Master's Curriculum for Bioinformatics and Computational Biomedicine (BCB) Program (available on-campus only)

The goal of the curriculum is to produce students capable of assuming appropriate jobs in biomedical informatics in both industry and academia. The BCB program offers 2 Master of Science (MS) options.

Master of Science (MS) Thesis:
The **Master of Science (MS) Thesis** curriculum consists of 55 credit hours, including 43 credit hours of required and individual competency coursework, and 12 credit hours of thesis work. OHSU operates on a quarter system, so a full-time student *may* be able to complete the MS Thesis in **8** quarters. Students have 6 years to complete the degree. The average time to completion of the MS Thesis is 2.5 years. Part-time enrollment in the program is permitted.

Master of Science (MS) Non-Thesis:
The **Master of Science (MS) Non-Thesis** curriculum consists of 49 credit hours including 43 credits of required and elective coursework and 6 credit hours of a capstone: internship (practical work experience for non-postdocs) or a publishable manuscript (postdocs only). OHSU operates on a quarter system, so a full-time student *may* be able to complete the MS Non-Thesis in **7** quarters. Students have 6 years to complete the degree. The average time to completion of the MS Non-Thesis is 2.5 years. Part-time enrollment in the program is permitted.

The required coursework includes five domains:

- Bioinformatics and Computational Biomedicine,
- Biomedical Sciences,
- Computer Science,
- Analytics and Biostatistics, and
- Thesis, Capstone:Internship (non-postdocs) or Capstone in the form of a publishable manuscript (postdocs only).

Each domain has a minimum number of credits. While most courses are taught by biomedical informatics faculty, some are taught by other departments at OHSU. Additional courses are available at Portland State University (PSU).

The five areas of the curriculum and their rationale are as follows:

Bioinformatics & Computational Biomedicine – Students should be able to apply bioinformatics algorithms and statistical methods to research problems.

Biomedical Sciences – Students should be able to apply knowledge of biology, especially its genetics aspects, to bioinformatics and computational biomedicine problems.

Computer Science – Students should have a basic understanding of computer science in order to understand the role and limitations of computers in health and biomedicine. A four-quarter sequence covers the basics of computer science deemed necessary for a bioinformatics professional. A prerequisite for admission is a college-level Computer Programming course taught in Python, C, C++, or Java that must be completed prior to enrolling in the CS courses.

Analytics and Biostatistics – Students should understand the fundamental aspects of scientific research. Including statistics, quantitative and qualitative research methods, epidemiology and health data analysis. Students should be able to apply basic statistical analyses to bioinformatics problems.

Graduation Requirements – Students will be able to address ethical issues in the field, to communicate effectively in oral and written form, and to complete an MS Thesis or an MS Non-Thesis (capstone:internship for non-postdocs or capstone:publishable manuscript for postdocs).

BIOINFORMATICS & COMPUTATIONAL BIOMEDICINE (13 credits)
Required courses (13 credits)
BMI 550/650 – Bioinformatics and Computational Biomedicine I: Algorithms (4)
BMI 551/651 – Bioinformatics and Computational Biomedicine II: Statistical Methods (4)
BMI 552/652 – Research in Bioinformatics and Computational Biomedicine (4)
BMI 553/653 – Readings in Bioinformatics and Computational Biomedicine (1)

Electives
Imaging:
- EE 584/684 Introduction to Digital Image Processing
- EE 588/688 – Introduction to Biomedical Imaging (3) – (PSU)
- CS 547/647 – Statistical Pattern Recognition (3)

Systems Modeling:
- SYSC 513 – Systems Approach (4) – (PSU)
- BME 565/665 – Introduction to Computational Neurophysiology (3)
- BMI 567/667 – Network Science and Biology (3)

Machine Learning, AI, NLP and IR:
- CS 560 – Artificial Intelligence (3)
- CS 562 – Natural Language Processing (3)
- CS/EE 623 Deep Learning
- CS/EE 679 Problem Solving with Large Clusters
- BMI 514/614 – Information Retrieval (3)
- BMI 516/616 – Standards for Interoperability (3)

Functional Genomics:
- EBS 598/698 – Current Topics in Proteomics (2) – (PSU)

BIOMEDICAL SCIENCES (6 credits)
Required courses (6 credits)
BMI 530 – Practice of Healthcare (3)
BMI 512 – Clinical Information Systems (3) **OR**
BMI 559 - Computational Genetics (3) OR

Electives
CON 661 – Structure and Function (3)
CON 663 – Bioregulation (3)
CON 664 – Molecular Cell Biology (3)
CON 665 – Development, Differentiation and Cancer (3)
HIP 514 – Molecular Biology for Clinical Research (2)

COMPUTER SCIENCE (9 credits)
Required courses (9 credits)
BMI 535 – Management and Processing of Large Scale Data (3)
BMI 546 – Software Engineering (3)
BMI 565 - Bioinformatics Programming and Scripting (3)
CS 559 – Machine Learning (3) **OR** CS 545 Machine Learning (3) (at PSU. See advisor)

Electives
BMI 516 - Standards for Interoperability (3)
BMI 548 – Human Computer Interaction in Biomedicine (3)

ANALYTICS AND BIOSTATISTICS (6 credits)
Required courses (6 credits)
BMI 569 Data Analytics (3)
MATH 530 Probability and Statistical Inference for Scientists and Engineers (3)

CAPSTONE/THESIS PREP (6 credits)
Required courses (6 credits):
BMI 576 – Managing Ethics in Biomedical Informatics (3)
BMI 570 – Scientific Writing and Communication for Informatics Students (3)

Graduation Requirements (6 or 12 credits):
BMI 503 – Master's Thesis (12)
BMI 581 – Capstone:Publishable Manuscript (6) (Postdocs only)
BMI 590 – Capstone:Internship (6)

ELECTIVES – Students may use any remaining credits to tailor their own projects and areas of study. They may transfer up to 20 credits from other departments and institutions. Courses must have been completed with a grade of B or higher (no B-) within five years of matriculation in the program. Courses may not be transferred in if they were applied to a previous degree. The program also allows study to be arranged under the following "generic" courses:
BMI 501 – Research
BMI 502 – Independent Study
BMI 505 – Reading & Conference
BMI 507 – Seminar
BMI 509 - Practicum