x 3 points	30
In class participation (group worksheets/assignments/news presentations)	10 x ~10 points	~100
Homework assignments (on Mastering)	15 x 5-10 points	~100
Lab participation (prompt attendance, full engagement, team player)	13 x 5 points	65
Post-lab assignments (sometimes on Mastering site)	8 x 5 points	40
Lab review assignments	3 x 20 points	60
Enzyme lab presentation I	8 points	8
Enzyme lab presentation II	20 points	20
Worm project activities	5 x 8 points; Poster 20	60
TOTAL POINTS		~883

Grading Scale

A	100-94	B-	83-80	D+	69-67
A-	93-90	C+	79-77	D	66-60
B+	89-87	C	76-74	F	< 60
B	86-84	C-	73-70		

Grades below a 70% or multiple missed labs will be reported as Unsatisfactory on mid-semester reports.

Lecture Exams

- Exams are best prepared for by studying early – for a brief time after each lecture. Don't try to learn it all at once. Additional study tips will be posted online.
- Skipping an exam will result in a score of 0.
- The final exam is similar to the other exams, but 10% of it will address general themes of the course. These themes will be repeated throughout the course.
- The final exam will only be given at the time scheduled by the college. Exception to this policy can only be approved by Dr. Fred A. Pierce, Associate Dean of Academic Services, 654-2164, fpierce@umw.edu

MasteringBiology® assignments

- Pre-class assignments will be posted on MasteringBiology®. While few points are associated with these assignments, you will not be able to receive credit for related class activities that follow these assignments. The class activities are worth more points and the pre-class assignments prepare you to fully participate in the class assignments.
- Homework with material covered in the lecture time, or material you are assigned to learn on your own will also be assigned through MasteringBiology®.
- All work on Mastering is open-book, open-notes. You should not work with others on you Mastering pre-class or homework assignments, unless specifically told to do so by your instructor.
- These assignments are designed to (1) help you to learn and apply the material, (2) help you determine whether you really understand the material, (3) provide me with information regarding class-wide understanding of the material, and (4) serve as an "open-book, take-home" exam. It is worthwhile to spend time on these!

In class participation (group worksheets/assignments)

Group demonstrations, worksheets, and question-answer sessions will occur during the lecture portion of the course. If you miss lecture you will miss out on the associated points. If you do not do the pre-assignment, you will be able to participate, but not get points from the class activity (because you are not prepared).

Post-lab Assignments

Post-lab assignments are due at the beginning of the following lab or on mastering biology (as assigned). Post-labs may not be turned in without participation in the lab. There will be 10 post-lab assignments. Your **top 8 scores will be included in your final grade**. Late post-lab assignments lose 2 points per day.

Lab review assignments

These essay format review assignments will be based on the lab exercises completed and help you to relate the course material to concepts learned in lab.

Enzyme Lab Oral Presentations

For the enzyme lab you will design and conduct your own experiments. Lab groups will present their proposed experiments, conduct them, and at a later date present an overview of their whole project, including results. Details will be discussed in lab.

Worm Project Activities and Poster

Various activities involving Nematode biology will be assigned throughout the semester.

For the poster assignment you summarize your work with worms from the entire semester and you will be able to work on it throughout the semester.

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The **Office of Disability Resources** has been designated by the University as the primary office to guide, counsel, and assist students with disabilities. If you need accommodations for this class make an appointment with me to discuss your approved accommodation needs. Please bring your accommodation letter with you to your appointment. If you need accommodations and have not made prior arrangements, I will be happy to refer you. The disability resources office can be reached at 654-1266, and will require appropriate documentation of disability. All information will be kept confidential.

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Flexibility - the schedule on the following page is tentative.

big assignments/exams in **bold**. worm related activities in *italics*

Week	Topic/Activity In M, W, F order	Text Reading	Week's Lab exercises Thu 2-4:45	Due in Lab/before lab
1 Aug 27-31	M – Syllabus, Exploring Life W – Exploring Life F – Chemical Basis of Life	Ch 1 2	pages v-x Laboratory Safety 1- How Scientific Knowledge is Acquired 2-Microscopy	safety quiz <i>CUR survey I</i>
2 Sept 3- 7	Chemicals continued Molecules of Cells Molecules of Cells	3	3-Biological Molecules	<i>Collected Worms</i> post-lab 1/2
3 Sept 10-14	Tour of the Cell Tour of the Cell Working Cell	4 5	4-Cell Diversity	post-lab 3
4 Sept 17-21	Working Cell <i>Molec. & Cells Review/Activity</i> Exam 1 (Ch. 1, 2, 3, 4, 5)	5	5-Osmosis and Diffusion	post-lab 4
5 Sept 24-28	Chemical Energy Chemical Energy Photosynthesis	6 6 7	6-Enzymes I (Learn Enzyme System) Lab review assignment 1 due at the beginning of lab	post-lab 5, By end: plan of independent expt.
6 Oct 1-5	Photosynthesis <i>Energy Review/Activity</i> Molecular Biology of the Gene	7 10	6-Enzymes II (Independent Experiment) - present formal plan first	Group presentation: 6
7 Oct 8-12	Molecular Biology of the Gene Controls Over Genes Controls Over Genes	10 11 11	7-Photosynthesis 8-Fermentation & Cellular Respiration	6 – Analysis of enzyme results
8 Oct 15 – 19	Fall Break <i>Genes Review/Activity</i> Exam 2 (Ch. 6, 7, 10, 11)		No lab this week. More time to study!	
9 Oct 22 – 26	DNA Technology, Genomics Cell Reproduction Mitosis	12 8 8	9-substitute – <i>PCR from worm samples</i> 6-Enzymes III (Presentations)	post-lab 7/8
10 Oct 29- Nov 2	Meiosis Patterns of Inheritance <i>Chromosome Review/Activities</i>	8 9	9-substitue - <i>Gel Electrophoresis of worm PCR</i> 10-Meiosis and Genetics	Lab review assignment 2 due at the beginning of lab
11 Nov 5-9	History of Evolution, microevolution Evolutionary Events Macroevolution	13 15	11- Evidence for Evolution	post-lab 9 & 10
12 Nov 12-16	Natural Selection, Speciation <i>The Great Clade Race</i> Exam 3 (Ch 8, 9, 12-15)	13, 14	12- Evolutionary Mechanics--Natural Selection and Genetic Drift	post-lab 11
13 Nov 19	Biosphere no class W or F	34	No lab this week. THANKSGIVING BREAK (Nov 21-23)	free
14 Nov 26-30	Behavior <i>Easter Island Activity</i> Population Ecology	35 36	13-Plant Competition I 14-Invertebrate Diversity I	post-lab 12 <i>Worm Poster</i>
15 Dec 3 - 7	Communities & Ecosystems Conservation/Sustainability Human Impacts / Review	37 38	data collection & analysis 13-Plant Competition II 14-Invertebrate Diversity II	<i>CUR survey II</i> Post-lab 13/14 at the end of lab
Wed, Dec 12	3:30-6 PM Exam 4 (Ch 34, 35, 36, 37, 38) Jepson 219; Lab review assignment 3 due at the final exam NO LAB			