Proposal for New Program: Certificate in Genome Medicine

1. “Rationale...” The proposed “Genome Medicine” certificate is designed for students interested in developing expertise in data science, with specialization in genomics. Data Science is an interdisciplinary discipline about methods and systems to extract knowledge or insights from large quantities of data coming in various forms. Data science employs techniques and theories drawn from many fields within the broad areas of mathematics, statistics, and computer and information sciences and applies them on a wide range of data-rich domains such as biomedical sciences, physical science, geoscience, social science, engineering, business, and education.

Data science is a very broad and multifaceted field and by necessity the certificate does not provide students with deep expertise in all aspects of the field. The “Genome Medicine” specialization will give students a strong background in mathematics, computational thinking, and biological data analysis, and will enable students to analyze large quantities of data to discover new knowledge and facilitate decision making. As part of the broader data science program, genomics is a critical track to include as a sub-area of focus for students interested in biology, ecology, evolution, human health and disease, and precision medicine. Over the past decade, the emergence of next-generation sequencing technologies has facilitated the rapid growth of genomic data; however, undergraduate training in big data management, big data processing, and big data analysis has not kept up with this rapid growth in large-scale genomic data generation.

Graduates of this program will have multiple career opportunities that will vary depending on their combination of major and certificate. Some of them will choose to find data science jobs in a private or a public sector and some will choose to continue with graduate studies either to deepen their overall data science expertise or learn how to better use their analytics skills in genomics.
## Minimum Prerequisite Path

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<tr>
<th>Term 1 (4 cr.)</th>
<th>Term 2 (4 cr.)</th>
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<tbody>
<tr>
<td>Chem 1031&amp;1033 General Chemistry I (3+1 cr.)</td>
<td>Chem 1032&amp;1034 General Chemistry II (3+1 cr.)</td>
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<tr>
<th>Term 3 (8 cr.)</th>
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<tr>
<td>Biol 2112 Introduction to Biology (4 cr.)</td>
<td>Chem 2201&amp;2203 Organic Chemistry I (3+1 cr.)</td>
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## Certificate Requirements

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<tr>
<th>Term 1 (6-7 cr.)</th>
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<tr>
<td>Biol 3111 Genomics in Medicine (3 cr.)</td>
<td>Biol 3112 Fundamentals of Genomic Evolutionary Medicine (3 cr.)</td>
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<td>DS: Genomics Elective (3-4 cr.)</td>
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Credits in the certificate: 12-14
Appendix B

New Genome Medicine Certificate

Minimum Prerequisites:
- Biol 2112 Introduction to Biology II (4 cr.)
- Chem 1031&1033 General Chemistry I (3+1 cr.)
- Chem 1032&1034 General Chemistry II (3+1 cr.)
- Chem 2201&2203 Organic Chemistry I (3+1 cr.)
- Math 1022 (4 cr.) Precalculus (typically completed prior to Temple)

Subtotal 12 credits

Certificate Requirements:
- Biol 3111 Genomics in Medicine (3 cr.)
- Biol 3112 Foundations Of Evolutionary Genomic Medicine (3 cr.)

Subtotal 6 credits

Elective Course Requirements (6-8 credits required):
- Biol 2296 Genetics (4 cr.)*
- Biol 3101 Evolution (4 cr.)
- Biol 3128 Genomics and Infectious Disease Dynamics (3 cr.)**
- Biol 3201 Human Genetics (3 cr.)***
- Biol 3225 Evolutionary Genetics (3 cr.)***
- Biol 3241 Genomics & Evolutionary Biology Of Parasites (3 cr.)**
- Biol 3368 Biology of Cancer (3 cr.)****
- Biol 3403 Genomics (3 cr.)
- Biol 4xxx Computational Bio courses being developed (3 cr.)
- CIS 1053/1057/1068 Programming in MatLab/Computer Programming in C/Program Design and Abstraction (4 cr.)
- Math 3043 (3-4 cr.) Numerical Analysis I

Total 12-14 credits

*This course requires an additional prerequisite of Chem 2202
**This course requires an additional prerequisite of BIOL 1111 and BIOL 2227
***This course requires an additional prerequisite of Chem 2202 and BIOL 2296
****This course requires an additional prerequisite of Chem 2202, BIOL 2296 and BIOL 3096
Comparison of Genome Medicine Certificate with Data Science: Genomics BS:

Requirements needed to complete Data Science: Genomics BS (53 additional credits):

Chem 2203 Organic Chemistry I (1 cr.)
Chem 2202&2204 Organic Chemistry I (3+1 cr.)
Math 1041 (4 cr.) Calculus I
Math 1042 (4 cr.) Calculus II
CIS 1166 (4 cr.) Mathematical Concepts in Computing I
CIS 2166 (4 cr.) Mathematical Concepts in Computing II
Math 3031 (3 cr.) Probability Theory I
Math 3032 (3 cr.) Probability Theory II
CIS 1068 (4 cr.) Program Design and Abstraction
CIS 2168 (4 cr.) Data Structures
Biol 1111 Introduction to Biology I (4 cr.)
Biol 3101 Evolution (3 cr.)
CIS 3715 (4 cr.) Principles of Data Science
Biol 2296 Genetics (4 cr.)
SCTC xxxx (3 cr.) Advanced Data Visualization