	Department of Biostatistics and Bioinformatics
Milken Institute School of Public Health THE GEORGE WASHINGTON UNIVERSITY	**Bachelor of Science** **Health Data Science** Academic Year 2023 – 2024 All curriculum revisions will be updated immediately on the website http://www.publichealth.gwu.edu

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Mission
The mission of the Health Data Sciences (HDS) program is to prepare students for graduate school or employment in the health data science sector. Students will gain analytical skills and experience with designing, conducting, analyzing, and reporting studies utilizing health data. Data will include omics, epidemiological, environmental, biomedical, and demographic data. HDS prepares students for immediate: i) post-graduate employment, ii) graduate programs to advanced training in health data science, iii) biostatistics, iv) bioinformatics, v) computational biology, and vi) professional programs, including medical, dental, business (biotech, pharma), and law (biotech, pharma) school.

Program Overview
Advancements in innovative technologies and collaborations across the globe generate vast amounts of health and related data that enable our understanding of complex systems in human health, nature, behavior, society, and beyond. Exploring health data and finding evidence and patterns provide opportunities to make informed decisions. The HDS curriculum designs a roadmap of skills and training in learning from quantitative and qualitative data, forming questions, generating and evaluating hypotheses, and making inferences.

The major in Health Data Science will provide students with a solid foundation in data science, mathematics, computer science, health, and biology, followed by specially designed biostatistics and bioinformatics analytics and ethics courses. A hands-on program will enable students to apply analytic methods to various real-world applications, take the skills learned in the classroom, and practice them in real-world problems, preparing them to address new challenges and questions.

Goals
The goals of the Bachelor of Science in Health Data Science are to ensure graduates can:
- Apply interdisciplinary knowledge of biostatistics, bioinformatics, computational biology, and health data science
- Design, conduct, analyze, are report experiments and other scientific studies
- Wrangle and manipulate data
- Effectively visualize data

- Analyze and interpret data
- Function effectively on multidisciplinary teams
- Integrate knowledge and experience across disciplines
- Communicate effectively
- Provide programming expertise to solve biomedical problems and answer biological questions

Program Specific Competencies
Upon completion of the Bachelor of Science in Health Data Science, students will possess the following functional competencies:

1. Identify important health-related problems and apply health data science as a method to find solutions [Relevant Courses: PUBH, 1010, 1101, 2110, 1142, 3131, 3151, 3136, 2110, 3131, BISC 1111]

2. Generate and manage a health data science project as a solution to a health-related problem [Relevant Courses: PUBH 1142, 4202, 4201, 1242, 2242, 2103, 3242, 3199]

3. Design, apply, and use data gathering, analytical, and reporting technologies inherent to health data science projects [Relevant Courses: PUBH 1242, 2242, 2142, 3242, 2118, 3199]

4. Generate and interpret the results of health data science analyses [Relevant Courses: PUBH 4201, 2142, 2110, 2142, 2242, 3199]

5. Assess the potential impact of policy changes based on health data analytical insights from health and/or biomedical data ecosystems [Relevant Courses: PUBH 1101, 3131, 3242, 1142, 4202, STAT 2118, STAT 2183, STAT 4157, MATH 1231, MATH 1232]

6. Develop skill sets as problem solvers and leaders in health data science [Relevant Courses: PUBH 1142, 1242, 2110, 2142, 2242, 2103, 3131, 3136, 3242, 4201, 4202, 4199]

7. Communicate the results of data science projects [Relevant Courses: PUBH 3242, 2142, 1101, 1101, 3136, 3131, 4199]

Milken Institute School of Public Health

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Bachelor of Science
Health Data Science

Program-at-a-Glance
2023- 2024

Degree Requirements

There are four categories of Degree Requirements for all students: (1) University General Education Requirements*; (2) Health Data Science Core Courses; (3) Health Data Science Electives; and 4) General Electives. Students in the **Pre-medical Professional Concentration** will also take **Pre-medical Professional Concentration** requirements/recommended courses. Students take additional elective courses to reach the 120 total credits required to graduate. The Health Data Science program follows the University's General Education Requirements (20 credits). Students complete 34 credits in specified courses for the concentration. These courses are double counted in other categories and are not taken in addition to the 120 total credits for the. See the University Bulletin website for the most up-to-date version of Gen Ed requirements and approved courses: http://bulletin.gwu.edu/university-regulations/general-education/

*Students must take one of the approved oral communications courses listed in APPENDIX at the end of the program guide.

Always see your advisor for course scheduling and sequencing strategies but remember that proper course selection, fulfilling requirements, and on-time graduation are your responsibilities.

Bachelor of Science in Health Data Science - Must Fulfill the Following Degree Requirements	
Requirement	**Credits**
General Education	22
Health Data Science Core (see program curriculum)	56-57
Health Data Science Electives (pre-approved or approved by advisor)	10
General Electives (to be chosen with advisor)	31-32
Total	**120**

University General Education Requirements (GenEd) Courses		
University Writing	UW 1020: UNIVERSITY WRITING or HONR 1015	4
Critical Thinking in the Humanities	ONE COURSE IN THE HUMANITIES (https://advising.columbian.gwu.edu/gpac-course-list)	3
Quantitative Reasoning	ONE COURSE IN EITHER MATH OR STATISTICS (https://advising.columbian.gwu.edu/gpac-course-list). If you take Math 1231 OR STAT 2118, it will count as a Gen Ed and towards your HDS major.	3
Scientific Reasoning	ONE COURSE IN NATURAL OR PHYSICAL SCIENCE WITH LABORATORY EXPERIENCE. If you take BISC 1111 OR BISC 1112, it will count as a Gen Ed and towards your HDS major.	3-4
Critical Analysis in the Social Sciences	TWO COURSES IN THE SOCIAL SCIENCES (https://advising.columbian.gwu.edu/gpac-course-list)	6
Oral Communications	ONE COURSE WITH AN APPROVED ORAL COMMUNICATIONS COMPONENT (*see Appendix B*)	3

Program Curriculum

Core Area	Required Core HDS Courses – 56-57 credits				
	Course number	**Course title**	**Credits**	**Prerequisites**	**Semester offered**
Programming and Data Processing	PUBH 4201 or CSCI 1011 or CSCI 1012	Practical Computing	3	BISC 1111 and BISC 1115 or BISC 1112 and BISC 1116; no prereqs for the CSCI courses	Fall
	PUBH 4202 or CSCI 1112	Bioinformatics Algorithms and Data Structures	3	PUBH 4201; CSCI 1111 with a C minimum and MATH 1220 or MATH 1231	Spr
Data Science	PUBH 1142	Introduction to Health Data Science	3	none	Fall
	PUBH 1242	Health Data Mining	3	none	Spr
	PUBH 2242	Natural Language Processing for Healthcare	3	PUBH 1242 or DATS 1001	Fall
	PUBH 3242	Health Data Visualization	3	PUBH 1142 or DATS 1001	Spr
Mathematics	MATH 1231*	Calculus 1	3	none	Fall, Spr, Sum
	MATH 1232	Calculus 2	3	MATH 1221 or MATH 1231	Fall, Spr, Sum
Biology	BISC 1111*	Biology: Cells & Molecules	4	none	Fall
	PUBH 2110 or BISC 1112*	Biology: Organisms or Public Health Biology	3-4	BISC 1005, 1006, 1007, 1008, 1111, 1112, or HONR 1033 in a biology topic	Fall, Spr
Probability and Statistics	PUBH 2142	Introductory Biostatistics	3	none	Fall, Spr
	STAT 4157	Introduction to Mathematical Statistics I	3	MATH 1232	Fall, Spr
	TBD or STAT 2118* or STAT 2183	Regression Analysis or Applied Statistical Methods	3	2118 - STAT 1051, 1053 and STAT 1111; 2183 - An introductory statistics course.	Fall, Spr, Sum
Public Health	PUBH 1010	First Year Experience in Public Health	1	none	Fall, Sum
	PUBH 1101	Introduction to Public Health and Health Services	3	none	Fall, Spr, Sum
	PUBH 3131	Introductory Epidemiology	3	One of the following: PUBH 2142, STAT 1051, STAT 1053, or STAT 1127	Fall, Spr, Sum
	PUBH 3199	Research Methods in Public Health	3	none	Fall, Spr
	PUBH 3136 or PUBH 3151	Ethics in Public health or Health Law	3	none	Spr, Sum
	PUBH 4199	Independent Study (capstone project)	3	none	Fall, Spr, Sum
	TOTAL			**56-57 credits**	

*This course fulfills a Gen Ed requirement

Pre-medical Professional Concentration		
Course Title	**Course Number**	**Credits**
Biology 2	BISC 1112	4
General Chemistry 1	CHEM 1111	4
General Chemistry 2	CHEM 1112	4
Organic Chemistry 1	CHEM 2151/2153	4
Organic Chemistry 2	CHEM 2152/2154	4
Introduction to Biochemistry	BISC 3261 or CHEM 3165	3
General physics 1	PHYS 1011 or 1021 or 1025	4
General physics 2	PHYS 1012 or 1022 or 1026	4
Psychology or Sociology	PSYC 1001 or SOC 1001	3
Total		**34**

Health Data Science Guided Electives

Biochemistry

BIOC 3820	Bioinformatics and Computational Biochemistry	2

Biological Sciences

BISC 2207	Genetics	3
BISC 2213	Biology of Cancer	3
BISC 2214	Developmental Biology	3
BISC 2336	Introductory Microbiology	3
BISC 2583	Biology of Proteins	3
BISC 2585	Biometry	3

Biomedical Engineering

BME 3825	Medical Measurement Laboratory	1
BME 4482	Medical Measurements	3

Computer Science

CSCI 1112	Algorithms and Data Structures	3
CSCI 1121	Introduction to C Programming	3
CSCI 1132	Data Structures and Software Design	3
CSCI 1311	Discrete Structures I	3
CSCI 2312	Discrete Structures II	3
CSCI 2441	Database Systems and Team Projects	3
CSCI 3212	Algorithms	4
CSCI 3362	Probability for Computer Science	3
CSCI 4314	Discrete Analysis-Computer Science	3
CSCI 4341	Continuous Algorithms	3
CSCI 4342	Computational Linear Algebra and Applications	3
CSCI 4364	Machine Learning	3
CSCI 4572	Computational Biology	3

| CSCI 4576 | Introduction to Biomedical Computing | 3 |
| CSCI 4577 | Biomedical Computing | 3 |

Data Science

DATS 2101	Ethical Life in a Digital World	3
DATS 2102	Data Visualization for Data Science	3
DATS 2103	Data Mining	
DATS 2104	Data Warehousing for Data Science	3

Economics

ECON 2123	Introduction to Econometrics	3
ECON 3105	Economic Forecasting	3
ECON 3148	Health Economics	3

Electrical and Computer Engineering

ECE 1120	C Programming for Electrical and Computer Engineering	3
ECE 1125	Data Structures and Algorithms for ECE	3
ECE 3220	Introduction to Digital Signal Processing	3
ECE 3225	Signal and Image Analysis	3

Mathematics

MATH 2184	Linear Algebra	3
MATH 2233	Multivariable Calculus	3
MATH 3125	Linear Algebra II	3
MATH 3342	Ordinary Differential Equations	3
MATH 3359	Introduction to Mathematical Modeling	3
MATH 3553	Introduction to Numerical Analysis	3
MATH 3740	Computational Complexity	3
MATH 4239	Real Analysis I	3
MATH 4240	Real Analysis II	3

Mechanical and Aerospace Engineering

| MAE 1117 | Introduction to Engineering Computations | 3 |

Physics

| PHYS 3100 | Math Methods for Physics | 3 |
| PHYS 3181 | Computational Physics | 3 |

Public Health

PUBH 3201	Introduction to Bioinformatics	3
PUBH 3202	Introduction to Genomics	3
PUBH 3995	Undergraduate Research	1-6

Statistics

STAT 2123	Introduction to Econometrics	3
STAT 2183W	Intermediate Statistical Laboratory: Statistical Comp. Packages	3
STAT 3119	Analysis of Variance	3

STAT 4158	Introduction to Mathematical Statistics II	3
STAT 4181	Applied Time Series Analysis	3
STAT 4188	Nonparametric Statistics Inference	3
STAT 4189	Mathematical Probability and Applications I	3
STAT 4190	Mathematical Probability and Applications II	3
STAT 4197	Fundamentals of SAS Programming for Data Management	3

Sample Course Schedule for Bachelor of Science in Health Data Science

Fall 1	Credits		Spring 1	Credits
PUBH 1010	1		PUBH 1142 (new)	3
PUBH 1101	3		PUBH 2142	3
BISC 1111*	4		BISC 1112	4
MATH 1231*	3		MATH 1232	3
UW 1020 - university writing (gen-ed req.)	4		Humanities gen-ed	3
Total	**15**			**16**

Fall 2	Credits		Spring 2	Credits
PUBH 4201	3		PUBH 4202	3
PUBH 3131	3		PUBH 3136	3
Social Science gen-ed 1	3		STAT 2183	3
Social Science gen-ed 2	3		Approved Comm elective*	3
elective	3		elective	3
Total	**15**		**Total**	**15**

Fall 3	Credits		Spring 3	Credits
PUBH 1242 (new)	3		PUBH 3242 (new)	3
PUBH 2242 (new)	3		STAT 4157	3
WID/elective*	3		elective	3
elective	3		elective	3
elective	3		elective	3
Total	**15**		**Total**	**15**

Fall 4	Credits		Spring 4	Credits
PUBH 3199	3		capstone project	3
elective	2		elective	3
WID/elective	3		elective	3
elective	3		elective	3
elective	3		elective	3
Total	**14**		**Total**	**15**

*This course fulfills a General Education requirement

Student Expectations and Policies

1. Students are strongly encouraged to consult the GW Schedule of Classes and meet with their advisor before finalizing their class schedule.
2. Consult your GWSPH Undergraduate Program Advisor prior to the first term's course registration and in future terms as needed. Students are expected to consult a program advisor in all matters affecting the program of study, such as substitutions or withdrawals.
3. Students following the PMP and pre-health concentration must consult with the University Pre-Health advising team (https://prehealth.gwu.edu/) regarding pre-health expectations and procedures.
4. Students must earn a C- or higher in all courses required for the major (core and elective) to graduate with a BSHDS major.

5. SPH will <u>only</u> double count courses that are required by an SPH major or minor <u>and</u> required by another major or minor. Courses that may be counted as electives in either major or minor may <u>not</u> be double counted toward any SPH major or minor. There is an exception for the Health Equity Micro Minor. Students may double count courses taken for the Health Equity Micro Minor towards an SPH major or minor if those courses are either required by the SPH major or minor or are on an approved elective list for an SPH major or minor.

6. Core requirement rule: Students are expected to complete all core courses at GW. Under special circumstances, students may petition their program director for an exception.

7. Students are responsible for reviewing, understanding, and following the policies and requirements as outlined in the Undergraduate Student Handbook (https://publichealth.gwu.edu/content/services-students)and the University's Bulletin (www.gwu.edu/~bulletin/).

8. Earn 120 total credits and satisfy all course requirements for the Public Health major and concentrations as listed above.

APPENDIX

Approved Oral communication courses

- AMST 2450 History and Meaning of Higher Education in the United States (effective Fall 2021)
- AMST 2620 Human Mind and Artificial Intelligence (effective Spring 2018)
- ANTH 1004 Language in Culture and Society
- ANTH 3838/ANTH 3838W Theory and Practice in Archaeology
- CHEM 2118W Practicing Science Communications (effective Summer 2020)
- COMM 1040 Public Communication
- COMM 1041 Interpersonal Communication
- EAP 1010 Oral Academic Communication for International Students (effective Fall 2019)
- ENGL 1365 Literature and the Environment (effective Fall 2017)
- GER 2109   Advanced Conversation and Composition (effective Fall 2018)
- GER 2109W   Advanced Conversation and Composition (effective Fall 2020)
- GTCH 2003 Step 1 and 2 Hybrid: Inquiry Approaches to Teaching and Lesson Design (new number effective Spring 2021) (formerly known as GTCH 1003) (effective Fall 2019)
- HONR 1034 Honors Seminar: Scientific Reasoning and Discovery (effective Spring 2018)
- ORSC 2000 Sophomore Colloquium: Diversity in Organizations (effective Spring 2018)
- SLHS 4201 Social Communication Development (ends effective Summer 2021)
- SOC 4195 Senior Research Seminar (effective Spring 2020)
- SOC 4195W Senior Research Seminar (effective Fall 2020)
- SPAN 3022 Advanced Oral Proficiency: Environmental and Social Sustainability in Latin America
- WLP 1020 Writing, Literature, and Society (effective Spring 2022)