overview: welcome to the genome, cell and developmental (gcdb) program within the biology department at indiana university! you are entering graduate school at an exciting time in the life sciences. the gcdb interdisciplinary graduate program provides classroom and laboratory training in key areas of genetics, genomics, cell biology, developmental biology, molecular biology, biochemistry, biology, cell biology, bioinformatics, and evolution. our faculty are engaged in a wide range of cutting-edge research activities, which offers incoming graduate students many choices for their thesis research. students in our program learn how to plan, execute, critically analyze, and communicate scientific research. professional development includes learning how to present seminars and write high-quality research papers and grants. the gcdb program provides students with research training and professional development to pursue careers in academic biomedical research, biotech industry, university-level teaching, and other life science careers.

doctor of philosophy (ph.d.) degree requirements

this bulletin, other information, and required forms for the gcdb program can be found in the gcdb folder on the cloud-sharing platform “iu box.”

degree information: students entering our program are expected to earn a major in genome, cell and developmental biology and a minor in a subject area that is of interest to the individual student and related to their thesis project. most students choose the genetics minor offered by gcdb.

teaching requirement: ph.d. candidates within the gcdb graduate program are required to teach for at least one semester during their graduate career. to prepare graduate students for their teaching assignments, the department of biology offers a teacher training workshop. all graduate students must enroll in this workshop prior to the onset of your first teaching assignment; however, we strongly suggest that students complete this workshop during orientation week prior to the start of your first year in graduate school. in addition, all graduate students must enroll within the associate instructor workshop on campus climate, which is offered by indiana university.

english proficiency exam: students whose native language is not english must pass the test of english for associate instructor (ai) candidates, an english fluency examination. the college of arts and sciences offers a formal course in english fluency (t502). information on this course is available in the graduate office. the t502 course and/or the ai english fluency exam must be successfully completed in the fall semester of the first year.

plagiarism tutorial: during orientation week, all first year gcdb graduate students must complete an online tutorial on plagiarism and submit a confirmation certificate to the biology graduate office. the gcdb program director will go over this requirement with first year students during orientation week. the online tutorial can be found at the following website: https://www.indiana.edu/~istd/ . violation of the plagiarism rules can result in dismissal from the program and graduate school.
**General Course Requirements:** A total of 90 credit hours are required for partial fulfillment of the Ph.D. degree. Of these, 22.5 credits are earned by completing the course requirements for the GCDB major (see below). An additional 6-12 credits are earned by completing the requirements for the minor, depending on type (see below). All remaining credits are earned through laboratory research rotations (year 1) and enrollment in L800, independent thesis research. A listing of courses for which graduate credit is offered in the 2016-17 years can be obtained from the Biology Graduate Office or from the Indiana University Office of the Registrar website.

**Course Requirement for the GCDB Major**

<table>
<thead>
<tr>
<th>First Year Fall</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B511 Biochemistry</td>
<td>3.0 cr</td>
</tr>
<tr>
<td>L585 Genetics</td>
<td>3.0 cr</td>
</tr>
<tr>
<td>Z620 Bioinformatics 2 Go</td>
<td>1.5 cr</td>
</tr>
<tr>
<td>L523 Critical Analysis Lit.</td>
<td>1.5 cr</td>
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<tr>
<td>L501 Rotations</td>
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<table>
<thead>
<tr>
<th>First Year Spring</th>
<th></th>
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<tbody>
<tr>
<td>L586 Cell Biology</td>
<td>3.0 cr</td>
</tr>
<tr>
<td>L587 Dev. Biology</td>
<td>3.0 cr</td>
</tr>
<tr>
<td>Z620 Journal Class²</td>
<td>1.5 cr (can be taken in second year)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Second Year Fall</th>
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<tbody>
<tr>
<td>Z620 Grant Writing</td>
<td>1.5 cr</td>
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</table>

<table>
<thead>
<tr>
<th>Third Year Spring</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Res Ethics and Career Dev.</td>
<td>1.5 cr</td>
</tr>
</tbody>
</table>

Total 22.5 cr

**Students should register for additional minor courses and/or independent research (L800) to total 12 credits each semester.**

**Students can register for 0-6 credits during the summer, but should first consult with their mentor and the Biology Graduate Office.**

¹The GCDB Graduate Program Director must approve any exemptions or substitutions of listed classes with equivalent courses.

²Journal Classes: Z620 Chromosome and Genome Biology or Z620 Cell Biology or P550 Physiology of Cancer

**G901 Status:** Once 90 credits are earned, students are in “G901 status.” Once this status is achieved, the potential tuition costs and fees charged by the college drop dramatically. G901 status is typically attained during the 4th year. Students then register for six G901 credits each semester instead of L800 research credits, but students cannot register for any more formal coursework. Students can use G901 status for six semesters, after which they lose G901 status and full tuition is charged again, even if 100% of their time is engaged in laboratory research.
Course Requirement for Minor: Indiana University requires that all graduate students obtain a minor. Ph.D. candidates must declare a minor by the end of the fall semester of the second year; however, we encourage students to declare a minor by the end of the first year so that minor coursework can begin in the second year. The GCDB program offers a six credit minor in Genetics. An approved list of courses for the Genetics minor can be found on page 9 of this bulletin. Students wishing to use courses for the minor that are not on this list must get pre-approval from the GCDB Graduate Program Director. Important: a course that is used to fulfill the minor requirement cannot count towards the major requirement and vice versa.

Information relating to the course requirements for minor degrees outside of the GCDB program can be obtained from the program director of the relevant graduate program. GCDB graduate students must obtain approval for minor degrees outside of Genetics from their thesis advisor, thesis committee, and the GCDB Graduate Program Director. All course requirements for the minor degree must be completed by the end of the spring semester of the third year.

GCDB Program Seminars: All Ph.D. candidates are required to attend the GCDB seminar series throughout their entire career within the program. These seminars are an opportunity to hear about the latest research from prominent invited scientists, and are an integral part of a diversified scientific training program. The seminars are held Thursday afternoons at 4pm during the fall and spring semesters. A complete listing of the invited speakers is available on the Biology Department website.

GCDB graduate students are also expected to attend the public portion of the thesis defenses of their fellow GCDB graduate student colleagues, and other special lectures including the Carlos O. Miller Lecture, the James P. Holland Lecture, the Tracey M. Sonneborn Lecture, tenure and promotion seminars by GCDB training faculty, and GCDB job candidate seminars. The dates and times of these seminars can be found on the Biology Department website.

Publications: To earn a Ph.D., your research must make a significant contribution to your field. By definition, a significant contribution requires that you publish your thesis research. Ph.D. students within the GCDB program are expected to publish at least two, significant, peer-reviewed papers prior to the thesis committee approving the student for graduation. Rare exceptions to this expectation must be approved by the thesis committee and GCDB Graduate Program Director.

Research Rotations: Each Ph.D. candidate is required to complete three research rotations (L501) during the fall semester of the first year. A complete listing of GCDB core and affiliated training faculty can be found below and on the GCDB program section of the Department of Biology website. In addition, many GCDB faculty members have lab web pages that are linked to their departmental site. During orientation week, multiple GCDB faculty present short research talks to help students select a rotation lab. Students are highly encouraged to meet individually with faculty members to learn more about their research before selecting a rotation lab. The GCDB Graduate Program Director will go over the rotation timeline and instructions for selecting a laboratory with incoming students during orientation week.

At the end of each rotation, the research supervisor must complete the “Rotation Evaluation” form and discuss it with the student. The faculty member and student must both sign the form, and then the student brings the form to the GCDB graduate program director. This form can be downloaded from the GCDB Grad Program Folder. Based on the three rotation evaluations, a final grade will be assigned for L501.
At the end of the third rotation in December, Ph.D. candidates are required to select a laboratory within which they will conduct their thesis research. In the rare case that students wish to do a 4\textsuperscript{th} rotation, they must obtain permission from the GCDB Graduate Program Director. The selection of a thesis home is a negotiation process between the faculty and student. Students are not guaranteed positions in laboratories, although in practice this is rarely an issue. It is important to note that entry into a research lab is a requirement for our graduate program, and students must have joined a lab by the end of the spring semester of the first year at the very latest.

**Thesis Committee:** At the end of the spring semester of the first year, students will need to select a Thesis Advisory Committee. The committee must include the thesis advisor and at least two other faculty members. A fourth member must be added no later than the end of the fall semester of the second year – and could be the minor representative. The committee members should be selected based on their ability to contribute to the student’s thesis project, and do not necessarily have to be members of the GCDB section. The “Appointment of Advisory Committee” form must then be filled out and turned in to the Graduate Office.

**Annual Committee Meetings:** Students must have their first thesis committee meeting no later than the end of the fall semester of second year. Ph.D. candidates are required to formally meet with their thesis advisory committee once a year. The meeting is designed to assess the progress of the student in the past year and to provide advice on the upcoming year’s experiments. Prior to meeting with the committee, the student should provide a written document summarizing progress over the past year and the experiments that are proposed for the upcoming year. Please see the “Committee Meeting Report Guidelines” for the format of this report. The report should be distributed to all committee members no later than one week prior to the annual meeting. The student is responsible for printing and bringing the “Committee Meeting Evaluation” form to the meeting, and submitting the signed form to the Biology Graduate Office shortly after the meeting. The student and advisor should discuss the contents of that form after the meeting and prior to its submission.

**Preliminary Exam Requirement:** In the fall semester of the third year all Ph.D. candidates in the GCDB graduate program are required to take the Preliminary Exam. Students write a proposal on their thesis research and then defend it orally. During the oral exam, students are also examined for general knowledge relevant to their research area. The GCDB Graduate Program Director will meet with all second year students in the spring semester to discuss the preliminary exam format and instructions.

The Preliminary Exam Committee will consist of the members of the thesis committee (minus the thesis advisor). After the examination a “Preliminary Exam Evaluation” form must be completed and signed by the committee, advisor, and directors of both GCDB and the Biology Graduate Program. The student then brings the form to the Biology Graduate Office. If the committee is satisfied with the student’s performance on the written and oral exam, then the student passes. If the members of the committee feel that the student’s performance does not warrant a passing grade, then they can either fail the student or provide the student with the opportunity to retake one or more portions of the exam. If the second option is selected, the student must successfully complete the required items by the end of the fall semester of the third year. If a student does not pass the preliminary exam by this date, they may not continue in the Ph.D. program. On a case-by-case basis, a student may be admitted to a program leading to a Master’s Degree in GCDB. Depending upon the circumstances, the thesis committee (in consultation with the GCDB graduate program director) can recommend that the student be enrolled in either a research or library Master’s program.
Nomination to Ph.D. candidacy: After passing the preliminary exam, and fulfilling all major and minor requirements, the student moves on to Ph.D. candidacy. The student must complete the “Nomination to Candidacy” form that is located on their personal One.IU site. This form is then submitted electronically to the Biology Graduate office. A list of courses that were taken to meet the major and minor requirements should be submitted with the Candidacy form. Completion of major and minor courses and submission of the candidacy form should be at the end of the third year.

Thesis Requirement: Submission of a written thesis to Indiana University is required for a Ph.D. degree. The thesis must represent a body of independent, published work that makes a significant contribution to science. Once the student and advisor agree that the thesis is nearly done, a student should begin to plan the thesis defense. At least six months in advance of the defense, the members of the Thesis Advisory Committee and the University Graduate School must approve the thesis prospectus. In order for the committee to make this determination, the student should provide the committee with an updated CV, copies of manuscripts that have been published, accepted, or are in a state of revision, and a detailed outline of the thesis. The student should also meet with the committee and present in seminar format the completed and anticipated research progress. The student should then select a date for the defense when all of the thesis committee members can be present.

Instructions on the proper thesis format are available at http://graduate.indiana.edu/theses-dissertations/index.shtml and sample written theses of former students are available at the Biology Graduate Office. Each thesis committee member must receive a copy of the thesis that both the student and advisor considers complete, including all figures, tables and references. The thesis must be submitted to the committee no later than four weeks prior to the defense. Committee members are expected to read the thesis promptly and carefully. If they have major objections, they will express them at this stage and the defense may be postponed. It is more common that committee members will suggest revision of only portions of the thesis, and reserve these comments for the thesis defense.

The thesis defense comprises two parts: a public presentation followed by a private exam by the Thesis Advisory committee. The public presentation (i.e. a seminar) must be announced in advance: the University Graduate School requires the submission of an Announcement (electronic) page, which can be found at: http://graduate.indiana.edu/theses-dissertations/index.shtml. This one-page summary is due 30 days prior to the scheduled defense. The student is also required to post a seminar announcement in the Biology Department "This Week in Biology." After the exam, theses may be accepted in their current form (rare), rejected (also rare), or accepted pending revision (common). Once a thesis has been revised to meet the committee’s standards and the University's format requirements, the committee and research advisor certify its acceptance to the Graduate School and recommend that the Ph.D. degree be awarded. It should be noted that the thesis must be accepted formally no later than 7 years from the date of admission to candidacy (successful passing of the preliminary exam). In most cases, however, it is expected that it will take much less time for a student to publish their research and defend their Ph.D.

Academic Standing: A student must maintain a 3.2 grade point average in order to remain in “good standing”. This is important for remaining in the program and receiving and retaining merit-based fellowships and/or awards. At Indiana University grades are assigned according to the following scale: A = 4.0, A- = 3.7, B+ = 3.3, B = 3.0, B- = 2.7 and C+ = 2.3. In addition, for a course to be counted towards the completion of a degree requirement, it must be passed with a
grade of a B- or better. A student who receives a course grade of less than a B- or obtains a semester GPA of less than 3.2 will be placed on academic probation. The student will then have one semester in which to correct the academic deficiency. Under extreme circumstances, this period can be extended but requires approval of the GCDB graduate program director. If the student is able to rectify the situation then the academic probation will be lifted. If the situation persists, then the student will be required to leave the program.

In addition to meeting all University individual course and semester grade requirements, a student must be making sufficient progress towards completing a thesis in order to remain in “good standing” within the GCDB program. If the research advisor and/or other members of the Thesis Advisory Committee become dissatisfied with a student's progress or efforts, a meeting of the student with the Thesis Advisory Committee must be called to discuss the reason(s) for concern. If the Committee determines that the student's progress is not satisfactory, then the student will be placed on probation. The probationary period of – one semester will provide an opportunity for the student to demonstrate effectiveness and progress in research. This research may be conducted in the same lab with the same research advisor or in a new lab with a different research advisor. If the Thesis Advisory Committee judges the student's progress to be satisfactory at the end of the probation period, probation will be lifted. If the Thesis Advisory Committee judges the student's progress to remain unsatisfactory, then the student will be required to leave the GCDB program and any departmental commitment to provide further financial support for the student will be suspended at the end of the semester during which the student is discharged from the program.

**General Outline of Graduate Career in the GCDB Program**

**First Year**

Important goals of the first year include successfully completing required coursework, selecting a research lab, beginning thesis research, and selecting a thesis advisory committee.

**Fall:** Students conduct three research rotations and then select a thesis research lab by the end of the fall semester. Students also enroll in a set of core courses that cover topics that are essential to molecular biology, cell biology, developmental biology, genomics, and genetics. Please see the “Course Requirements for Major” list for details.

**Spring / Summer:** Students begin their thesis research and continue to take required courses. In rare cases, and with approval by the GCDB program direction, students may do a 4th rotation that extends into the second half of the year. By the end of the spring semester each student must assemble a thesis committee to help oversee their progress toward the Ph.D.. All rotations, the selection of a thesis advisor, and the assembly of a thesis committee must be completed by the end of the spring semester of the first year. During the summer, students focus on making significant research progress. Another important summer goal is to write the first draft of the thesis research proposal in preparation for the first thesis meeting in the fall.

**Second Year**

The second year of graduate school is primarily focused on becoming fully immersed in thesis research, preparing for the preliminary examination, and completing required coursework for the major and minor degrees. A student should continue to strive to become increasingly adept at reading the scientific literature and directing their own research, important goals of graduate training.
Fall: In addition to required course work, students must meet with their thesis advisory committee. There are also a number of external graduate fellowship deadlines in the fall to which students should apply. Information about these fellowships can be found online in the GCDB folder. The thesis proposal that students began writing during the previous summer should be a good first draft for these external proposals.

Spring / Summer: At the end of the spring semester, the GCDB program director will meet with all second year students to discuss the upcoming preliminary examination that will take place in the fall semester of the third year.

Third Year: The important goals of the third year of graduate school are the preliminary examination, completing all major and minor coursework, and transitioning to full-time research.

Fall: As described above, students must take the preliminary examination in the fall semester. This examination seeks to determine whether each student has successfully prepared for a career as an independent scientist. Students who pass the exam are admitted to formal candidacy for the Ph.D. degree. Once admitted to candidacy, students spend the majority of their time working on their research projects. Students who fail this exam will leave the program.

Spring / Summer: In the spring semester, all students are required to enroll in Z620 Research Ethics and Career Development. The student must submit an electronic Nomination to Candidacy form and the graduate office will formally nominate them for candidacy at the end of the third year. To be admitted to candidacy, all coursework for minor and major must be completed as well as passing the preliminary exam.

Fourth and Fifth Years: During the fourth and fifth years of graduate school all students are expected to devote 100% of their time and efforts towards completion of their dissertation research. Students who are serving as associate instructors must budget extra time for their thesis research. Students must meet with their thesis committees once a year to remain in good standing. Each Ph.D. candidate should be working towards publishing manuscripts and writing and defending their thesis at the end of their fifth year. The GCDB program expects that all students publish two peer-reviewed primary research articles. Given the inherent uncertainties of research, it is not uncommon for a graduate career to extend somewhat beyond the fifth year. Students should, however, exert significant effort to ensure that their career in graduate school is as short and productive as possible. By the end of the fourth year you must submit the Nomination of Research Committee form, which is required by the University Graduate School. This form is located on the One.IU site. This form formalizes your dissertation title, provides a brief prospectus of your research, and solidifies your research committee. You must submit this form prior to advancing to your defense.
List of GCDB Graduate Training Faculty
Please see the GCDB page on the Biology Department website for details:
http://www.bio.indiana.edu/graduate/gcdb/index.shtml

<table>
<thead>
<tr>
<th>GCDB Core Training Faculty</th>
<th>GCDB Affiliated Training Faculty</th>
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<tbody>
<tr>
<td>Carol Anderson</td>
<td>Matthew Bochman</td>
</tr>
<tr>
<td>Steve Bell</td>
<td>David Daleke</td>
</tr>
<tr>
<td>Volker Brendel</td>
<td>Pranav Danthi</td>
</tr>
<tr>
<td>Brian Calvi</td>
<td>John Foley</td>
</tr>
<tr>
<td>Roger Hangarter*</td>
<td>Wayne Forrester</td>
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<tr>
<td>Ke Hu</td>
<td>Matthew Hahn</td>
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<tr>
<td>Roger Innes</td>
<td>Richard Hardy</td>
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<tr>
<td>Thom Kaufman*</td>
<td>Peter Hollenhorst</td>
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<td>Justin Kumar</td>
<td>Heather Hundley</td>
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<tr>
<td>Soni Lacefield</td>
<td>David Kehoe</td>
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<tr>
<td>Michael Lynch</td>
<td>Anirban Mitra</td>
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<td>Scott Michaels</td>
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<tr>
<td>Craig Pikaard</td>
<td>Tuli Mukhopadhyay</td>
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<tr>
<td>Beth Raff*</td>
<td>Ken Nephew</td>
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<tr>
<td>Sidney Shaw</td>
<td>Irene Newton</td>
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<tr>
<td>Nicholas Sokol</td>
<td>Hengyao Niu</td>
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<tr>
<td>Jason Tennessen</td>
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<tr>
<td>Andrew Zelhof</td>
<td>Jeff Palmer*</td>
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<tr>
<td>Gabe Zentner</td>
<td>Anne Prieto</td>
</tr>
<tr>
<td>Miriam Zolan*</td>
<td>Erik Ragsdale</td>
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<tr>
<td></td>
<td>Haixu Tang</td>
</tr>
<tr>
<td></td>
<td>Claire Walczak</td>
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</tbody>
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*not taking new students
Course Listings for Genetics Minor

L533  Evolution of Genes and Genomes (3cr)  
L534  Evolution of Proteins and Cells (3cr)  
L567  Evolution (3cr)  
L585  Molecular Genetics (3cr)  
L586  Cell Biology (3cr)  
L587  Developmental Biology (3cr)  
Z620  BioInformatics-2-Go (1.5 cr)  
Z620  Introduction to Computational Data Processing in Biology (1.5cr)  
Z620  Introduction to Computational Workflow Design in Biology (1.5cr)  
Z620  CyberInfrastructure-enabled Computational Genome Science (3cr)  
Z620  Phylogenetics (3cr)  
Z620  Evolution (3cr)  
Z620  Introduction to Genomics and BioInformatics (1.5cr)  
Z620  Genetics of Behavior (1.5cr)  
Z620  Chromosome and Genome Biology Journal Class  
Z620  Cell Biology Journal Class  
P550  Physiology of Cancer Journal Class  
Z620  Methods in Epigenomics  
Z620  The Legacy of Drosophila: Contributions to a fundamental understanding of genes, chromosomes, and genetics (3cr)  
Z620  Digital Imaging and Light Microscopy  
I519  Introduction to Bioinformatics (3cr)  
I590  SNP Discovery and Population Genetics (3cr)  
P467  Diseases of the Nervous System (3cr)  
P526  Neurobiology of Learning and Memory (3cr)  
P566  Molecular and Cellular Neurobiology (3cr)  
M580  Molecular Biology of Cancer (3cr)  
M511  Molecular Biology of Prokaryotes (3cr)  
M541  Bacterial Pathogenesis and Virology (3cr)  

1 Or an equivalent course at IU or graduate work transferred from another university with approval of the GCDB Graduate Program Director  
2 GCDB students cannot use these courses for the Genetics minor due to overlap with major degree requirements.  
3 The same journal class cannot be taken twice to fulfill the major and minor. However, different journal classes can be taken for the major and minor.
Contact Information: The following individuals will serve as your primary contacts for information about the GCDB graduate program.

Brian R. Calvi Ph.D.          Roger Hangarter Ph.D.
GCDB Graduate Program Director Director of Graduate Studies
Jordan Hall, Room 361B        Myers Hall, Room 352
bcalvi@indiana.edu            rhangart@indiana.edu
812.855.5450 phone            812.855.5456 phone

Gretchen Clearwater          Melody Inabinette
Graduate Advisor             Administrative Assistant
Myers Hall, Room 150          Myers Hall, Room 150
gclearwa@indiana.edu         mjschell@indiana.edu
812.855.1861 phone           812.856.5522 phone

Helpful Websites
IU Box GCDB folder:
Indiana University, Bloomington: http://www.iub.edu
Biology Department: http://www.bio.indiana.edu
Faculty Strengths: http://www.bio.indiana.edu/faculty/strengths/index.shtml
GCDB Program: http://www.bio.indiana.edu/graduate/gcdb/index.shtml
Graduate Awards and Scholarships: http://www.bio.indiana.edu/graduate/awards/index.shtml
Lectures and Seminars: http://www.bio.indiana.edu/events/index.shtml
Indiana University Graduate School (University Bulletin): http://graduate.indiana.edu
College of Arts and Sciences: http://college.indiana.edu/graduate/
Teaching Resources for AIs: http://citl.indiana.edu/index.php