

Geoffrey D Hannigan

Curriculum Vitae

Email: hanni035@umn.edu

Website: <http://microbiology.github.io>

EDUCATION

University of Pennsylvania

Ph.D. | 2015

School of Medicine

Program: Cell & Molecular Biology

Concentration: Gene Therapy & Vaccines

Certificate: HHMI Med-Into-Grad Scholar

University of Minnesota Duluth

B.S. | 2011

College of Science and Engineering

Major: Cell & Molecular Biology

Minors: Chemistry, Philosophy

RESEARCH & RELATED EXPERIENCE

Associate Principal Scientist (July 2017 – Present)

Merck Research Labs, Exploratory Science Center

Systems Biology Research Group

Cambridge, MA

Topics: *Microbiome, Immunology, Machine Learning, Natural Products, Biomanufacturing*

Postdoctoral Research Fellow (October 2015 – July 2017)

University of Michigan, Medical School

Dr. Patrick Schloss (Principle Investigator)

Topics: *Gut Microbiome, Virome, Virus-Host Interactions, Bioinformatics, Machine Learning*

Scientific Advisory Board Member (April 2015 – July 2017)

SmartPhage, Inc

San Francisco, CA

Custom Phage Company

PhD Candidate (2012 – 2015)

University of Pennsylvania, School of Medicine

Dr. Elizabeth Grice, Ph.D. (Principal Investigator)

Topics: *Skin Microbiome & Virome, Bioinformatics, Dermatologic Disease Etiology*

Undergraduate Researcher (2009 – 2011)

University of Minnesota Duluth, Department of Biology

Dr. John Dahl, Ph.D. (Principal Investigator)

Topics: *Microbial Ecology, Microbiology, Mycobacteria, Bacteriophages, Biochemistry*

Undergraduate Research Fellow (Summer 2010)

Mayo Clinic Graduate School, Department of Virology and Gene Therapy

Dr. Roberto Cattaneo, Ph.D. (Principal Investigator)

Dr. Patricia Devaux, Ph.D. (Research Advisor)

Topics: *Measles Virus Evasion of Immune System, Molecular Biology of Measles Infections*

Undergraduate Researcher (2008 – 2009)

University of Minnesota Duluth, School of Medicine

Dr. Jean Regal, Ph.D. (Principal Investigator)

Topics: *Mechanisms of Lung Injury, Asthma, Allergies, Immunology*

PUBLICATIONS

Hannigan GD, Prihoda D, Palicka A, Soukup J, Klempir O, Rampula L, Durcak J, Wurst M, Kotowski J, Chang D, Wang R, Piizzi G, Hazuda DJ, Woelk CH, Bitton DA. 2019. A Deep Learning Genome-Mining Strategy For Biosynthetic Gene Cluster Prediction. *Nucleic Acids Research*. doi: 10.1093/nar/gkz654.

Hannigan GD, Duhaime MB, Ruffin IV MT, Koumpouras CC, and Schloss PD. 2018. Diagnostic Potential & the Interactive Dynamics of the Colorectal Cancer Virome. *mBio*. doi: 10.1128/mBio.02248-18.

Hannigan GD, Duhaime MB, Koutra D, and Schloss PD. 2018. Biogeography and Environmental Conditions Shape Bacteriophage-Bacteria Networks Across the Human Microbiome. *PLOS Computational Biology*. doi: 10.1371/journal.pcbi.1006099.

Bartow-McKenney C, **Hannigan GD**, Horwinski J, Hesketh P, Horan A, Mehta S, Grice EA. 2018. The Microbiota of Traumatic, Open Fracture Wounds is Associated with Mechanism of Injury. *Wound Repair Regen*. doi: 10.1111/wrr.12642.

Hannigan GD, Zheng Q, Meisel JS, Minot S, Bushman FD, Grice EA. 2017. Evolutionary and Functional Implications of Hypervariable Loci Within the Skin Virome. *PeerJ*. doi: 10.7717/peerj.2959.

Meisel JS, **Hannigan GD**, Tyldsley AS, SanMiguel AJ, Hodkinson BP, Zheng Q, Grice EA. 2016. Skin microbiome characterizations are biased by experimental design. *Journal of Investigative Dermatology*. doi: 10.1016/j.jid.2016.01.016.

Hannigan GD, Meisel JS, Tyldsley AS, Zhang Q, Hodkinson BP, SanMiguel AJ, Minot S, Bushman FD, Grice EA. 2015. The human skin dsDNA virome: Topographical and temporal diversity, genetic enrichment, and its dynamic associations with the host microbiome. *mBio*. 6(5):e01578-15. doi: 10.1128/mBio.01578-15.

Hannigan GD, Hodkinson BP, McGinnis K, Tyldsley AS, Anari JB, Horan AD, Grice EA, Mehta S. 2014. Culture-independent pilot study of microbiota colonizing open fractures and association with severity, mechanism, location, and complication from presentation to early outpatient follow-up. *J Orthop Res*. 32(4):597-605. doi: 10.1002/jor.22578.

Hannigan GD, Pulos N, Grice EA, Mehta S. 2014. Current concepts and ongoing research in the prevention and treatment of open fracture infections. *Advances in Wound Care*. doi: 10.1089/wound.2014.0531.

Hannigan GD, Weiner DB. 2014. Current Progress in DNA Vaccine Cancer Therapy. *Advanced Textbook on Gene Transfer, Gene Therapy and Genetic Pharmacology*. D. Scherman, Editor. Imperial College Press.

Hannigan GD, Grice EA. 2013. Microbial ecology of the skin in the era of metagenomics and molecular microbiology. *Cold Spring Harb Perspect Med*, Fiona Watt and Tony Oro, Editors. doi: 10.1101/cshperspect.a015362.

Hannigan GD, Krivogorsky B, Fordice D, Welch JB, Dahl JL. 2013. *Mycobacterium minnesotense* sp. nov., a photochromogenic bacterium isolated from sphagnum peat bogs. *International journal of systematic and evolutionary microbiology* 63: 124-128.

PATENTS

Hannigan GD, Prihoda D, Soukup J, Woelk CH, Bitton DA. 2018. *Identifying Biosynthetic Gene Clusters*. 62/779.697.

PUBLISHED SOFTWARE

Hannigan GD, Loesche MA, Hodkinson BP, Mehta S and Grice EA. **Creator** (cre), **Author** (aut). patPRO: Visualizing Temporal Microbiome Data. <http://CRAN.R-project.org/package=patPRO>

Oksanen J, et al. **Contributor** (ctb). Vegan: R Package for Community Ecologists. <http://CRAN.R-project.org/package=vegan>

COMPUTATIONAL SKILLS

Bash Scripting, R, Perl, Python, Julia, MySQL, Neo4j/Cypher, GNU Make, Unix/Linux, Machine Learning, Microbiome processing (e.g. Qiime/Mothur), Genomic processing (Bowtie, Blast, etc), RNA-seq Processing & Analysis (e.g. DESeq2, edgeR), RHEL, CentOS, Ubuntu, Mac OS, Windows OS, Windows Office, Adobe Creative Suite.

AWARDS & COMPETITIVE GRANTS

Merck Exploratory Science Center Team Award

2018

Merck PASRD Award for Fostering Collaboration & Driving Results

2018

University of Michigan Molecular Mechanisms in Microbial Pathogenesis Fellowship (MMMP)

2016 - 2017

National Defense Science & Engineering Graduate Fellowship (NDSEG)

2012 - 2015

University of Pennsylvania Biomedical Graduate School TRE Award

2014-2015

University of Pennsylvania Biomedical Graduate School Student Travel Award

2014

University of Minnesota Undergraduate Research Opportunity Program Grant

2011

Mayo Clinic Summer Undergraduate Research Fellowship

2010

University of Minnesota Undergraduate Research Opportunity Program Grant

2009

SELECT PUBLISHED ABSTRACTS & INVITED PRESENTATIONS

Oral Presentations

Hannigan GD. *BGCs and the Microbiome*. Cambridge Startup Public Presentation. September 09, 2019. Cambridge, MA.

Hannigan GD. *Extracting Functional Microbiome Information Through Deep-Learning*. MicroSeminar Series (Available on YouTube). July 25, 2019. Cambridge, MA.

Hannigan GD, Prihoda D, Palicka A, Soukup J, Klempir O, Rampula L, Durcak J, Wurst M, Kotowski J, Chang D, Wang R, Piizzi G, Hazuda DJ, Woelk CH, Bitton DA. *A Deep Learning Genome-Mining Strategy Improves Biosynthetic Gene Cluster Prediction*. Merck Discovery, Pre-Clinical, and Early Development (DPED) Symposium. [INTERNAL]. April 24, 2019.

Hannigan GD. *Keynote Speaker: Colorectal Cancer Classification Using The Gut Virome*. October 23, 2017. Chicago, IL.

Hannigan GD, Duhaime MB, Ruffin IV MT, Koumpouras CC, and Schloss PD. *Viral and Bacterial Communities of Colorectal Cancer*. American Society for Microbiology General Meeting. June 5, 2017. New Orleans, Louisiana.

Hannigan GD, Meisel JS, Tyldsley AS, Zheng Q, Hodkinson BP, SanMiguel AJ, Minot S, Bushman FD, Grice EA. *The Human Skin dsDNA Virome: Topographical and Temporal Diversity, Functionality, and its Dynamic Associations with the Host Microbiome*. 5th International Human Microbiome Congress. April 2, 2015. Luxembourg, Luxembourg.

Hannigan GD, Meisel JS, Tyldsley AS, Zheng Q, Hodkinson BP, SanMiguel AJ, Minot S, Bushman FD, Grice EA. *The Human Skin dsDNA Virome: Topographical and Temporal Diversity, Functionality, and its Dynamic Associations with the Host Microbiome*. University of Pennsylvania Dermatology Research Seminar. April 7, 2015. Philadelphia, PA.

Hannigan GD, Meisel JS, Tyldsley AS, Zheng Q, Hodkinson BP, SanMiguel AJ, Minot S, Bushman FD, Grice EA. *The Human Skin dsDNA Virome: Topographical and Temporal Diversity, Functionality, and its Dynamic Associations with the Host Microbiome*. University of Pennsylvania Dermatology Basic Research Symposium. October 9, 2014. Philadelphia, PA.

Hannigan GD, Hodkinson BP, McGinnis K, Tyldsley AS, Horan AD, Mehta S, Anari JB, Grice EA. *The Dynamic Microbiomes Associated with Traumatic Wound Healing*. 5th Annual HHMI Med Into Grad Symposium. June 14-15, 2013. New Haven, CT.

Poster Presentations

Hannigan GD, Duncan P, Klempir O, Maritz J, Sze M, Bitton D, Woelk CH, Benetti L, Hazuda DJ. [INTERNAL]. Merck Boston Science Symposium. November 15, 2019.

Hannigan GD, Swaminathan G, Aliprantis A, Liu W, Liang X, Norton J, Citron M, Xiao J, Cho C, Kang J, Datta S, Kommineni S, Danilchanka O, Woelk CH, Espeseth A, Gutierrez D, Hazuda DJ. [INTERNAL]. Merck Early Development Course. October 14, 2019.

Liang X, Swaminathan G, Perera S, Kopinja J, Citron M, Xiao J, **Hannigan GD**, Norton J, Kommineni S, Woelk CH, Gutierrez D, Hazuda DJ. *Gut microbiome perturbation by oral antibiotics leads to immune hypo-responsiveness*. Keystone Symposia: Microbiome: Therapeutic Implications. October 6, 2019.

Swaminathan G, **Hannigan GD**, Citron M, Xiao J, Norton J, Lee KJ, Liang X, Kommineni S, Gutierrez D, Hazuda DJ. *Gut microbiome perturbation by oral antibiotics leads to vaccine hypo-responsiveness*. Cold Spring Harbor Microbiome Meeting. July 1, 2019.

Hannigan GD, Prihoda D, Palicka A, Soukup J, Klempir O, Rampula L, Durcak J, Wurst M, Kotowski J, Chang D, Wang R, Piizzi G, Hazuda DJ, Woelk CH, Bitton DA. *A Deep Learning Genome-Mining Strategy Improves Biosynthetic Gene Cluster Prediction*. American Society for Microbiology. June 29, 2019.

Hannigan GD, Prihoda D, Palicka A, Soukup J, Klempir O, Rampula L, Durcak J, Wurst M, Kotowski J, Chang D, Wang R, Piizzi G, Hazuda DJ, Woelk CH, Bitton DA. *A Deep Learning Genome-Mining Strategy Improves Biosynthetic Gene Cluster Prediction*. Merck Data Science Symposium [INTERNAL]. March 23, 2019.

Hannigan GD, Prihoda D, Palicka A, Soukup J, Klempir O, Rampula L, Durcak J, Wurst M, Kotowski J, Chang D, Wang R, Piizzi G, Hazuda DJ, Woelk CH, Bitton DA. *A Deep Learning Genome-Mining Strategy Improves Biosynthetic Gene Cluster Prediction*. MIT Microbiome Symposium. March 07, 2019.

Hannigan GD, Duhaime MB, Ruffin IV, MT, Schloss, PD. *Unraveling the Role of the Gut Virome in Colorectal Cancer*. 6th International Human Microbiome Congress. November 9-11, 2016.

Hannigan GD, Meisel JS, Tyldsley AS, Zheng Q, Hodkinson BP, SanMiguel AJ, Minot S, Bushman FD, Grice EA. *The Human Skin dsDNA Virome: Topographical and Temporal Diversity, Functionality, and its Dynamic Associations with the Host Microbiome*. University of Michigan ASM Branch Meeting. October 23-24, 2015. Ann Arbor, MI.

Hannigan GD, Meisel JS, Tyldsley AS, Zhang Q, Hodkinson BP, SanMiguel AJ, Grice EA. *Topographical and Temporal Diversity of Healthy Human Skin Phage and Bacterial Communities*. 2014 Molecular Genetics of Bacteria and Phages Meeting. August 5-9, 2014. Madison, WI.

Hannigan GD, Hodkinson BP, McGinnis K, Tyldsley AS, Horan AD, Mehta S, Anari JB, Grice EA. *The Dynamic Microbiomes Associated with Traumatic Wound Healing*. University of Pennsylvania Center for Musculoskeletal Disorders Scientific Symposium. November 13, 2013. Philadelphia, PA.

Devaux P, **Hannigan GD**, Hudacek AW, Cattaneo R. *Characterization of glycine-rich region involved in the interaction between measles virus P protein and STAT1*. 30th Annual Meeting of the American Society for Virology. July 16-20, 2011. Minneapolis, MN.

Hannigan GD, Dahl JL. *Mycobacterium arupense in Northern Minnesota Bogs*. 16th Annual University of Minnesota Duluth Undergraduate Research & Artistic Showcase. April 15, 2011. Duluth, MN.

Panel Presentations

Harvard Boston Bacterial Meeting | Student Career Panel (2019)

University of Pennsylvania Cell & Molecular Biology Symposium | Career Panel (2019)

Harvard Boston Bacterial Meeting | Student Career Panel (2018)

FORMAL TEACHING EXPERIENCE

Workshop Leader, Intro to Bioinformatics, Linux, and High Performance Computing, May 2018
Workshop Leader, Introduction to R Programming, October 2017
Workshop Leader, Lab Notebooks and Project Management with GitHub, October 2016
Workshop Leader, Introduction to R Programming, September 2016
Workshop Leader, Introduction to Human Virome Analysis, June 2015
Workshop Leader, Introduction to R Programming, March 2015
Workshop Leader, Introduction to Bioinformatics & Programming, September 2014
Teaching Assistant, Undergraduate Genetics Supplemental Instruction. 2010.
Tutor, Undergraduate Mathematics. 2009.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Society for Microbiology

Member, 2013-Present

International Society for Viruses of Microorganisms

Member, 2013-Present

OUTREACH & LEADERSHIP

Boston Microbiome Meetup Organizer (April 2018 - Present)

Annual NDSEG Fellowship Review Panelist (2016 - Present)

Research Blogger at “Prophage” (2013 – Present)

Ann Arbor R User Group Organizer (2016 - 2017)

Co-Leader of Data Analysis Reading Group (2016 - 2017)

Program Representative in Biomedical Graduate Student Association (2013 – 2015)

Co-founder and Leader of Microbiome Graduate School Journal Club (2012 – 2015)

REFERENCES

Available Upon Request