BIOINFORMATICS AND COMPUTATIONAL BIOLOGY (PH.D.)

Doctor of Philosophy. Major in Bioinformatics and Computational Biology.

Admission to this program is highly competitive; meeting admission requirements is not a guarantee of admission. Students who wish to enter the master's or doctoral degree program must demonstrate mathematical maturity, skill in the use of high-level programming language, and a basic knowledge of molecular biology. However, students lacking one of these may be admitted with the requirement that they make up the deficiency. The minimum admission requirements are at least a 3.0 undergraduate GPA if the student graduated within the last five years, although this may be waived under exceptional circumstances. Students for whom English is a second language must have a TOEFL score of 600 (250 computer-based or 100 IBT) or higher. Applicants must provide at least three letters of reference, speaking to the applicant's aptitude for graduate research, and a statement of research interests that clearly identifies the research the student would like to pursue and why they want to pursue it at the University of Idaho.

Both the M.S. and Ph.D. degrees require a thesis. Students will take research and thesis credits BCB 500 or research and dissertation credits BCB 600. The M.S. degree will require at least nine credits of thesis research and the Ph.D. degree will require at least thirty credits. M.S. theses for a BCB degree will demonstrate a high level of scholarly achievement, and doctoral dissertations will represent a significant, original contribution to the field. In addition to the thesis and dissertation, students will publish their work in appropriate peer-reviewed venues. Students will present their thesis and dissertations publicly at their final defense.

Each student’s graduate committee will consist of at least four faculty members. This committee will represent the three BCB disciplines (biological sciences, computer sciences, and mathematical sciences) and will include at least three participating BCB faculty members. Co-advising by major professors in different disciplines will be particularly attractive for BCB degrees, and is possible at the discretion of the student and his or her committee. There is no explicit requirement for an "external" committee member, since each committee will already includes faculty from at least three different disciplines.

There will be no qualifying examination. The Ph.D. will require a preliminary examination, which will be taken no later than the end of the fifth semester. The preliminary examination will have three components. First, it will include a written thesis proposal prepared in the format of a federal research grant and submitted to the committee at least four weeks prior to the oral examination. Second, there will be a public, oral presentation of the research proposal. Third, the committee will conduct a non-public oral examination in which committee members will ask questions about the proposed research, and about background and core coursework.

Incoming students admitted with background deficiencies will take background courses. For example, biology majors with little formal introduction to computation will take background courses in computer science. The specific required background courses will be determined by the students’ graduate committees with the approval of the program director. Note that credits from courses numbered 300 and below do not count toward the BCB degree requirements, though they may be required to fulfill deficiencies.

The core courses form a central, shared educational experience for all BCB students. These courses will enable them to share a common language and to discuss problems from multiple disciplinary points of view. This shared experience will also give BCB students a sense of identity and community, which will encourage them to help each other overcome cultural and terminological differences that usually make such interdisciplinary interactions challenging. When possible and appropriate, core courses will include group projects using team members with backgrounds in different disciplines.

The depth courses provide more detailed knowledge of bioinformatics and computational biology, and provide the springboard for graduate research. The list of courses will evolve with the research interests of the BCB faculty participants, and will be added as new faculty members join the program. See the program webpage at www.uidaho.edu/cogs/bcb (http://www.uidaho.edu/cogs/bcb/) for the latest information.

Other courses may be required as determined by the student’s committee.

To explicitly make it easier to bridge the traditional gap between disciplines, the BCB program includes four bridging activities:

- **Seminars and Workshops**: Seminar series are available and BCB students are required to participate. Seminars are an opportunity for students to interact with experts in a variety of fields. Workshops will provide practical experience with tools and techniques.
- **Lab rotations**: In order to expose doctoral students to the research perspectives of another discipline, we will require them to spend at least one semester in a lab outside the discipline of their major professor. The lab will be the research lab of one of the participating BCB faculty outside the discipline of the student’s major professor. The student’s committee will determine, in conjunction with participating faculty members, with whom the student will meet this requirement. There is no lab rotation requirement for M.S. students.
- **One Credit Supplements**: General courses in computer science, mathematics, and statistics sometimes lack material specific to bioinformatics and computational biology. Participating faculty will offer one-credit supplements to current courses in order to provide this connection without duplicating courses in the current catalog. These will be required of BCB students as determined by their graduate committees.
- **Teaching experience**: Each doctoral candidate will be required to have at least one semester of teaching experience relevant to the BCB program with the details of this requirement determined by his or her committee. This requirement may be satisfied, for example, by teaching a course, running a workshop, offering a supplement, or working as a teaching assistant.

The M.S. requires a minimum of 32 credits and the Ph.D. requires a minimum of 78 credits. The BCB program assumes the usual graduate full time load of at least 9 credits per semester. Note that the Ph.D. requires at least 18 credits of “other,” supplemental, or workshop courses at the 400-level or above since there are a total of 60 minimum required core, depth, thesis, seminar, and laboratory credits, and the student must have at least 78 credits to graduate.
### Ph.D. Degree

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Core Courses:</td>
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<tr>
<td>CS 515</td>
<td>Computational Biology: Sequence Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 522</td>
<td>Molecular Evolution</td>
<td>3</td>
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<tr>
<td>MATH 563</td>
<td>Mathematical Genetics</td>
<td>3</td>
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<tr>
<td>Depth Courses:</td>
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<td>Students must complete at least 6 credits in Biological Sciences and 6 credits in Computer/Mathematical/Statistical Sciences</td>
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**Biological Sciences**

| BIOL 421 | Advanced Evolution/Population Dynamics |       |
| BIOL 444 | Genomics                                |       |
| BIOL 526 | Systems Biology                         |       |
| BIOL 545 | Phylogenetics                           |       |
| BIOL 547 | Virology                                |       |
| BIOL 554 | Biochemistry II                         |       |
| BIOL 585 | Prokaryotic Molecular Biology           |       |
| BIOL 587 | Cellular and Molecular Basis of Disease |       |
| PLSC 588 | Genetic Engineering                     |       |
| WLF 561  | Landscape Genetics                      |       |

**Computer/Mathematical/Statistical Sciences**

| BIOL 526 | Systems Biology                         |       |
| CS 511   | Parallel Programming                    |       |
| CS 570   | Artificial Intelligence                 |       |
| CS 572   | Evolutionary Computation                |       |
| MATH 451 | Probability Theory                      |       |
| MATH 452 | Mathematical Statistics                 |       |
| MATH 538 | Stochastic Models                       |       |
| MATH 428 |                                          |       |
| PHYS 533 | Statistical Mechanics                   |       |
| STAT 519 | Multivariate Analysis                   |       |
| STAT 565 | Computer Intensive Statistics           |       |

**Seminar:**

| BCB 501 | Seminar | 3     |

**Lab Rotation:**

Students with a math or computer science emphasis take BCB 506 (biological science) and students with a biology emphasis take BCB 507 (computer science) or 508 (mathematical science)

| BCB 506 | Laboratory Experience in the Biological Sciences |       |
| BCB 507 | Laboratory Experience in the Computational Sciences |       |
| BCB 508 | Laboratory Experience in Mathematics or Statistics |       |
| BCB 598 | Internship                                       |       |

**Dissertation:**

| BCB 600 | Doctoral Research and Dissertation | 30 |

**Teaching Requirement:**

| BCB 597 | Practicum | 3 |

**Other:**

|            |           | 15 |

**Total (min):**

|            |           | 78 |

1. Obtain understanding of the disciplines of Bioinformatics and Computational Biology (BCB): the biological sciences, computational sciences, and mathematical sciences. Master the fundamental concepts of BCB from the perspective of each of the three program disciplines with the ability to integrate the multidisciplinary principles.

2. Acquire specialized expertise and master state-of-the-art research topics in one of the three BCB areas: biological sciences, computational sciences, or mathematical sciences.

3. Successfully propose significant and innovative interdisciplinary research by combining concepts and theories from the three BCB areas.