

GRADUATE CERTIFICATE IN BIOINFORMATICS AND BIOMARKERS

The Biomarkers and Bioinformatics (BRIM) Certificate Program introduces students to the rapidly growing fields of bioinformatics, proteomics and genomics, and provides a core knowledge of analytical approaches used in these fields. It is particularly valuable for PhD students whose research would be strengthened by expertise in bioinformatics.

Applying to the BRIM/BPG Certificate Program

UT students who are currently in a PhD program:

- Complete the Request to Add a Graduate Certificate form at the following link, and return to the Graduate School for processing: https://www.utoledo.edu/graduate/files/Request_to_add_a_grad_certific.pdf
- Submit a letter of support from major advisor.

Applicants who are NOT UT graduate students:

- Complete online application. <https://www.utoledo.edu/graduate/apply/>
- Submit Official transcripts
- Earned bachelors or graduate degree
- Statement of Purpose
- Two letters of recommendation are required, three letters are optional. In the event that a student decides to pursue the BIPG MSBS degree, it will save time to have the letters of recommendation already on file.

MD/MSBS Bioinformatics Degree

This is designed for students already in our MD program, who want preparation for clinical research in gene therapy, biomarker discovery, or other aspects of cutting-edge medicine. It involves one year of coursework and research between the 2nd and 3rd years of the standard medical curriculum.

BS/MSBS "Pipeline" Program

This is an integrated program that can be completed in as little as 5.5 years, yielding both a University of Toledo bachelors of sciences in Biological Sciences and an MSBS in Bioinformatics. This reduced time is made possible in part by 9 University of Toledo credit hours being allowed to count towards both degrees. Students (University of Toledo biology majors) typically apply at the end of their second year, but can apply as incoming first-year students. For more information, go to the Pipeline Program website: <https://www.utoledo.edu/med/depts/bioinfo/pages/Pipeline.html>.

Students enrolled in the BRIM Certificate Program take three courses covering the following subject areas:

- Introduction to the scope of bioinformatics, proteomics and genomics: "Fundamentals of BPG"
- Training in statistical methods used in biomarker research and bioinformatics: "Statistical Methods in Bioinformatics"
- Handling and manipulation of databases and introduction to computer programming skills needed to analyze large quantities of nucleic acid and protein sequence data: "Introduction to Bioinformatic Computation"
- EITHER "Applications of BPG", in which faculty members using these methods will discuss and demonstrate how these techniques are utilized to solve research problems, OR "Biomarker Discovery, Validation and Implementation", in which faculty will provide an overview of biomedical discovery and validation techniques followed by application in selected aspects of individualized medicine.

Upon completion of the Program, students will be prepared to utilize biomarker research and bioinformatics techniques, and be able to interact with specialists in a range of biomedical sub-disciplines.

The curriculum consists of three, 3-credit courses, for a total of 9 credits, that can be taken over 1-4 years: BPG – (Bioinformatics and Proteomics/Genomics; BRIM-Biomarker Research and Individualized Medicine). The following shows the five available courses. The choice of which three courses to take should be made in consultation with the Program Director. Of BRIM 6200 and BIPG 6400, only one may be applied to the certificate.

Code	Title	Hours
Select three of the following:		
BIPG 5100	Fund Bioinformatics Proteomics	9
BIPG 5200	Statistical Methods in Bioinformatics	
BIPG 6100	Bioinformatic Computation	
<i>If only two of the above courses are chosen then select one of the two courses below:</i>		
BRIM 6200	Biomarker Disc,Valid & Impleme (even years)	
BIPG 6400	Applications of Bioinformatics (odd years)	

The curriculum consists of three, 3-credit courses, for a total of 9 credits (listed below) that can be taken over 1-4 years: (BPG – Bioinformatics and Proteomics/Genomics; BRIM- Biomarker Research and Individualized Medicine). Successful completion of any THREE of the following FIVE courses, except that only ONE of the two: "Applications in Bioinformatics" and "Biomarker Discovery, Validation and Implementation" may be taken due to partial overlap in their content.

BIPG 5100 Fundamentals in Bioinformatics
BIPG 5200 Statistical Methods in Bioinformatics
BIPG 6100 Bioinformatic Computation

If only two of the above courses are chosen then select:
EITHER BRIM 6200 Biomarker Discovery, Validation, and Implementation (even years) OR BIPG 6400 Applications in Bioinformatics (odd years)

*BMSP 6340 Current Problems & Research Approaches in Genes and Genomes, or equivalent course approved by the BRIM/BPG Program, is required for admission into the Bioinformatics & Biomarkers Certificate Program.

First Term		Hours
BIPG 5100	Fund Bioinformatics Proteomics	3
BIPG 5200	Statistical Methods in Bioinformatics	3
Hours		6
Second Term		Hours
BIPG 6100	Bioinformatic Computation	3
or BIPG 6400	or Applications of Bioinformatics	
or BRIM 6200	or Biomarker Disc,Valid & Impleme	
Hours		3
Total Hours		9

BMSP 6340 Current Problems & Research Approaches or equivalent course approved by the BRIM/BPG Program, is required for admission into the Bioinformatics & Biomarkers Certificate Program.

NOTES: The above Plan of Study grid is only an example. University of Toledo PhD or MSBS students may also take individual BPG or BRIM courses as electives, with permission of the instructor. To receive a Certificate in Biomarkers and Bioinformatics, however, an online application to the program must be submitted and accepted. All applications will be reviewed by the BIPG Program Admissions Committee. The online application must be filed ONLY for those seeking a certificate, and is not required for those taking these courses as electives.

- PLO 1: Students are able to describe and explain mammalian and nonmammalian genome structure and function.
- PLO 2: Students are able to describe and explain processes of genome evolution.
- PLO 3: Students are able to describe and use analytic tools associated with systems/bioinformatic approaches.\n
- PLO 4: Students are able to choose and use appropriate tests for statistical analysis of macromolecular sequence information.
- PLO 5: Students are able to apply bioinformatic methods to clinically-relevant problems, and describe and explain a) biomarker discovery and validation, and b) major human diseases such as cancer, diabetes, and autoimmunity.