

# MASTER OF SCIENCE IN BIOINFORMATICS

## Student Learning Outcomes

Students graduating from this program will:

- Demonstrate knowledge and skills in biomedical informatics.
- Demonstrate knowledge and skills in statistical analysis.
- Demonstrate competency in generating a research hypothesis.
- Demonstrate integrity in proposing, conducting, and reporting research.
- Demonstrate competency in communication.

## Program Description

The Department of Biomedical and Health Informatics at the School of Medicine, in cooperation with the School of Science and Engineering, offers the Master of Science in Bioinformatics degree. Students may complete the degree without an area of emphasis or may choose one of five emphasis areas (Clinical Research, Computational Bioinformatics, Genomic Bioinformatics, Individualized Informatics, or Epidemiology and Biostatistics).

The program is designed to prepare a new generation of informatics professionals who will have the necessary skills to work collaboratively for the advancement of health sciences. Graduates are expected to be effective team members who can contribute to education, research, and development in the fields of bioinformatics and/or clinical research. This degree program prepares students to assume a variety of professional informatics positions in translational research and development, institutional management, public policy, information systems, hospitals, private industry, or as members of a clinical research team. Students interested in pursuing a career involving independent conduct of research should enroll in the thesis/capstone track. A non-thesis track is available for students pursuing industry careers, where demonstration of specific skills and expertise are valued. Students completing the M.S. Bioinformatics degree may also choose to continue their education at advanced graduate levels.

## Program Goals

1. Produce competent researchers at the interface of biomedical and health informatics and clinical research
2. Produce graduates able to establish partnerships with stakeholders and the community
3. Produce effective communicators
4. Produce ethical and responsible researchers

## Degree Requirements

A minimum of 30 to 36 credit hours are required to earn the Master of Science in Bioinformatics degree (30 for non-thesis track and 36 for thesis/capstone track). Students must complete the program of study while maintaining a 3.0 or better grade point average. The total number of credit hours, required coursework, elective course work and Thesis or Capstone requirements vary based on the MS Bioinformatics emphasis area and final research experience selected by the student. These options are shown in the tables below.

|                          | Individualized Informatics Emphasis | Computational Emphasis | Clinical Research Emphasis | Epidemiology and Biostatistics Emphasis | Genomics Emphasis |
|--------------------------|-------------------------------------|------------------------|----------------------------|---|-------------------|
| Required course hours    | 18                                  | 24                     | 24                         | 24                                      | 34                |
| Elective course hours*   | 12                                  | 6                      | 6                          | 6                                       | 0                 |
| Research & Thesis hours* | 6                                   | 6                      | 6                          | 6                                       | 5                 |
| Capstone option*         | Yes                                 | Yes                    | Yes                        | Yes                                     | No                |
| No Thesis Option*        | Yes                                 | Yes                    | Yes                        | Yes                                     | Yes               |
| Minimum Total hours      | 30 - 36                             | 30 - 36                | 30 - 36                    | 30 - 36                                 | 34 or 39          |

\*Students may choose to complete either a 3 credit hour Capstone course with 3 additional elective credit hours, or no thesis, in place of Research and Thesis credit hours.

### MSB Emphasis Options

1. Individualized Informatics: Gives students flexibility to complete a bioinformatics curriculum that best meets their academic and career goals.
2. Clinical Research: Emphasizes the creation and understanding of data generated by patient care and clinical studies and on the statistical methodology needed for clinical research and improved bedside care.
3. Computational Bioinformatics: Emphasizes the development and use of the next generation of bioinformatics tools and software.

4. Genomic Bioinformatics: Emphasizes the use of existing software for biological analysis and the analysis of a diverse set of biological data.
5. Epidemiology and Biostatistics: Emphasizes the knowledge and skills necessary to design, conduct and evaluate population health research.

The required coursework for each M.S. Bioinformatics option are listed below. Information about elective coursework can be obtained from program faculty. Please visit our Department Website (<http://med.umkc.edu/msb/>) to learn more about this program.

#### M.S. Individualized Informatics Emphasis area

| Code  | Title                               | Credits    |
|---|-------------------------------------|------------|
| MEDB 5501   | Applied Biostatistics I             | 3          |
| MEDB 5502   | Applied Biostatistics II            | 3          |
| MEDB 5510   | Clinical Research Methodology       | 3          |
| MEDB 5561   | Responsible Conduct of Research     | 3          |
| <b>At least 2 from the following:</b>                             |                                     | <b>6</b>   |
| MEDB 5520   | Introduction to Medical Informatics |            |
| or MEDB 5521  | Clinical Bioinformatics             |            |
| or BIOLOGY 5525   | Bioinformatics and Data Analysis    |            |
| or COMP-SCI 5566  | Introduction to Bioinformatics      |            |
| <b>Electives:</b>   |                                     | <b>12</b>  |
| <b>Research Experience Options (choose one of the following):</b> |                                     | <b>0-6</b> |
| Thesis (6 hours)  |                                     |            |
| Capstone (3 hours and one additional elective course)             |                                     |            |
| No Thesis or Capstone   |                                     |            |
| Total Credits   |                                     | 30-36      |

#### Clinical Research Emphasis

| Code  | Title                                       | Credits    |
|---|---|------------|
| MEDB 5501   | Applied Biostatistics I                     | 3          |
| MEDB 5502   | Applied Biostatistics II                    | 3          |
| MEDB 5510   | Clinical Research Methodology               | 3          |
| MEDB 5511   | Principles and Applications of Epidemiology | 3          |
| MEDB 5512   | Clinical Trials                             | 3          |
| MEDB 5513   | Overview of Health Services Research        | 3          |
| MEDB 5520   | Introduction to Medical Informatics         | 3          |
| MEDB 5561   | Responsible Conduct of Research             | 3          |
| <b>Electives:</b>   |   | <b>6</b>   |
| <b>Research Experience Options (choose one of the following):</b> |   | <b>0-6</b> |
| Thesis (6 hours)  |   |            |
| Capstone Course (3 hours and one additional elective course)      |   |            |
| No Thesis or Capstone   |   |            |
| Total Credits   |   | 30-36      |

#### Computational Emphasis

| Code            | Title  | Credits |
|-----------------|--|---------|
| MEDB 5501       | Applied Biostatistics I                          | 3       |
| MEDB 5502       | Applied Biostatistics II                         | 3       |
| MEDB 5510       | Clinical Research Methodology                    | 3       |
| MEDB 5520       | Introduction to Medical Informatics              | 3       |
| MEDB 5561       | Responsible Conduct of Research                  | 3       |
| COMP-SCI 470    | Introduction to Database Management Systems (or) | 3       |
| or COMP-SCI 371 | Database Design, Implementation and Validation   |         |
| COMP-SCI 5565   | Introduction to Statistical Learning             | 3       |
| COMP-SCI 5566   | Introduction to Bioinformatics                   | 3       |

**Electives:** 6

**Research Experience Options (choose one of the following):** 0-6

Thesis (6 hours)

Capstone (3 hours and one additional elective course)

No Thesis or Capstone

Total Credits 30-36

### Epidemiology and Biostatistics Emphasis

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

|           |                               |   |
|-----------|-------------------------------|---|
| MEDB 5510 | Clinical Research Methodology | 3 |
|-----------|-------------------------------|---|

|           |   |   |
|-----------|---|---|
| MEDB 5511 | Principles and Applications of Epidemiology | 3 |
|-----------|---|---|

|           |  |   |
|-----------|--|---|
| MEDB 5535 | Quantitative Aspects of Epidemiologic Research | 3 |
|-----------|--|---|

|           |                         |   |
|-----------|-------------------------|---|
| MEDB 5501 | Applied Biostatistics I | 3 |
|-----------|-------------------------|---|

|           |                          |   |
|-----------|--------------------------|---|
| MEDB 5502 | Applied Biostatistics II | 3 |
|-----------|--------------------------|---|

|           |                                 |   |
|-----------|---------------------------------|---|
| MEDB 5561 | Responsible Conduct of Research | 3 |
|-----------|---------------------------------|---|

Elective Courses (Epidemiology and Biostatistics): 6

|           |  |
|-----------|--|
| MEDB 5503 | Biostatistics III-Mixed-Effects Models |
|-----------|--|

|           |                                     |
|-----------|-------------------------------------|
| MEDB 5573 | Biostatistical Consulting Practicum |
|-----------|-------------------------------------|

|           |                           |
|-----------|---------------------------|
| MEDB 5514 | Human Genome Epidemiology |
|-----------|---------------------------|

|           |                |
|-----------|----------------|
| MEDB 5589 | Special Topics |
|-----------|----------------|

|           |                   |
|-----------|-------------------|
| MEDB 5505 | Introduction to R |
|-----------|-------------------|

|           |                     |
|-----------|---------------------|
| MEDB 5507 | Introduction to SAS |
|-----------|---------------------|

|           |                     |
|-----------|---------------------|
| MEDB 5508 | Introduction to SQL |
|-----------|---------------------|

Elective Coursework: 6

|           |                 |
|-----------|-----------------|
| MEDB 5512 | Clinical Trials |
|-----------|-----------------|

|           |                                      |
|-----------|--------------------------------------|
| MEDB 5513 | Overview of Health Services Research |
|-----------|--------------------------------------|

|           |                               |
|-----------|-------------------------------|
| MEDB 5525 | Social Determinants of Health |
|-----------|-------------------------------|

|           |                                     |
|-----------|-------------------------------------|
| MEDB 5520 | Introduction to Medical Informatics |
|-----------|-------------------------------------|

|           |                         |
|-----------|-------------------------|
| MEDB 5521 | Clinical Bioinformatics |
|-----------|-------------------------|

|           |                                    |
|-----------|------------------------------------|
| MEDB 5540 | Multidisciplinary Graduate Seminar |
|-----------|------------------------------------|

|           |                         |
|-----------|-------------------------|
| MEDB 5550 | Health Outcomes Seminar |
|-----------|-------------------------|

**Research Experience Options (choose one of the following):** 0-6

Thesis (6 hours)

Capstone Course (3 hours and one additional elective course)

No Thesis or Capstone

Total Credits 30-36

### Genomic Emphasis

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

|           |                         |   |
|-----------|-------------------------|---|
| MEDB 5501 | Applied Biostatistics I | 3 |
|-----------|-------------------------|---|

|           |                          |   |
|-----------|--------------------------|---|
| MEDB 5502 | Applied Biostatistics II | 3 |
|-----------|--------------------------|---|

|           |                               |   |
|-----------|-------------------------------|---|
| MEDB 5510 | Clinical Research Methodology | 3 |
|-----------|-------------------------------|---|

|           |                                 |   |
|-----------|---------------------------------|---|
| MEDB 5561 | Responsible Conduct of Research | 3 |
|-----------|---------------------------------|---|

|             |                              |   |
|-------------|------------------------------|---|
| LS-CBB 5530 | Cell and Molecular Biology I | 3 |
|-------------|------------------------------|---|

|             |                               |   |
|-------------|-------------------------------|---|
| LS-CBB 5520 | Cell and Molecular Biology II | 3 |
|-------------|-------------------------------|---|

|             |                        |   |
|-------------|------------------------|---|
| LS-MBB 5561 | General Biochemistry I | 4 |
|-------------|------------------------|---|

|             |                         |   |
|-------------|-------------------------|---|
| LS-MBB 5562 | General Biochemistry II | 3 |
|-------------|-------------------------|---|

|              |                         |   |
|--------------|-------------------------|---|
| BIOLOGY 5519 | Principles of Evolution | 3 |
|--------------|-------------------------|---|

|              |                                  |   |
|--------------|----------------------------------|---|
| BIOLOGY 5525 | Bioinformatics and Data Analysis | 3 |
|--------------|----------------------------------|---|

|              |   |   |
|--------------|---|---|
| COMP-SCI 470 | Introduction to Database Management Systems | 3 |
|--------------|---|---|

|                 |  |
|-----------------|--|
| or COMP-SCI 371 | Database Design, Implementation and Validation |
|-----------------|--|

**Research Experience Options (choose one of the following):** 0-5

Thesis (5 hours)

No Thesis

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Total Credits

34-39

**Admission Requirements**

Please visit our Admissions Page (<https://med.umkc.edu/msb/>) to learn about our requirements.