From:	Smith, Randy
To:	Faith, Seth A.; Hale, Vanessa; Sullivan, Matthew
Cc:	Evans, Kevin (Kevin.Evans@osumc.edu); Reed, Katie; Smith, Randy; Stone, Morley O.; Moses, Randy; Harris, Brad; Weisenberger, Jan; McPheron, Bruce A.; Givens, Ben; Cole, Susan; Amy Darragh; Lee, Ken; Martin, Andrew; Bielefeld, Eric
Subject:	Center for Microbiome Science
Date:	Wednesday, November 4, 2020 4:35:24 PM
Attachments:	image001.png

Seth, Vanessa, and Matthew:

The proposal to establish the Center for Microbiome Science was approved by the Council on Academic Affairs at its meeting on November 4, 2020. Thank you for attending the meeting to respond to questions/comments.

The proposal will now be sent to the University Senate with a request that it be on the agenda for the Senate meeting on November 19, 2020. The Chair of the Council, Professor Kevin Evans, will present the proposal on your behalf, but it is important that at least one of you attends that meeting to respond to questions/comments. I will provide you with details as I receive them.

There is no additional level of review/approval required following Senate action.

Please keep a copy of this message for your file on the proposal and I will do the same for the file in the Office of Academic Affairs.

If you have any questions, please contact Professor Evans (Kevin.Evans@osumc.edu) or me.

Congratulations on the successful completion of this important stage in the approval process.

Randy

THE OHIO STATE UNIVERSITY

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August 3, 2020

Proposal to Establish
The Ohio State University
Center of Microbiome Science

THE OHIO STATE UNIVERSITY

CENTER OF
MICROBIOME SCIENCE

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Introduction

Microbes are often regarded as deadly pathogens, drug-resistant superbugs, toxins contaminating water supplies, and biofouling organisms. However, not all microbes are "bad" (i.e., cause illness), and it is increasingly apparent that many microbes may provide solutions to some of the world's greatest problems, such as climate change, energy, and human health. Recent studies have illustrated that there are many beneficial microbes and it is these native microorganisms that drive nearly all living systems, including humans. Remarkably, there are more microbes than human cells in and on the human body and this collection of microbes – a microbiome – is increasingly recognized as controlling our food cravings, behavior, aging, and susceptibility to disease. Beyond humans, large and elaborate microbiomes work like a coordinated symphony to control nutrient and energy cycles that run entire ecosystems, influence agricultural food production, and impact animal health. Though less studied, viruses, much smaller in size than bacteria and likely equally as important, are being recognized for organizing microbiomes and modulating their impacts via unique and underappreciated mechanisms. In whole, this emergent field of *microbiome science* is intensively interdisciplinary, leverages many areas of excellence present at The Ohio State University (from bench science, to computing and modeling, to bedside and farmland), and is already transforming the life sciences and our understanding of the *rules of life.*

Since 2013, faculty at Ohio State have collaborated across disciplines to form a robust network focused on microbiome science. This network was more formally structured in 2017 with the establishment of the Infectious Diseases Institute (IDI) and its Microbial Communities Thematic Program, one of six thematic programs in the institute. As a result, Microbial Communities faculty, staff, and trainees have met monthly for seminars, and more recently to develop curriculum, collaborations, and a web presence (https://u.osu.edu/coms). The microbiome science community at Ohio State is rapidly growing and demonstrating high impact outcomes in research, teaching, and outreach.

Box 1: Impact, growth, and differentiators of microbiome science at Ohio State

- Sixty-four faculty across seven colleges, i.e., well beyond 'human microbiome'
- Multi-million-dollar microbiome focused grants, i.e. recent >$3M DOE Systems Biology and $12.5M NSF Biology Integration Institute
- World-renowned biennial *Viromics Workshop*, and upcoming *Microbiome Symposium*
- Unique-in-the-world *Microbiome Science Training Track*
- Powerful computational microbiome toolkit developed and tested at the Ohio Supercomputer Center
- Strong and integrated connections to successful Office or Research supported OSU Centers (RNA Biology, Byrd Polar Climate Research Center) and Institutes (Infectious Diseases, Translational Data Analytics)

Leveraging our strengths and differentiators (Box 1), we recognize that Ohio State can uniquely approach microbiome science with an advanced whole ecosystem analysis, using environmental science, data analytics, and viromics to provide an unrivaled 'ecosystem aware' position that would differentiate the center from efforts at other top institutions. This work leverages significant investments from the IDI, and bridges to numerous Discovery Themes (DT), such as the Sustainability Institute, the Translational Data Analytics Institute, and the Foods for Health

DT program that represent an incredible breadth of resources, talent, expertise, and trainees to apply to microbiome science.

We propose to establish the Center of Microbiome Science (CoMS) at Ohio State to implement a research and academic mission built upon three specific themes: *Community, Compute,* and *Curriculum*. This will formalize seven years of cross-unit and cross-college interactions and engagement, spearheaded by members of the IDI Microbial Communities Thematic Program. University center-level organization would provide global visibility, accelerate career advancement and research/training opportunities for recent microbiome faculty hires and students, and establish a world-class intellectual nexus to enable large-scale extramural funding opportunities in one of the most highly fundable and broadly emergent disciplines in the life sciences.

I. MISSION:

To empower Microbiome Science for the design and prediction of microbial communities in animal, plant, human, environmental, and engineered systems.

A. Missions of the university (research, teaching, and service/outreach) relevant to CoMS
A university-level plan was established from input by the IDI Microbial Communities Thematic Program directors, a mini-symposium in the fall of 2019, and a retreat in the spring of 2020 that brought together the Ohio State microbiome community to discuss opportunities, challenges, strengths, weaknesses, and scope of current research programs. The conclusions of the community discussions identified the following thrust areas for the center: (i) build community in microbiome science, (ii) enable investigators to perform microbiome studies, and (iii) focus on trainee education in high-tech digital skills (computational microbiology/bioinformatics). This inspired and translated to the three CoMS themes of *Community*, *Compute*, *Curriculum*. To describe these themes in comparison to Ohio State's missions in *research*, *teaching*, and *outreach*, recommendations from The Microbiology Society, *Unlocking the Microbiome Report*[1] were adapted as the following:

Research:

1. Enable investigators to obtain support for large-sample and longitudinal studies to validate associations, identify biomarkers, and assess the long-term implications of human or environmental changes to microbiomes.

2. Work together with internal and external stakeholders to facilitate community-led collaborations that are:

- Interdisciplinary – joining disciplines such as microbiology and biochemistry with clinicians, social scientists, and a wide range of other professionals.
- Cross-cutting – linking experts in human, animal, and environment microbiomes.
- Effective at local, national and international levels.

[1] Marchesi, Microbiology 2018;164:1005–1006

Teaching:

3. Develop targeted early career training and education in areas such as bioinformatics and basic microbiology skills (detailed in Appendix G).

4. Support workshops, training networks, and infrastructure for established research groups to develop and gain access to required resources.

Outreach:

5. Manage data effectively and efficiently for the long term, to ensure maximum benefit can be derived from well-maintained and curated databases.

6. Focus on facilitating academic/industry collaborative networks.

7. Ensure that the potential of this emerging science and innovation is communicated accurately, people are enabled to make informed decisions, and the scientific community is always regarded as a trusted source of information.

B. Interdisciplinary nature of the center

Microbiome science is widely recognized as a highly interdisciplinary field. Letters of support from existing microbiome centers and programs (Appendix D) support this assertion and illustrate that Ohio State is an ideal environment for a Center of Microbiome Science on these merits. From a bottom-up perspective, microbes are present all around us, and impact plants, animals, humans, and the environment. Collaboration across fields occurs by virtue of the shared microbes across environments and the need to apply resources and sophisticated data analysis methods between disciplines. The next connecting layer for interdisciplinarity is the scientific approach to microbiome science. Studies rely on practitioners to collect samples, microbiologists to manipulate samples, molecular biologists to produce genomic data sets, chemists to produce molecular fingerprints, computational scientists to process data with large computing resources, and data scientists and statisticians to analyze the data. As microbiome science matures, the best studies require such intensively interdisciplinary contributions to maximize knowledge gained. Furthermore, the modern microbiome scientist needs to be well trained in this field. For example, they will need to process samples in a laboratory, and analyze the resultant data with bioinformatics tools (AKA: code) that they have written themselves. Microbiome science is incredibly powerful, due to the importance of microbes to all of the life sciences, but it is an emergent discipline that requires communication across vastly different fields of science. Ohio State, and its efforts to build a culture of interdisciplinary research, are ideal for developing microbiome scientists.

C. Goals of the center that cannot be met with existing academic units

The CoMS community has provided a robust list of needs that a university center could provide. These needs have been articulated as goals for the center that follow on the themes of *Community*, *Compute*, *Curriculum*. The following goals have been established in alignment to the Ohio State Office of Research (OR)'s *Research and Creative Expression Strategic Plan Strategic Plan Framework* (2019). CoMS goals are presented with numbered reference for applicability back to the OR goals. Goals that are key differentiators of the center are designated with an asterisk.

Office of Research Strategic Goals:

1. Build and sustain a culture of excellence that attracts, engages and supports top faculty and staff talent, enabling them to perform at the highest levels.
2. Attract, develop and support an inclusive and innovative community to educate future research leaders who create impact in academia, industry, and broader communities.
3. Establish Ohio State as the leading university in interdisciplinary research and creative expression.
4. Provide high quality, innovative physical space, infrastructure and financial support for research and creative expression.
5. Broadly expand Ohio State's research and creative expression engagement beyond the campus to accelerate impact.

*CoMS **Community** goals*

1) Establish and support working groups for practical instruction and cohort development across campus centered on various aspects of microbiome science (OR goals 1,2,3)*

2) Support and expand seminar series and community events (e.g., ideation workshops, interdisciplinary mixers) across campus within the scope of microbiome science (OR goals 1,2,3)

3) Encourage practices of diversity and inclusion in leadership and all aspects of decision-making (OR goals 1,2)

4) Grow the CoMS community by increasing awareness and access to microbiome science resources for faculty expanding into a microbiome space, and by supporting faculty hiring and postdoc/graduate recruitment committees to help recruit top microbiome science talent (OR goals 1,2)

5) Communicate CoMS related resources, events, opportunities, and highlights regularly to CoMS community and external partners (OR goals 1,2,3,5)

*CoMS **Compute** (and research infrastructure) goals*

6) Support and further develop the microbiome science computing toolkit presently at the Ohio Super Computer (OR goals 3,4)*

7) Enable CoMS members to become 'power users' of the Ohio Supercomputer Center and related high-performance computing platforms through training, workshops, customized tools, and microbiome science specific resources (OR goals 3,4)

8) Establish fee-for-service virome and microbiome capabilities, e.g., sample preparation, ultra-economized sequencing, analytical workflows (OR goal 4)

9) Support center-level grant proposal efforts by helping faculty develop team grants that broadly benefit center membership and interdisciplinary research efforts (OR goal 3)

*CoMS **Curriculum** goals*

10) Support and further develop Microbiome Science Training Track to attract top students and provide internationally recognized training (OR goal 1) *

11) Incentivize CoMS faculty to add microbiome science topics into existing courses, and to develop new courses that cover CoMS-approved under-explored areas of microbiome science (OR goal 1)

12) Support the world-recognized semi-annual Ohio State Viromics Workshop and identify and develop additional workshops and symposia in microbiome science (OR goal 5)

II. FACULTY:

A. Criteria for selection of faculty membership

Members of CoMS are selected through their expressed interest in participating in the center. Membership requirements are as follows:

1) Members must be involved in research and/or education that is broadly related to microbes and/or viruses in animals, plants, humans, and/or the environment.

2) Members must be engaged in center activities, such as educational and scientific programs, administrative committees, interactions with other elements of the university, activities related to community growth (workshops, training, seminars, consulting services), and functions that promote the center growth in research and educational programs.

The following criteria define the categories of membership in the Center of Microbiome Science:

Full member

- Full members must be Ohio State faculty or independent university researchers (e.g., principal investigator, research scholar, research associate) responsible for research and education.
- Full members should be actively involved in basic, applied, clinical or translational research, and be a principal investigator on an extramurally funded grant or a principal investigator of an individual project within a larger extramurally funded program project grant.

Trainee member

- Undergraduate students with an interest in microbiome science
- Graduate or professional students with an interest in microbiome science
- Post-graduate fellows or trainees with an interest in microbiome science

Staff member

- Staff performing research in a full member's laboratory and have interest in microbiome science

External member

- Individuals actively involved in basic, applied, clinical or translational research in microbiome science that are not primarily affiliated with Ohio State. Appointment to this

category requires approval by center leadership. While external members may participate in seminars and other center activities, they are not eligible to receive financial benefits, such as support for meeting attendance.

Membership Review Procedures
To fulfil the theme of *Community*, CoMS will not prohibit initial membership to anyone meeting the criteria described above. However, the director, with support from CoMS executive leadership, will review the participation of each member in center activities on a biennial basis. The two-year review procedure shall assess the following criteria, for which, three of the seven conditions must be met and self-reported to retain membership:

1) Mentor or serve as a committee member of a microbiome scientist,
2) Host for a seminar speaker in microbiome science,
3) Contribute to a center grant proposal as PI, co-I, or contributing faculty,
4) Contribute to CoMS resource development efforts in computing,
5) Contribute to CoMS curriculum, short-courses and/or workshops,
6) Serve as a CoMS consultant to study design and/or analysis, or
7) Serve on the Executive Advisory Committee.

A consistent lack of involvement will generate a communication from the director, and after two years of inactivity, membership will be abolished if extenuating circumstances are not communicated and/or accepted. Upon loss of membership, the individual will not qualify for certain incentives of the center, such as seed grants, support for proposal development, and consulting services. Membership may be reinstated after a minimum of one-year demonstrated activity to the criteria above and formal petition to the director.

B. Faculty expressing interest in associating with the center:
Currently, there is diverse and widespread support for CoMS among faculty throughout OSU. Sixty-four faculty from seven colleges: Arts & Sciences, Dentistry, Engineering, Food, Agricultural and Environmental Sciences, Medicine, Public Health, and Veterinary Medicine; two schools: Environment and Natural Resources, and Earth Sciences; as well as collaborators at Nationwide Children's Hospital have expressed interest in membership in the center. CoMS faculty conduct interdisciplinary microbiome science across all environments including soil, water, agricultural and engineered systems, built environments, and host-associated microbial communities including plant, animal, and human microbiomes. A complete listing including departmental and college affiliations and contact information is provided in Appendix A. Accompanying letters of support from departmental chairs and directors are provided in Appendix B.

C. Student/staff involvement
The center will create student working groups, provide workshops, seminars, symposia, discussions, and will communicate with members via monthly emails, and through the CoMS website.

Current opportunities available to center students and staff, and/or trainees include:

- **Working Groups**: Student working groups mobilized around topics such as viromics, advanced ecological statistics, and microbiome analyses will meet monthly to create a space for learning, discussion, and idea generation (Appendix H).
- **Microbiome Science Curriculum**: Four new courses created by center members are focused on the theory and implementation of microbiome science and microbial community analysis. (Appendix G). These serve as formalized training mechanisms with various entry points for a diversity of backgrounds and experiences of Ohio State trainees.
- **Weekly and Monthly Seminars**: Center faculty, staff, and trainees are active participants, organizers, and attendees of several relevant seminar series including:
    - **Monthly Biofilms Seminar**–hosted by the Department of Microbial Infection and Immunity within the College of Medicine (with support from IDI). This seminar features biofilms research from OSU and external speakers.
    - **Weekly Infectious Diseases Institute (IDI) Work-in-Progress Seminar**–co-hosted by the IDI Microbial Communities and Host Defense and Microbial Biology Thematic Programs. This seminar features host/microbe research by trainees and is a space for feedback and honing future presentations and research.
- **Internship and Job Placement Opportunities**
    - CoMS will seek opportunities for trainees with external partners. For example, CoMS is presently forging an Educational Partnership Agreement with the Air Force Research Labs, 711th's Human Performance Wing to create workforce development opportunities with top-notch talent at Ohio State (see Letter of Support – Appendix D). Through a monthly email newsletter, CoMS will also distribute notices of employment and training opportunities for trainees.

CoMS will provide upcoming opportunities available to all center faculty, staff, and/or trainees include:

- **Ohio State University Biennial Viromics Workshop** (5th Meeting is May 2021): This 2.5 day workshop will kick off with a mini-symposium to showcase diverse virome-enabled science and then seeks to introduce graduate students, postdocs, and junior faculty to the informatics tools (iVirus, IMG/VR, KBase) available to develop biological understanding of viruses from viral and microbial metagenomic datasets. Virtually all of this viral toolkit has been developed by Ohio State researchers and, unlike microbiome workshops, there is no other 'virome' workshop like this in the world. https://u.osu.edu/viruslab/viromics-workshop/
- **Midwest Microbiome Symposium** (May 2021 and May 2022): Will be co-planned and hosted at Purdue University in May 2021 and then organized and hosted at Ohio State in May 2022. Faculty, staff, and trainees will be involved in the planning of these event and trainees will also have opportunities to speak and present posters during the symposia.
- **Monthly Networking/Science Socials:** These events are both formal and informal opportunities to network within and between center members and members of other relevant groups around campus.
    - **CoMS Research Networking Events** – an opportunity for center faculty, staff, and trainees to meet to discuss research interests.
    - **Connect and Collaborate Events** – an opportunity for center faculty, staff and trainees to learn about research interests of individuals in other relevant groups (e.g., IDI, TDAI, Foods For Health) and identify potential shared areas of interest

III. ADMINISTRATION:

The Center of Microbiome Science will report through the Office of Research with a direct reporting line to the senior associate vice president for research. The organizational structure is designed to empower individual members, foster more open communication, and improve coordination and speed of implementing ideas/plans (Figure 1). The center's organizational structure includes a director who reports to the Office of Research, executive director, associate director, executive advisory committee (EAC), business manager (.1 FTE), and program coordinator (TBD - based on availability of future resources). Within the 'microbiome ecosystem', CoMS will have strong connections to the Infectious Diseases Institute to help in co-developing synergistic activities, the Microbiome Community consisting of Ohio State investigators and trainees and external academic organizations, and Non-academic partners (e.g., industry and government).

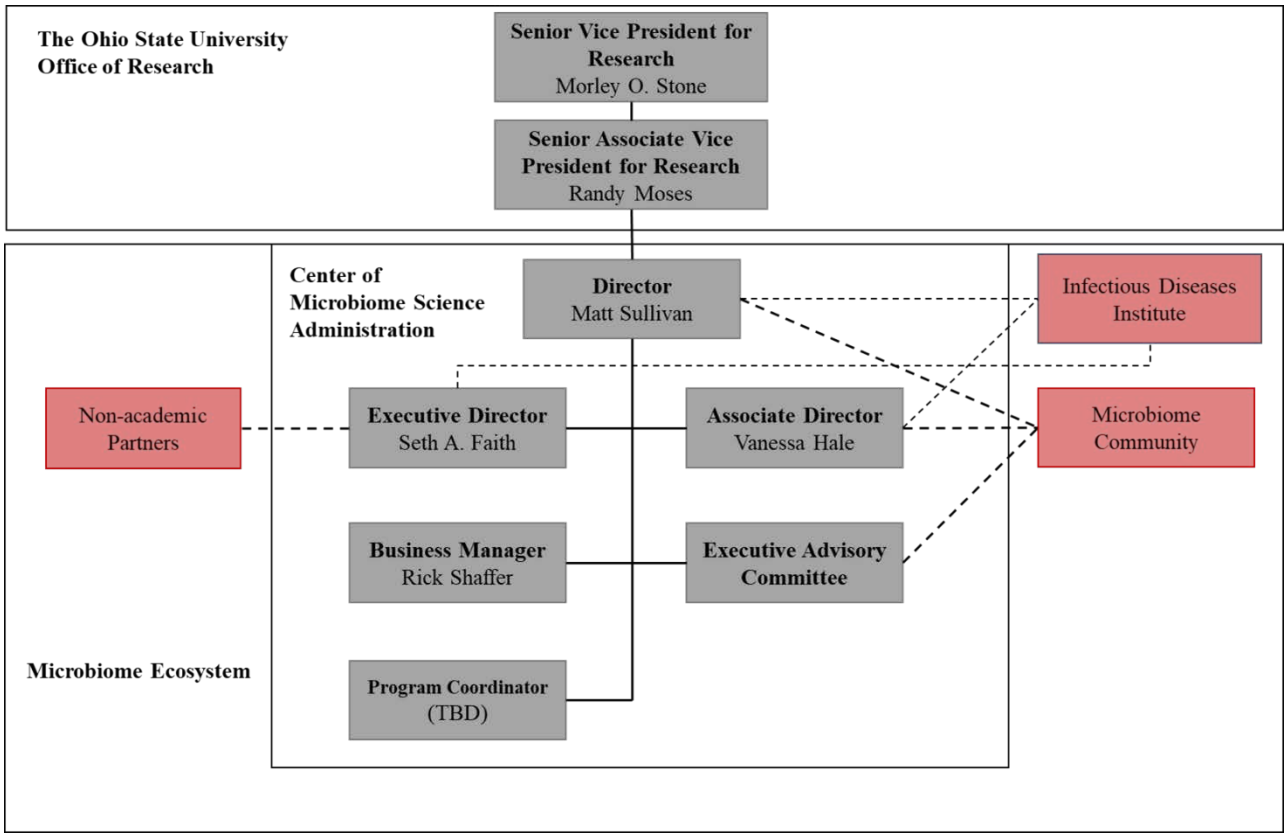

Figure 1 - Center of Microbiome Science Organizational Chart

A. Director

The director is Matthew Sullivan, Ph.D., Professor, Departments of Microbiology and Civil, Environmental and Geodetic Engineering; Gordon and Betty Moore Foundation Investigator; co-director of the IDI Microbial Communities Thematic Program.

Responsibilities of the director

The director will oversee all aspects of center operation but will do so with the executive director and associate director with the intentions of strengthening the position of Ohio State in the microbiome space. Functions include:

1) Implement strategy and tactics to achieve center goals,
2) Foster a culture of excellence based on integrity, sound fiscal policy, and accountability,
3) Represent the center within the university community and to the greater scientific community,
4) Implement policy decisions made in consultation with the executive and associate directors, and where possible after advisement from the executive advisory committee, and
5) Be a model of leadership in research and education in microbiome science both internally and externally.

B. Executive Director

The executive director is Seth A. Faith, Ph.D., strategic alliance officer, Infectious Diseases Institute, and principal investigator in the Office of Research. The executive director works closely with the director to advance the mission, goals, and strategies of the center. Functions include:

1) Lead the development of a long-term financial sustainability plan in conjunction with the director, associate director, and the executive advisory committee,
2) Identify and develop strategic internal and external partnerships with an emphasis on industry, government, and non-profit organizations,
3) Manage administrative aspects of external partnerships (e.g., teaming agreements, MOUs, educational partnerships, intellectual property),
4) Develop strategies to position CoMS as leader in microbiome science, and
5) Manage center staff (upon growth).

C. Associate Director

The associate director is Vanessa L. Hale, MAT, DVM, Ph.D., assistant professor, Department of Veterinary Preventive Medicine, College of Veterinary Medicine; co-director of the IDI Microbial Communities Thematic Program. The associate director works closely with the director and executive director to advance the mission, goals, and strategies of the center. Functions include:

1) Serve as a strategic advisor to the director,
2) Lead communications efforts within the CoMS community,
3) Build community within and between regional academic institutions to advance center goals and enhance connectivity of the microbiome research community, and
4) Engage in and support research and education in microbiome science and aligned with center goals.

D. Composition and function of the CoMS Executive Advisory Committee

The composition of the executive advisory committee (EAC) will represent the interests of CoMS. The initial composition of the EAC was determined by inclusion of one faculty member from each college with representation in the center. Recommendations for EAC membership are made by the director to the committee, with the selection determined by the majority vote of the director, executive director, associate director, and EAC. EAC terms are for two years, renewable up to six years upon majority vote

of the director, executive director, associate director, and EAC, with an effort to maintain diversity (gender, background, colleges represented, experience) on the EAC.

The EAC will work with the director to:

1) Support the director in the development and implementation of the center's strategic plan,
2) Support educational and scientific programs,
3) Engage in outreach within the university community and with the greater scientific community,
4) Mentor junior faculty and facilitate the professional development of graduate students, postdoctoral fellows, and
5) Support annual reviews of the performance of the center.

The current members of the CoMS Executive Advisory Committee are:

- Alison Bennett, Ph.D., associate professor, Department of Evolutional, Ecology, and Organismal Biology, College of Arts and Sciences
    - Alternate: Zakee Sabree Ph.D., associate professor, Department of Evolutional, Ecology, and Organismal Biology, College of Arts and Sciences
- Karen Dannemiller, Ph.D., assistant professor, Department of Civil, Environmental and Geodetic Engineering (secondary appointment. Environmental Health Sciences, College of Public Health)
- Steven D. Goodman, Ph.D., professor, Department of Pediatrics, College of Medicine and (secondary appointment. Center for Microbial Pathogenesis, Abigail Wexner Research Institute at Nationwide Children's Hospital)
- Jiyoung Lee, Ph.D., professor, Department of Environmental Health Sciences, College of Public Health (secondary appointment. Department of Food Science & Technology, College of Food, Agricultural, and Environmental Sciences)
- Phillip Popovich, Ph.D., professor and chair, Department of Neuroscience; Center for Brain Science and Spinal Cord Repair, College of Medicine
- Christopher G. Taylor, Ph.D., associate professor, Department of Plant Pathology, College of Food, Agricultural, and Environmental Sciences
- Jenessa Winston, D.V.M., Ph.D., DACVIM, Veterinary Clinical Sciences, College of Veterinary Medicine

E. Reporting line

The proposed center will report through the Office of Research (figure 1). The director will report to Dr. Randy Moses, senior associate vice president (SAVP) for research administration within the Office of Research. The center director will work with the SAVP to formalize budgets and set strategies in alignment with the Office of Research strategic priorities. The SAVP will represent the center to the leadership of the Office of Research and the senior vice president for research administration.

F. Pattern of administration (to be formally established within one year)

The primary components of the center's administration are detailed in sections III.A-D. Since receiving temporary center status in spring of 2020, the described pattern of administration has been established with exemplary members committed to leading the center's strategy. Given the established structure, there will be no delay in establishing the administration upon formal center status designation.

IV. BUDGET/FUNDING:

Strategic input provided by the senior vice president for research was to "accelerate the science" and "emerge onto the world stage for microbiome sciences." With this guidance, initial investments and funding have been prioritized to foster research collaboration in high-impact research areas to advance the three CoMS themes: *Community*, *Compute*, and *Curriculum*.

Appendix C provides information and justification for the CoMS FY21—FY22 strategic budget in alignment with the identified goals based on projected sources and uses. The recently announced financial control initiative by the Office of Business and Finance as a result of the COVID-19 pandemic presents an unanticipated measure that could impact fund usage (i.e., expenses will be reviewed on a case-by-case basis by the Office of Research SFO). The budget described herein maximizes the present financial resources afforded to CoMS to successfully execute its mission.

A. Expected budget

Sources (~$300,000)

An initial two-year investment of $200,000 from the Office of Research has been provided, and a two-year commitment of $100,000 has been made by the College of Arts and Sciences ($50K in each FY21 and FY22). However, OR's proposed target budget to be obtained from OR and other internal sponsors (i.e., colleges) is $1M.

Remaining commitments towards the $1M budget will be negotiated over time with various colleges whose faculty will contribute to, and benefit from, the center. Discussions with the Colleges of Medicine, Engineering, and Food, Agricultural, and Environmental Sciences are on-going.

In addition to the monetary commitments, the Infectious Diseases Institute is providing "in-kind" administrative staff support to assist with establishing the center and on-going support until the center is fully functional with consideration given to long-term sustainability as the IDI is committed to the success of CoMS. As well, Seth Faith will serve in a long-term role as executive director of CoMS.

Uses

FY21 (~$250,000 currently committed)

The Uses section of the budget is organized into three activity categories that are intended to accelerate Ohio State's microbiome science and are critical to initial, phase one strategies. The categories are outlined below and described in full detail in Appendix C with additional explanation regarding the relevance and importance to establishing the Center. Note that the near-term salary/benefit expense being proposed all represent support for *current Ohio State employees* (GAs, postdocs, etc.) for identified periods of time and do not require new job positions, which are presently on-hold for the entirety of Ohio State.

Table 1 - Proposed use of budget FY21, full narrative provided in Appendix C

Uses	Deliverables/Outcomes
1.0 Compute ($69,844)	
1.1 Microbiome Toolkit Optimization and Visibility	
1.1.1 OSC tool buildout, verification, and validation	Continued OSC 'microbiome' app availability, documentation, visibility; support Microbiome Informatics 'hands-on' course; support trainee-led working groups
1.1.2 Evaluate cloud computing service	Cloud platform tools that can be leveraged as a capability for extramural funding, tools to support fee for service
1.2 Developing low-cost metagenomics services for Ohio State investigators	Experimental assessment of various scalable plate-based sequencing capabilities to assess multiplexing; Ultra-low-cost metaG/metaT sequencing capabilities (targeting $10-20 metagenomes, down from >10-fold that cost)
1.3 Fee for service process evaluation	Verified workflows for sequencing and analysis, working group to act as consultants to CoMS investigators
2.0 Demonstration Projects ($171,570)	
2.1 Multi-layer network analytics	Multi-layer network analytics applied to multi-omics datasets to provide next generation analytical capabilities; high-profile paper applying these to marine model system data already in-hand to provide Ohio State a unique multi-omics capability
2.2 Viral tag and grow	High-profile 'Methods' paper on new Viral Tag and grow high-throughput capture and characterization capability - technology for single viral genomics and characterization to disrupt phage therapy in a transformative way; High-profile 'biology' paper on applying; VT+grow to field samples to assess variation in nature, and demonstrate applicability for phage therapy capture and characterization; Provides Ohio State a unique technological capability; develop tech bulletin/white paper for the technology and new capability (description and benefits) for internal and external communication
2.3 Climate change demonstration	High-profile 'microbiome' paper on how thawing permafrosts will affect climate-active gases; trainee-led 'microbiome' working group, technical bulletin or “postcard” for metabolic modeling and applications (e.g., importance and application to health and agriculture) for internal and external communication
2.4 Byrd-polar “Ice”	High-profile 'microbiome' paper, collaboration with another prominent Center, press-coverage of study
2.5 Biomedical Demo	High-profile 'microbiome' paper, presentation to clinical and Col of Med faculty for “how-to” conduct microbiome studies
3.0 Curriculum **($0)**	
	Workshops, education of internal workforce; Accelerate the science, build community, microbiome, virome, and advanced ecological statistics working groups, complement the recently established 3- to 4-course Microbiome Science Training Track (here) and recent “Data Science Bootcamp”
	Future plans with additional funding include: travel awards, community of practice leadership stipends, and seed awards
4.0 Travel and Marketing ($ remaining budget, upon approval)	
	Networking and pre-solicitation marketing of CoMS

FY22 ($50,000 currently committed)

CoMS executive leadership will assess the FY22 budget in Spring 2021, when additional university financial guidance and resources are better known following the recovery from the pandemic. With the committed $50,000 and any additional funds committed by college level support, a prioritization will be made for the following activities: investigator seed grants, trainee support (travel grants and seed awards), a robust seminar series, annual symposium, and programmatic support with a full- or part-time program coordinator.

B. Facilities, equipment, and resources

Presently, the center can leverage many facilities and resources aligned faculty members and provided by the University infrastructure. Members of the center are users of a key Ohio State resources, such as the Ohio Supercomputer Center (OSC), which is presently provided at minimal cost to investigators. Additionally, CoMS researchers will utilize the services of Ohio State Comprehensive Cancer Center's Genomics Shared Resource and Nationwide Children's Hospital Institute for Genomic Medicine to provide critical laboratory resources/equipment. Their services will be utilized by center investigators to reduce the large costs associated with establishing and maintaining a genomic core laboratory.

Presently, the IDI is leading an effort to repurpose office and conference room space in the Biological Sciences Building that is intended to be a hub for the IDI and aligned research communities such as, microbiome science, computational microbiology, modeling, and applied microbiology. The present plans include administrative and conference room space for CoMS that is an ideal co-location to facilitate interactions between the center, the IDI and other university units. The long-term financial elements of the space will be reassessed with IDI yearly, but the near-term commitment is in-kind contribution from IDI to support the collaboration (see Letter of support from Dr. Michael Oglesbee, IDI Director, Appendix D).

Strategic growth could include building additional computing resources in the Cloud (e.g., Amazon Web Services), securing equipment grants for genomic analysis (e.g., sequencing), and forging formal partnership with genomic service providers in academia and industry. These tactics will be assessed annually by the director and the EAC.

C. Sustainability of the center —possibilities for external funding, and details of related funding proposal submissions.

One of the greatest benefits of attaining center status is competitive advantage for extramural funding in large interdisciplinary programs.

Extramural research and trainee funding

With the growing understanding of the microbiome's importance in human health, and its role as a "canary in the coal mines" for individual, community, animal, and environmental health, many federal agencies and private foundations are now allocating funds directly or indirectly to microbiome research. These emerging funding priorities will add to the center's financial sustainability. Federal funding for the field of microbiome is on target to be close to $1B annually in 2020 (Appendix F, Figure 1).

Given the interdisciplinary nature of this field, and the diversity of agencies and private foundations now funding into this space across, the center will also be able to have broad impact across the university environment, helping to converge multidisciplinary research teams to pursue opportunities at the intersection of human, animal, and environmental research long-term. The active grants that Ohio State has received in this space has been substantially growing year-over-year as can be seen in Appendix F, Figure 2. This trajectory will continue in the coming years with the increasing role of microbiome in interdisciplinary research.

Detailed information about several key priority shifts in federal agencies and private foundations will guide the center's strategy for identifying and proposing to extramural research programs. Supporting data for funding levels of organizations other than those detailed below can be found in Appendix F, figure 3.

Federal funding strategy:

1. National Institutes of Health (NIH):

As it currently stands, 21 of the 27 NIH institutes and centers currently fund microbiome research. Since 2012, NIH's support for human microbiome research has exceeded $100M annually and the cumulative total over the past eight years exceeds $1 billion. CoMS will be able to pursue a "3rd aim" strategy to work with biomedical and clinical researches to include microbiome research in their future NIH proposals and/or to submit supplements to funded projects to add microbiome dimensions, where appropriate, for existing work. Building upon of this synergy, the NIH has recently launched their 2020-2030 Strategic Plan, which largely focuses on precision nutrition. Microbiome research plays an integral, cross-cutting, role in all of the strategic goals of this decadal funding strategy and the establishment of CoMS will position Ohio State to diversify our traditional microbiome funding portfolio, expanding our NIH funding footprint in this space in the years to come. CoMS intends to explore program level grant opportunities at NIH, for example in microbiome design and phage therapy.

2. National Science Foundation (NSF):

As a part of their '10 Big Ideas' process in 2016, the NSF identified microbiome science as an emerging, important field of research. As an example, their "Understanding the Rules of Life: Microbiome Theory and Mechanisms (URoL:MTM)" program is an integrative collaboration, spanning multiple NSF directorates and offices that provides $3 million over five years. This mechanism specifically calls for interdisciplinary teams that involve engineering, computational, statistical, biological, physical, and chemical approaches. CoMS is exceptionally positioned to pursue these funds from NSF in the coming years.

This year, NSF launched a new program granting opportunity for Biology Integration Institutes. This call sought large-scale teams whose overarching research theme brings together different biological disciplines around a specific research program whose interwoven research projects connect with each other to advance the overall research theme, and also includes educational activities that integrate with the research and advance the goal of cross-disciplinary training. OSU granted temporary center status for CoMS to apply for this $12.5M 5-year award, the proposal passed the first filter to get a (virtual) reverse site visit in June, and we just received word that **our proposal for a new Biology Integration Institute is being recommended for a $12.5M award**. This is a prime example of the kind of interdisciplinary funding CoMS can enable.

NSF also holds Science and Technology Center calls every three years. These are $50M awards that "support innovative, potentially transformative, complex research and education projects that require large-scale, long-term awards. STCs conduct world-class research through partnerships among academic institutions, national laboratories, industrial organizations, and/or other public/private entities, and via international collaborations, as appropriate. They provide a means to undertake significant investigations at the interfaces of disciplines and/or fresh approaches within disciplines. STCs may involve any areas of science and engineering that NSF supports. STCs investments support the NSF vision of advancing discovery, innovation and education beyond the frontiers of current knowledge, and empowering future generations in science and engineering." In the 2019 round, CoMS Director (Sullivan) is part of a proposal led by the Woods Hole Oceanographic Institute on ocean chemistry that has advanced to the (virtual) site visit stage. Through this experience in the process and CoMS formation and anticipated synergy with partners across campus, we expect CoMS should be well positioned to support a team to compete for an STC award in the next 1 or 2 cycles of competitions.

Finally, NSF partners with USDA-NIFA in their Plant Biotic Interactions Program, which supports research on the processes that mediate beneficial and antagonistic interactions between plants and their viral, bacterial, oomycete, fungal, plant, and invertebrate symbionts, pathogens and pests. CoMS members have applied to this program prior to CoMS establishment, but been unsuccessful. Now, through the added capabilities and expertise that CoMS coalesces, we anticipate a new proposal going back to this program in the near-term.

3. United States Department of Agriculture (USDA):

The USDA Agriculture and Food Research Initiative (AFRI) has established a cross-cutting foundational and applied science program priority area that focuses in agricultural microbiomes. The center, in collaboration with the College of Food, Agricultural, and Environmental Sciences researchers could support multiple awards in this area, and work towards a Center of Excellence (CoE) designation in plant microbiome research within the next two-three years. This CoE designation would open up additional venues for program funding in the future, as well as partnerships with industry and other funding entities.

A team of OSU researchers were involved in submitting a $10M proposal to the AFRI – Sustainable Agricultural Systems (SAS) RFA. The team proposed to examine the role of the microbiome in hydroponic plant production systems and whether it can be functionally changed to increase plant growth and yield while simultaneously reducing energy and chemical inputs. The proposal failed in part due to the need for more data on the established role of microbiomes in these production systems. **The team has subsequently been working on building a microbiome platform that will be greatly enhanced by training and research capacity that CoMS could provide to address the comments in a resubmission of the proposal in late 2020.**

4. Department of Defense:

The Department of Defense (DoD) has formed a Tri-Service Microbiome Consortium to coordinate investments and progress in microbiome research. Funding generally falls under DoD biotechnologies for health and human performance; however, their funding support spans the development of novel computational and diagnostic tool development, and developing design principles to generate synthetic

microbial communities. This provides a fertile area of opportunity for funding that the center can pursue that is a natural bridge between engineering, biomedical, and clinical research.

5. Department of Energy:

The US Department of Energy has committed a portfolio of $66 million for research on plants and microbes. As a part of this, the Biological and Environmental Research program supports scientific research and facilities to achieve a predictive understanding of complex biological, earth, and environmental systems with the aim of advancing the nation's energy and infrastructure security. A key goal is an understanding of the underlying biology of plants and microbes as they respond to and modify their environments to eventually reengineer microbes and plants for energy and other applications. This intersection of environmental, computational, and microbial science is a key strength of CoMS that will expand the footprint of Ohio State in this area of federal funding in the coming years. Two CoMS faculty have led separate BER-funded large grants, each >$3M (IsoGenie and VirSoil Systems Biology).

6. National Science and Technology Council Committee on Science (NSTCCS):

The NSTCCS has assembled a U.S. governmental agency working group comprised of 23 agencies around the microbiome domain through which they have defined a five-year microbiome research strategic plan that provides interagency opportunities focused on:

- Supporting interdisciplinary, collaborative research to enable a predictive understanding of the function of microbiomes in diverse ecosystems in order to enhance public health, improve food and environmental security, and grow new bioeconomy product areas.
- Developing platform technologies to generate critical insights and improve access to and sharing of microbiome data collected across ecosystems.
- Expanding the microbiome workforce through educational opportunities, citizen science and public engagement.

Private foundation funding strategy

Similar to the federal funding agencies, many private foundations are pivoting funds towards microbiome and microbiome-adjacent areas, such as autoimmune disorders. This funding is often geared towards disease-specific focus areas (e.g., cancer) with a particular emerging focus on gut health and its impact on mental health. However, several private foundations (Sloan, Simons, Moore, Schmidt) provide significant funding to environmental microbiome research. CoMS membership have relationships with several of these private funders and funding successes for both human and environmental microbiome research. A list of private foundations that are funding microbiome related science is provided in Appendix F. We expect CoMS to nucleate opportunities in this space and provide the kinds of innovative team-building activities that will lead to the high-risk, high-reward science that private foundations prefer to fund.

More directly, our landscape assessment and benchmarking has shown that successful and highly regarded university-aligned microbiome centers across the US have received significant philanthropic support that leveraged substantive university seed funding into longer-term sustainability budget models and endowments. The "microbiome" is a very important topic for human health and the health of our pets, plants, and the planet. For this reason, CoMS will work with Ohio State foundations and advancement offices to identify additional sources of support for the center and strategies to establish such support.

Industry-facing capabilities and opportunities

CoMS is well positioned to establish several additional sources of revenue while serving CoMS membership and external partners. First, in partnership with the IDI and the newly established Applied Microbiology Services Laboratory (AMSL), an interdisciplinary earnings unit co-created by IDI and the Department of Microbiology to perform testing services, CoMS will recruit industry-sponsored testing and evaluation programs that align with microbiome science. At present, there is a growing portfolio of partners in the food, agriculture, manufacturing, and healthcare domains who seek services related to microbiome science (see industry support letters – Appendix D). These may include testing antibiotics, screening samples for microbes, assessing diagnostics, and characterizing genes in complex environments/organisms. The potential to develop contracts with partners in this space will grow capabilities that align with microbiome science, as well as serve as a seed for larger industry-sponsored research projects. Thus, CoMS aims to leverage the AMSL for small-scale testing and evaluation contracts that, in-turn, could lead to long-term industry-sponsored research, which will foster broad, interdisciplinary engagement in the CoMS faculty and trainee communities.

Second, CoMS will host educational/training workshops, such as summer institutes that focus on 'omics' technology and computational microbiology, which will generate revenue through registration fees. Though likely not a core revenue stream, these workshops will serve an additional function by catalyzing collaborations and raising the global visibility and national recognition of the center.

Strategic growth

The proposed activities for FY21-FY22 will enable the establishment of CoMS and generation of a robust and engaged microbiome community at Ohio State. A key strategic goal of CoMS will be bioinformatic/computational microbiology support to research programs. While CoMS will make major advancements in enhancing the skills of the microbiome research community in bioinformatic/computational microbiology, full-time scientific staff will be an immeasurable asset to advance this goal. As CoMS continues to secure additional sources of funding, opportunities to expand the workforce with dedicated bioinformatic/computational microbiology staff is a priority.

V. EVALUATIVE CRITERIA AND BENCHMARKS:

It is critical for CoMS to constantly assess its performance because the field of microbiome science is a technology space that is still very new and growing at a rapid pace. Failure to be aware of the direction of the global community, the needs of our faculty and trainees, and the future trajectory of funding and other initiatives, could lead to very low effectiveness. So, evaluation criteria and benchmarks have been described as the means to assess center performance and, importantly identify and correct tactics for maximal benefits to Ohio State.

A. Evaluation criteria

Criteria for evaluation of the success of CoMS will include:

1) Increased funding of center members,
2) Increased number of collaborative grant applications,
3) Increased number of publications in microbiome science scholarly journals with a priority in collaborative work (both total and high-impact publications),
4) New external collaborations between center members and investigators,

5) Honors and awards for center members,
6) Improvements in student and postdoc training, measured by increased numbers and impact of publications and research presentations, successful job placement after graduation, and computational skills acquisition,
7) Industry, non-profit, and government partnerships in education, workforce development, and research,
8) Diverse and inclusive environment,
9) Support development of new microbiome-relevant courses, workshops, and seminars, and
10) Provide valuable microbiome resources (e.g., computing tools, consulting services, fee-for-service, proposal support).

B. Benchmarks

Objective measurements for performance against the evaluation criteria as follows:

1) Extramural funding increase of greater than 10% each year for center member investigators,
2) Increase and sustain CoMS supported collaborative grant applications,
3) A 20% increase each year in number of microbiome publications,
4) A 10% increase in membership each year, and demonstrated collaborations arising from center activities,
5) Recognition of microbiome science excellence for numbers and prestige of awards bestowed,
6) Academic excellence measured in publications (emphasis on high impact), student and post-doc career outcomes, and growth of trainee led communities,
7) New and sustained partnerships each year through formal agreements, contracts, or other engagements,
8) Internal and external comparisons to measure underrepresented group representation in membership and leadership,
9) CoMS opportunities awareness survey, and increased number of microbiome related courses, workshops, and seminars, and
10) Establish and sustain microbiome resources measured by increased use of resources and community feedback.

C. Evaluation of center performance

Per Ohio State University Academic Center Guidelines, Faculty Rule 3335-3-36 Centers and Institutes, CoMS leadership shall initiate a comprehensive self-study with guidance from at least two external reviews (identified by the director and executive advisory committee) aligned to the criteria for evaluation described above. The executive director will be responsible for obtaining performance metrics for awards proposed and awarded per annum, student performance and placement, and demonstrations of internal and external collaborations. Upon yearly review, the director and EAC will establish strategies to bolster areas of performance that do not meet or exceed benchmark criteria. Furthermore, as defined in 3335-3-6, the center will be reviewed two years after initial establishment and at four-year intervals thereafter, as articulated in 3335-3-36.

VI. SUPPORTING MATERIALS:

A. Letters of support from Departmental Chairs, Deans and Center Directors within the University

Each of the chairs, deans and directors of units whose faculty will benefit from the creation of CoMS were asked to provide letters of support. These are provided in the indicated appendices.

B. Organizations supporting CoMS (Appendix D)

The following organizations have provided letters of support expressing the value and importance of of CoMS and the potential for collaborations and partnerships.

Letters of support from Ohio State offices, institutes, and centers (in alphabetical order)

- Byrd Polar Research, Drs. Lonnie G. Thompson and Ellen Mosley-Thompson, sr. research scientists
- Campus Chemical Instrument Center, Dr. Vicki Wysocki, director
- Center for Design Manufacturing Excellence, Mr. Nate Ames, executive director
- Center for RNA Biology, Dr. Juan Alfonzo, director
- Infectious Diseases Institute, Dr. Michael Oglesbee, director
- Office of Research, Dr. Morley Stone, senior vice-president for research
- Ohio Supercomputer Center, Dr. David Hudak, executive director

Letters of support from collaborating academic organizations

- Colorado State University, Soil and Crop Sciences, Dr. Kelly Wrightson, associate professor
- Duke University, Microbiome Center, Dr. Lawrence David, assistant professor and associate director
- Mayo Clinic, Microbiome Program, Drs. Nicholas Chia and Purna Kashyap, associate directors
- University of California, Irvine, Microbiome Initiative, Dr. Jennifer B.H. Martiny, professor, director

Letters of support from non-profit, private organization, and governmental partners

- Air Force Research Lab, 711th Human Performance Wing, Dr. Rajesh R. Nai, chief scientist
- Lawrence Livermore National Lab, Department of Energy, Office of Biological and Environmental Research, Dr. Jennifer Pett-Ridge, lead “Microbes Persist” Science Focus Area
- Microbiome Centers Consortium, Dr. Jennifer B.H. Martiny, lead ** Submitted with UC Irvine Letter
- Ohio Department of Agriculture, Division of Animal Health, Animal Disease Diagnostic Lab, Dr. Yan Zhang, interim laboratory director
- The Tara Oceans Project, Dr. Chris Bowler, director

Letters of support from industry partners

- Amazon Web Services, Sanjay Padhi, head of AWS research, US education
- Illumina, Inc., Kathy Davy, vice president, Global Marketing
- Metabolon, Inc., Rohan Hastie, CEO and president
- Rev1 Ventures, Inc., Wayne Embree, executive vice-president, Investments and Venture Acceleration

C. Entities with similar emphasis

To benchmark CoMS, an international landscape assessment was performed. A total of 76 microbiome programs, centers, institutes or initiatives were identified – 58 in the United States, and 18 international.

After preliminary screening, 11 highly regarded organizations were selected for benchmarking assessment. The full assessment is found in Appendix E. The executive summary is as follows:

1. Many high-profile tier one research universities have microbiome centers and an international Microbiome Center Consortium has been established for this emerging field. Notably, strong research and academic programs are at Arizona State University, California Institute of Technology, Duke University, Johns Hopkins, Colorado State Lawrence Berkley National Lab, and UC Davis. Within the Big Ten, four schools have established microbiome programs or centers: University of Michigan, Penn State University, Rutgers University, and University of Wisconsin. With 64 faculty members already signed on, an on-campus Ag school and multi-billion-dollar hospital, and established curriculum, OSU and CoMS are positioned to be leaders in this space.

2. Although strong and impactful in research and education, many of the programs focus on sub-fields within the microbiome science. Human health is the predominant area, while other programs may focus on the environments. Most centers are designed around capabilities, rather than an integrated *Curriculum*, *Compute*, and *Community* effort like CoMS'.

3. Leading microbiome centers are only beginning to use metagenomic sequencing, and even fewer advanced to multi-omics capabilities. While CoMS has no core facility for data generation capability, CoMS membership are world leaders in applying multi-omics approaches as evidenced by the recent NSF Biology Integration Institute recommendation for $12.5M award to develop and train in these capabilities for connecting the microbiome and climate change.

4. Many leading institutions support or are in development of core services in sequencing (laboratory) and/or bioinformatics (computing). CoMS is presently not able to support laboratory development due to limitations of funds, but is leveraging partnership with the Ohio Super Computer to pursue computing tool and resource development.

5. Numerous leading microbiome organizations are supported by foundation and/or federal grant support. These leading organizations started with strong internal seed funding (approximately $300k per year) and have clearly evidenced strong return on investment. CoMS has already successfully competed for the $12.5M NSF BII award, and CoMS has a clear vision for sustainability through other large granting mechanisms and working with OSU's donor services to secure private donor support.

6. Most organizations have a stated priority in education and training, supporting workshops, training activities, seed and travel grants, and trainee focused symposia. However, only 11 of the 58 US institutions had clearly identified microbiome courses. This is a key opportunity for Ohio State since we already have a unique-in-the-world *Microbiome Science Training Track* that includes didactic and hands-on coursework, as well as working group support.

7. From the perspective of research foci, it can be concluded that Ohio State is well-positioned to become an international leader in microbiome science in these areas (i.e., differentiators):

- **Multi-omics** – Advanced methods that go beyond the fundamental "16S" approaches
- **Ecosystem aware** – Integration of expertise to holistically assess microbiome patterns
- **Beyond human health** – Focus on diverse environments where microbes live
- **Educational** – a unique-in-the-world Microbiome science training track

Summary

Microbiome science is an interdisciplinary biological research discipline that is disrupting the Life Sciences by “seeing” microbes and all they do. This new flavor of microbiology is powered by advances in instrumentation, sequencing and computing, but also has excelled where a systems-level approach has been applied. Ohio State is an ideal environment to grow and lead microbiome science research and education. Years of informal gatherings that grew into and this CoMS community is now in synergy with the IDI. The university-wide strategy presented herein was developed by faculty input centered around three themes: *Community*, *Compute,* and *Curriculum*. CoMS shares goals with external partners in industry, government, and other academic organizations, which will facilitate interdisciplinary collaborations, catalyze major discoveries, and produce the training-grounds for the next-generation workforce. Building upon the microbiome science research networks, CoMS will provide the formal, organizational structure to harness the collective strength of the microbiome community to position Ohio State as a world leader in microbiome science.

Appendix A - Faculty supporting this request

	Member Name *denotes DT hire	**Titles (in TIU)**	**Department(s)**	**College(s)**	**Other Affiliations**
1	Brian Ahmer	Professor	Microbial Infection and Immunity; Microbiology	COM, CAS	Food Innovation Center
2	Matthew Anderson*	Assistant Professor	Microbial Infection and Immunity; Microbiology	COM, CAS	
3	Michael Bailey	Associate Professor	Center for Microbial Pathogenesis; Pediatrics	NCH, COM	
4	Clifford Beall	Research Associate Professor	Biosciences	COD	
5	Soledad Benitez	Assistant Professor	Plant Pathology	CFAES	
6	Alison Bennett	Associate Professor	Evolution, Ecology and Organismal Biology	CAS	
7	Prosper Boyaka	Professor	Veterinary Biosciences	CVM	
8	Jessica Cooperstone	Assistant Professor	Horticulture & Crop Sciences and Food S/T	CFAES	
9	Chuck Daniels	Professor	Veterinary Biosciences	CVM	
10	Karen Dannemiller*	Assistant Professor	Civil, Environmental and Geodetic Engineering; Environmental Health Sciences	COE, CPH	
11	Jayajit Das	Associate Professor	Pediatrics	COM	
12	Dubraska Diaz-Campos	Assistant Professor	Veterinary Clinical Sciences	CVM	
13	Richard Dick	Professor & Ohio Eminent Scholar	School of Environment and Natural Resources	CFAES	
14	Samantha Evans	Assistant Professor	Veterinary Biosciences	CVM	
15	Seth Faith	Principal Investigator	Office of Research, Infectious Diseases Institute	OR.IDI	
16	Kurt Frederick	Professor	Microbiology	CAS	
17	Steven Goodman	Professor	Center for Microbial Pathogenesis; Pediatrics	NCH, COM	
18	Ann Griffen	Professor	Pediatric Dentistry	COD	
19	Andrea Grottoli	Professor	School of Earth Sciences	CAS	Director, Coral Bleaching Research Coordination Network
20	John Gunn	Professor	Center for Microbial Pathogenesis; Pediatrics; Microbiology	NCH COM, CAS	
21	Tamar Gur	Assistant Professor	Psychiatry and Behavioral Health	COM	
22	Gregory Habing	Associate Professor	Veterinary Preventive Medicine	CVM	
23	Vanessa Hale*	Assistant Professor	Veterinary Preventive Medicine	CVM	Co-director, IDI Microbial Communities Program

24	Natalie Hull*	Assistant Professor	Civil, Environmental and Geodetic Engineering	COE	
25	Jonathan Jacobs*	Assistant Professor	Plant Pathology	CFAES	
26	Rafeal Jimenez-Flores	Professor	Food Science and Technology	CFAES	
27	Igor Jouline	Rod Sharp Endowed Professor	Microbiology	CAS	
28	Brian Keller	Assistant Professor	Pulmonology	COM	
29	Samantha King	Associate Professor	Pediatrics	COM	
30	Matthias Klein	Assistant Professor	Food Science and Technology	CFAES	
31	Benjamin Kopp	Assistant Professor	Center for Microbial Pathogenesis; Pediatrics	NCH, COM	
32	Steven Krakowka	Professor Emeritus	Veterinary Biosciences	CVM	
33	Joseph Kryzycki	Professor	Microbiology	CAS	
34	Purnima Kumar	Professor	Periodontology	COD	
35	Jesse Kwiek	Associate Professor & Vice-Chair	Microbiology	CAS	Vice chair for teaching and undergraduate affairs
36	Christian Lauber	Research Assistant Professor	Center for Microbial Pathogenesis; Pediatrics	COM, NCH	
37	Chang-Won (Charles) Lee	Professor	Veterinary Preventive Medicine	CVM	Food Animal Health Research Program
38	Jiyoung Lee	Professor	Environmental Health Sciences; Food Science & Technology	CPH, CFAES	Co-director, IDI Ecology, Epidemiology, & Pop Health Program
39	Andrew May	Assistant Professor	Civil, Environmental and Geodetic Engineering	COE	
40	Stacey Meeker	Assistant Professor	Veterinary, Preventative Medicine	CVM	Director of Rodent Medicine, ULAR
41	Ellen Mosley-Thompson	Distinguished University Professor	Geography	CAS	Byrd Polar
42	Subhadeep Paul*	Assistant Professor	Statistics	CAS	Translational Data Analytics Institute
43	Barbara Piperata	Associate Professor	Anthropology	CAS	
44	Phillip Popovich	Professor & Chair; Director	Neuroscience; Center for Brain Science and Spinal Cord Repair	COM	Faculty Affiliate – Chronic Brain Injury
45	Leah Pyter	Assistant Professor	Psychiatry and Behavioral Health	COM	
46	Gireesh Rajashekara	Professor	Veterinary Preventive Medicine	CVM	Program Head, Food Animal

					Health Research Program
47	Greg Rempala	Professor	Biostatistics	CPH	
48	Virginia Rich	Assistant Professor	Microbiology	CAS	Co-lead, IsoGenie Consortium; Co-founder, Ecosystem Genomics Institute (U Arizona)
49	Zakee Sabree	Associate Professor	Evolution, Ecology and Organismal Biology	CAS	
50	Linda Saif	Distinguished University Professor	Veterinary Preventive Medicine	CVM,	Food Animal Health Research Program
51	Stephanie Seveau	Associate Professor	Microbial Infection and Immunity	COM	
52	Sarah Short*	Assistant Professor	Entomology	CFAES	
53	Chi (Chuck) Song	Assistant Professor	Plant Pathology	CFAES	
54	Daniel Spakowicz	Research Assistant Professor	Division of Medical Oncology	COM	
55	Matthew Sullivan	Professor and Moore Foundation Investigator	Microbiology; Civil, Environmental and Geodetic Engineering	CAS, COE	Co-director, IDI Microbial Communities Program
56	Christopher Taylor	Associate Professor	Plant Pathology	CFAES	
57	Lonnie Thompson	Distinguished University Professor	School of Earth Sciences	CAS	
58	Haitao Wen	Assistant Professor	Microbial Infection & Immunity	COM	
59	Jenessa Winston	Assistant Professor	Veterinary Clinical Sciences	CVM	
60	Ye Xia	Assistant Professor	Plant Pathology	CFAES	
61	Ryan Winston	Assistant Professor	Food, Agricultural, and Biological Engineering	CFAES	
62	Daniel Wozniak	Professor & Vice-Chair	Microbial Infection and Immunity; Microbiology	COM, CAS	Co-Director, IDI Microbial Communities Program
63	Vicki Wysocki	Professor & Ohio Eminent Scholar	Chemistry and Biochemistry	CAS	Director, Campus Chemical Instrument Center
64	Zhongtang Yu	Professor	Animal Sciences	CFAES	

Appendix B – Chair and Director Letters of Support for Faculty Membership

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THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of the Department of Biostatistics, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my department listed below:

Grzegorz Rempala, Biostatistics
Chi Song, Biostatistics

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Kellie Archer
[illegible]

Kellie J. Archer, PhD
Professor and Chair
Department of Biostatistics
College of Public Health
archer.43@osu.edu

THE OHIO STATE UNIVERSITY

July 14, 2020

Dear Drs. Faith and Sullivan,

I am the chair of the Department of Pediatrics within the College of Medicine at The Ohio State University and president of the Abigail Wexner Research Institute at Nationwide Children's Hospital and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at Ohio State, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including seven faculty from my department listed below:

Dr. Michael Bailey
Dr. Jayajit Das
Dr. Steven Goodman
Dr. Samantha King
Dr. Benjamin Kopp
Dr. John Gunn
Dr. Christian Lauber

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
John Barnard
[illegible]

John A. Barnard, MD
Professor and Chair
Department of Pediatrics, College of Medicine
President, Abigail Wexner Research Institute at Nationwide Children's Hospital
John.Barnard@nationwidechildrens.org

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Food Science and Technology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my department listed below:

Rafael Jiménez-Flores, Food Science and Technology
Mattias Klein, Food Science and Technology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Sheryl Ann Barringer
62B5CB3B1E5E4A9...

Sheryl Barringer, PhD
Professor and Chair
Department of Food Science and Technology
College of Food, Agricultural, and Environmental Sciences
barringer.11@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Veterinary Clinical Sciences, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my department listed below:

Dubraska Diaz-Campos, Veterinary Clinical Sciences
Jenessa Winston, Veterinary Clinical Sciences

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Richard Michael Bednarski
15A8577B10B51A6...

Richard M. Bednarski, DVM, MS, Diplomate ACVA
Professor and Chair
Department of Veterinary Clinical Sciences
College of Veterinary Medicine
bednarski.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Environmental Health Sciences, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Jiyoung Lee, Environmental Health Sciences

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Michael Salvatore Bisesi
226658F35B0F45E...

Michael Bisesi, PhD
Professor and Sr. Associate Dean of Academic Affairs; Interim Chair
Department of Environmental and Health Sciences
College of Public Health
bisesi.12@osu.edu

THE OHIO STATE UNIVERSITY

July 14, 2020

Dear Drs. Faith and Sullivan,

I am the interim chair of Department of Veterinary Biosciences within the College of Veterinary Medicine, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members with several participating faculty from my department.

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Prosper N Boyaka
7189CB9A2B4A450...

Prosper Boyaka, PhD
Professor and Interim Chair
Department Veterinary Biosciences
College Veterinary Medicine
boyaka.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Animal Sciences, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Zhongtang Yu, Animal Sciences

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
John C. Foltz
[illegible]

John C. Foltz, PhD
Professor and Chair
Department of Animal Sciences
College of Food, Agricultural, and Environmental Sciences
foltz.75@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Evolution, Ecology and Organismal Biology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my department listed below:

Allison Bennett, Evolution, Ecology and Organismal Biology
Zakee Sabree, Evolution, Ecology and Organismal Biology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
John V. Freudenstein
[illegible]

John Freudenstein, PhD
Professor and Chair
Department of Evolution, Ecology and Organismal Biology
College of Arts and Sciences
freudenstein.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Anthropology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Barbara Piperata, Anthropology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:

B6C8E6EB4DF3434...

Kristen Gremillion, PhD
Professor and Chair
Department of Anthropology
College of Arts and Sciences
gremillion.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the director of Pulmonary, Critical Care and Sleep Medicine, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my division listed below:

Brian Keller, Pulmonary, Critical Care and Sleep Medicine

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my division to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Jeffrey Horowitz
[illegible]

Jeffrey Horowitz, MD
Professor and Director
Division of Pulmonary, Critical Care and Sleep Medicine
College of Medicine
Jeffrey.Horowitz@osumc.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Microbiology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 7 faculty from my department listed below:

Chuck Daniels, Microbiology
Kurt Frederick, Microbiology
Igor Jouline, Microbiology
Joseph Kryzycki, Microbiology
Jesse Kwiek, Microbiology
Virginia Rich, Microbiology
Matthew Sullivan, Microbiology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Michael Ibba
[illegible]

Michael Ibba, PhD
Professor and Chair; Distinguished Scholar
Department of Microbiology
College of Arts and Sciences
ibba.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of the Department of Civil, Environmental and Geodetic Engineering, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 3 faculty from my department listed below:

Karen Dannemiller, Civil, Environmental and Geodetic Engineering
Natalie Hull, Civil, Environmental and Geodetic Engineering
Andrew May, Civil, Environmental and Geodetic Engineering

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Allison A Mackay
A1BBEFBE9408D4B5...

Allison MacKay, PhD
Professor and Chair
Department of Civil, Environmental and Geodetic Engineering
College of Engineering
mackay.49@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Horticulture and Crop Science, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Jessica Copperstone, Horticulture and Crop Science

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
James David Metzger
910EA711B36D49B...

Jim Metzger, PhD
Professor and Chair
Department of Horticulture and Crop Science
College of Food, Agricultural, and Environmental Sciences
metzger.72@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Plant Pathology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 4 faculty from my department listed below:

Soledad Benitez, Plant Pathology
Jonathan Jacobs, Plant Pathology
Christopher Taylor, Plant Pathology
Ye Xia, Plant Pathology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Thomas K Mitchell
18C252D6CB1364F0...

Thomas K. Mitchell, PhD, MS
Professor and Chair
Department of Plant Pathology
College of Food, Agricultural, and Environmental Sciences
mitchell.815@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Geography, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Ellen Mosley-Thompson, Geography

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Darla Karin Munroe
A4AE2237AC4D4AA...

Darla Munroe, PhD
Professor and Chair
Department of Geography
College of Arts and Sciences
munroe.9@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Microbial Infection and Immunity, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 5 faculty from my department listed below:

Brian Ahmer, Microbial Infection and Immunity
Matthew Anderson, Microbial Infection and Immunity
Stephanie Seveau, Microbial Infection and Immunity
Haitao Wen, Microbial Infection and Immunity
Danial Wozniak, Microbial Infection and Immunity

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Eugene Oltz
C3778B4F7DAB4BC...

Eugene Oltz, PhD
Professor and Chair
Department of Microbial Infection and Immunity
College of Medicine
Eugene.Oltz@osumc.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Psychiatry and Behavioral Health, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my department listed below:

Tamar Gur, Psychiatry and Behavioral Health
Leah Pyter, Psychiatry and Behavioral Health

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
[signature]
[illegible]

K. Luan Phan, MD
Professor and Chair
Chief of Psychiatry Services for Health System
The Charles F. Sinsabaugh Chair in Psychiatry
Department of Psychiatry and Behavioral Health
College of Medicine
Luan.Phan@osumc.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of the Division of Biosciences, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my division listed below:

Clifford Beall, Division of Biosciences

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my division to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Peter Reiser
00DC3DF[illegible]

Peter J. Reiser, MS, PhD
Professor and Chair
Division of Biosciences
College of Dentistry
reiser.17@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the director of the School of Earth Sciences, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 2 faculty from my school listed below:

Andrea Grottoli, School of Earth Sciences
Lonnie Thompson, School of Earth Sciences

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my school to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Matthew R Saltzman
[illegible]

Matthew Saltzman, PhD
Professor and School Director
School of Earth Sciences
College of Arts of Sciences
saltzman.11@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the director of the School of Environment and Natural Resources, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my school listed below:

Richard Dick, School of Environment and Natural Resources

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my school to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Jeff S Sharp
[illegible]

Jeff S. Sharp, PhD
Director and Professor of Rural Sociology
School of Environment and Natural Resources
College of Food, Agricultural, and Environmental Sciences
sharp.123@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Food, Agricultural and Biological Engineering, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Ryan Winston, Food, Agricultural and Biological Engineering

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
S.A. Shearer
[illegible]

Scott A. Shearer, PhD, MS
Professor and Chair
Department of Food, Agricultural and Biological Engineering
College of Food, Agricultural, and Environmental Sciences
shearer.95@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Entomology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Sarah Short, Entomology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
James Strange
17535575D367469...

Jamie P. Strange, PhD
Professor and Chair
Department of Entomology
College of Food, Agricultural, and Environmental Sciences
strange.54@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Pediatric Dentistry, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my division listed below:

Ann Griffen, Pediatric Dentistry

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my division to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Janice A. Townsend
[illegible]

Janice A. Townsend, DDS, MS
Associate Professor and Chair
Division of Pediatric Dentistry
College of Dentistry
Janice.Townsend@NationwideChildrens.org

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Chemistry and Biochemistry, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my department listed below:

Vicki Wysocki, Chemistry and Biochemistry

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Claudia Turro
54C4B13C2706D3...

Claudia Turro, PhD
Professor and Chair
Department of Chemistry and Biochemistry
College of Arts and Sciences
turro.1@osu.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the director of the Division of Medical Oncology, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 1 faculty from my division listed below:

Daniel Spakowicz, Medical Oncology

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my division to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Claire F. Verschraegen
ID:33D9E769D4B5...

Claire F. Verschraegen, MD
Professor and Director
Division of Medical Oncology
College of Medicine
Claire.Verschraegen@osumc.edu

THE OHIO STATE UNIVERSITY

June 26, 2020

Dear Drs. Faith and Sullivan,

I am the chair of Veterinary Preventative Medicine, and I am pleased to write this letter in support of the establishment of the Center of Microbiome Science within the Office of Research at The Ohio State University, and participation of my faculty in the center.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields including environmental science and climate change, medicine and health, agriculture, and bioremediation. This center arose out of broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The center currently has 64 members including 6 faculty from my department listed below:

Gregory Habing, Veterinary Preventative Medicine
Vanessa Hale, Veterinary Preventative Medicine
Chang-Won Lee, Veterinary Preventative Medicine
Stacey Meeker, Veterinary Preventative Medicine
Gireesh Rajashekara, Veterinary Preventative Medicine
Linda Saif, Veterinary Preventative Medicine

The mission of the Center of Microbiome Science is to empower microbiome science for the design and prediction of microbial communities. Center activities broadly include opportunities to advance research through cutting-edge workshops, seminars, symposia, and targeted research funding; to advance training through microbiome-specific curriculum development, working groups, short courses, and workshops; and to access and develop computational support and pipelines for microbiome research.

The Center of Microbiome Science will provide new interdisciplinary opportunities for faculty and students within my department to advance their research and training programs through the center's strategic initiatives. Moreover, it will position Ohio State as a world leader in microbiome education and research, and I enthusiastically provide my support for the establishment of this university center.

Sincerely,

DocuSigned by:
Thomas Wittum
F8E977083E1348C7...

Thomas E. Wittum, MS, PhD
Professor and Chair
Department of Veterinary Preventive Medicine
College of Veterinary Medicine
wittum.1@osu.edu

Appendix C – Center of Microbiome Science Budget Narrative FY21 - FY22

4 Jul 2020

Purpose
The Ohio State University (OSU) Center of Microbiome Sciences (CoMS) was strategically designed by faculty input over the course of the winter and spring terms (2019/20) with the **mission** to empower microbiome science for the design and prediction of microbial communities in animal, plant, human, environmental, and engineered systems. As commissioned by the OSU Senior Vice President for Research and the Office of Research to "Accelerate the Science" and emerge onto the world stage for Microbiome Sciences, CoMS aims to execute it's mission with three specific themes: Community, Compute, Curriculum.

The purpose of this document is to provide information and justification for the CoMS FY21—FY22 budget based on projected sources and uses. The recently announced financial control initiative by the Office of Business and Finance as a result of the current COVID-19 pandemic presents an unanticipated measure that could impact fund usage (i.e., expenses will be reviewed on a case-by-case basis by the Office of Research SFO). The budget described herein maximizes the present financial resources afforded to CoMS to successfully execute its mission.

Sources (~$300,000)
An initial two-year investment of $200,000 from the Office of Research has been provided, and a two-year commitment of $100,000 has been made by the College of Arts and Sciences ($50K in each FY21 and FY22). However, OR's proposed target budget to be obtained from OR and other internal sponsors (i.e., colleges) is $1M.

Remaining commitments towards the $1M budget will be negotiated over time with various colleges whose faculty will contribute to, and benefit from, the center. Discussions with the Colleges of Medicine, Engineering, and Food, Agricultural, and Environmental Sciences are on-going.

In addition to the monetary commitments, the Infectious Diseases Institute is providing "in-kind" administrative staff support to assist with establishing the center (i.e., OAA center approval) and on-going support until the center is fully functional. As well, Seth Faith will serve in a long-term role as managing-director of CoMS.

FY21
Uses (~$241,414 planned, $8,586 reserved)
The Uses section of the budget is organized into three activity categories that are intended to accelerate OSU's microbiome science and are critical to initial, phase one strategies. The categories are outlined below with additional explanation re: the relevance and importance to establishing the center. Note that the near-term salary/benefit expense being proposed all represent support for *current OSU employees* (GAs, postdocs, etc.) for identified periods of time and do not require new job positions, which are presently on-hold for the entirety of OSU.

Compute

1.0 Microbiome toolkit optimization, visibility, and fee-for-service core ($69,844)

1.1 OSC tool buildout, verification and validation
The Ohio Supercomputer (OSC) represents a powerful State of Ohio compute infrastructure that has for years augmented the ability of biophysicists, biochemists and modelers to more competitively apply for grants. Since 2015, Matt Sullivan has been lobbying for hardware modifications (more high-memory nodes) and working with OSC staff to install countless microbiome and virome software applications and databases. An overview of the kinds of tools needed in a microbiome/virome workflow are noted in Figure 2 of the publication here.

While much of this workflow is established at OSC, it is not yet well documented and the field and its associated analytics are changing rapidly. To this end, it is critical that CoMS (i) improve the visibility and documentation of these capabilities at OSC so that the broader CoMS research community can better utilize these game-changing capabilities, and (ii) augment the pipeline with suggestions from CoMS members via the proposal mechanism to keep our OSC capabilities cutting-edge.

To support these improvements, we request 0.5FTE support for a computational scientist (B. Bolduc, May 2020-June 2021). Bolduc is already the point person from the Sullivan Lab for these improvements at OSC, while also a developer of many of the virome capabilities (e.g., see the iVirus capabilities here). He will also be a technical support for various CoMS training efforts (described below).

1.1.2 Evaluate cloud computing service

Within the scope of work for the OSC tool development, we aim to build partnerships with top cloud computing service providers, such as Amazon Web Services, to deliver solutions not presently afforded by OSC, such as HIPAA compliance for human research, federal government security standards, specialized data storage, and customized environments to facilitate external collaborations with industry, academia and government. We will seek grants to cover cloud costs to avoid utilizing CoMS budget for purchasing services.

1.2 Developing low-cost metagenomics services for OSU investigators

Lowering the cost on metagenomic sequencing is a priority for CoMS. Specifically, lowering current per-metagenome costs from $200/sample to $20/sample is doable (Sullivan collaborator Rob Knight at UCSD recently published at method for $7/sample metagenomes), and would be a game-changing competitive advantage for CoMS members to securing grants. Thus we request support for a research associate, Natallie Solonenko (33%, Sullivan Lab, 1 year) to evaluate plate-based library prep methods and sequencing center quality in collaboration with OSUCCC- James Genomics Shared Resource (GSR) and/or Nationwide Children's Hospital. Though we are in preliminary discussions with the sequencing center, this is a win-win capability, even if only library preps occurred here. Reagent and sequencing costs would be covered by the OSU sequencing center. The 50% computational scientist (funded above) will process these data as the read-out for capability performance.

1.3 Fee for service (FFS) process evaluation

In parallel with the demonstration activities below and activities 1.1 and 1.2, we will identify a streamlined sample to results workflow for OSU PIs, which will encompass tutorials/workshops, consulting, sample extraction, sample lab analysis (sequencing), and data analysis (bioinformatics)

The first step of this process will be an internal survey to perform a needs assessment (e.g., what types of studies would be performed, what resources are available for microbiome work, what barriers presently exist to microbiome work, and what is the base knowledge in microbiome research). The survey will assist CoMS in developing tutorials, website content and workshops that serve as a primary point of entry for PIs to the CoMS offerings.

Stemming from the survey, we will also convene an internal consulting team of experts to advise investigators on study design and proposal writing. We hope to grow the consulting activity into a ComS service, but will learn the nature and scope of the consulting through the first year activities. In year two, a formal consulting process will be established based on lessons learned in the first year.

We will also facilitate microbiome services, to include a robust assessment of external providers in comparison to a business plan for a CoMS cost-center for sequencing and analysis services. We will work closely with the newly established Applied Microbiology Lab (IDI, ASC) to evaluate costs of fee-for-service offerings to include sample analysis (sequencing) and data analysis (bioinformatics). PI feedback from the survey, the external landscape analysis, internal business plan/model, and process driven requirements learned from the CoMS year 1 activities will be used a comprehensive assessment to instruct year 2 activities in the FFS model.

Community

2.0 CoMS Demonstration Projects ($171,570)
Beyond building out OSU's Microbiome Science capabilities and training the broader CoMS community in their use, OR has requested that its $200K support be primarily used to 'accelerate the science' to establish OSU's world-class leadership in this space. These demonstration projects, therefore, need to (i) have near-term, high-impact deliverables with regard to CoMS capabilities (e.g., new analytics / workflows) and science (e.g., peer-reviewed publications), but also (ii) leverage existing capabilities and funding towards new (i.e., not funded) CoMS-related goals. To start, the below projects are proposed. However, we anticipate that their success should enable a proposal-driven mechanism of support in this area in the future.

2.1 *Multi-layer network analytics ($5,825)*
Developing multi-layer network analytics for multi-omics datasets is a critical CoMS need. A faculty member in the Department of Statistics within the College of Arts and Sciences, Dr. Subhadeep Paul, has worked with CoMS on statistics of multi-omics datasets (see this paper here) and wants to take the next step for this critical analytic. He is pre-tenure and wants to get a grant together in this space, as well as publish. To enable this effort, CoMS will fund 50% of the salary/benefits/tuition of a current GA, K. Lovekar, for summer term 2020. This leverages unprecedented transcriptome, proteome, metabolome and lipidome data already generated through a DOE User Award (measurements only, no salary support), and support from elsewhere for a Sullivan Lab postdoc to lead the biological publication. Deliverables include: a new analytical capability for multi-omics data, and a top-tier publication (planned submission Fall 2020).

2.2 *Viral tag and grow ($100,894)*
This CoMS activity is a differentiator for phage-designed microbiome research, which has been identified as a unique OSU capability against the backdrop of the many other Microbiome Centers emerging. It is projected to have the biggest impact, and leverages four years of methods development. This category requires the largest allocation of funds, which includes salary/benefits for a current Sullivan lab postdoc (Hobin Jang, 1FTE) and technician (Lauren Chittick, 0.5FTE), and approximately $29,000 for reagents (~six plate of single virus sequencing). Deliverables include: proof-of-concept workflows for high-throughput capture and characterization of wild viruses that infect nuisance bacteria, single-virus genomic capabilities, and two high-impact manuscripts on the method (planned submit Fall 2020) and a first field application (planned submit Winter 2020).

2.3 *Climate change demonstration ($39,851)*
OSU students rank climate change as one of the most important topics of their generation. CoMS member Virginia Rich leads IsoGenie, an international team of biochemists, modelers, microbiologists that have studied for a decade how greenhouse gas emissions and microbial / viral communities change as permafrost soils thaw. The IsoGenie Consortium have an OSU-led $12.5M Biology Integration Institute proposal pending at NSF, and a decade of unprecedented scale high-resolution biochemistry measurements coupled to multi-omics community data (metagenomics, metatranscriptomics, metaproteomics, metabolomics). However, the DOE support for this area under the current administration has waned, which leaves salary support lacking. CoMS support for a 12-month GA (salary/benefits/tuition; D. Cronin, current GA in V Rich's lab, 1FTE) would enable a highly leveraged opportunity to assess how microbial communities will respond to permafrost thaw. Deliverables include: optimized MAG-generation pipeline (collaborative with Gene Tyson at Queensland University of Technology and Jill Banfield at UC Berkley), optimized scalable metabolic predictions (collaborative with Kelly Wrighton at University of Colorado), and a high-profile paper (submitted Fall 2020) with likely 2 more specialized follow-on papers (Spring 2021).

2.4 Byrd Polar 'Ice' Demonstration ($12,500)
The Byrd Polar Climate Research Center houses an unprecedented archive of >8K glacial ice cores that are rewriting our understanding of Earth's history. CoMS members Ellen Mosley-Thompson and Lonnie Thompson have collaborated with Virginia Rich and Matt Sullivan on studying one of these ice cores using the Sullivan Lab's quantitative ultra-low biomass metagenomic capabilities and analytics. CoMS support of a summer GRA (salary/benefits/tuition, F. Tian) would accelerate this study where floods of data are now available. This project leverages a DOE Community Sequencing award (no salary support) that has generated >50 metagenomes and partial funding for Byrd Polar postdoc Zhiping Zhong.

Deliverables include: optimized population genetics analytics for metagenomics, and a high-profile paper (submitted Fall 2020) describing viral and microbial speciation through ~700K years of Earth's history. Note the sample preparation methods for glacial ice are so novel that the *preprint* describing them was picked up by *Science* and countless other news sources.

2.5 Biomedical Demonstration ($12,500)
Though OSU has a large medical school on campus, there are few researchers fully engaged in assessing how microbiomes impact medicine, with the bulk of these limited to gene-marker-based studies. This leaves OSU's Biomedical Microbiome Science short of the mechanistic understanding needed to best establish clinical responses. This project seeks to leverage a new collaboration between CoMS members Phil Popovich and Matt Sullivan, as well as an unprecedented dataset investigating how the microbiome and virome respond to spinal cord injury from 300+ mice. CoMS support of a summer GRA (salary/benefits/tuition, M. Mohamed) would empower this unfunded research direction to accelerate the science as a demonstration of OSU's prowess in the medical space. Deliverables include: biomedical demonstration project for the microbiome/virome workflow, new virus-host linkage analytical capabilities, and a high-profile manuscript (planned submission Winter 2020).

Curriculum

3.0 Activity Trainee working groups ($0)

While getting software and databases in place on OSC is a laudable goal, there is also need for the broader CoMS community to be trained in how to utilize this newly emergent field of Microbiome Science (the rules and approaches are quite different to either biomedical informatics or microbiology). To complement the recently established 3- to 4-course *Microbiome Science Training Track* (here) and recent "Data Science Bootcamp" efforts by EEOB, BMI and TDAI, CoMS will establish trainee-led working groups to provide practical training in specialized areas not being addressed curricularly or where year-round support is needed. The goal of CoMS Working Groups is to build trainee-led communities around cutting-edge microbiome analytical methods. This is a critical CoMS activity to develop a cohesive group focused on microbiome/virome science. Three areas have been identified by CoMS leadership for initial focus: **microbiome**, **virome**, and **advanced ecological statistics**.

Pragmatically, with trainees in telework mode, there is exceptional opportunity for building out skills and capabilities for trainees. To get started right away, working group leads will be selected from Sullivan Lab trainees whom have already taken the hands-on *Microbiome Informatics* course, have administered and/or are developing the virome and/or microbiome pipelines in their own research, and are engaged with CoMS demonstration projects (see below). However, in the future (starting Jan 2021), working group leads will be selected via a formal review process. We view these working group leads as being motivated by the opportunity to plan, teach, and mentor peers in a rapidly-evolving discipline where the trainees themselves will benefit from the process. Reporting to and planning with CoMS leadership will be required. Those selected will be will be expected to be a resource for trainees across the CoMS membership, as well as facilitate working group meetings where they will have prepared short-lectures and then lead a Q&A session. Additional requirements are outlined in the CoMS Working Group Leaders requirements document.

To facilitate this, we anticipate tapping 3 GRAs (CoMS-supported for demonstration projects) and a postdoc (not CoMS supported) with expectation that approximately 2-4 hours per week will be devoted to these efforts. Microbiome would be led by D. Cronin, virome by F. Tian and M. Mohamed, and advanced ecological statistics by A. Zayed (not funded here). In the future, we intend to draw from applicants to support via a $1-5K award depending upon budget constraints.

4.0 Marketing and engagement ($ remaining budget, upon approval)
The co-directors were previously registered to attend the Microbiome Consortia Center Directors meeting in June 2020. The meeting was cancelled, and OSU travel has been postponed indefinitely, pending the resolution of the pandemic. Thus, we will utilize reserve budget to attend meetings, provide briefings to prospective sponsors, and conduct other activities that help advance CoMS in the global community.

FY22 ($50,000 currently committed)
CoMS executive leadership will assess the FY22 budget in Spring 2021, when additional university financial guidance and resources are better known following the recovery from the pandemic. With the committed $50,000 and any additional funds committed by college level support, a prioritization will be made for the following activities: investigator seed grants, trainee support (travel grants and seed awards), a robust seminar series, annual symposium, and programmatic support with a full- or part-time program coordinator.

Summary
The uses being proposed in the FY21-FY22 budget based on current known resources are critical expenses to launch the Center of Microbiome Science and to 'Accelerate' microbiome science. These initial activities will enable CoMS to elevate Ohio State's microbiome scientific community in order to position the organization to lead in a highly competitive space.

Center of Microbiome Science Deliverables and Outcomes Per Budget Use		
Uses	**Deliverables**	**Outcomes**
1.0 Compute ($69,844)		
1.1 Microbiome Toolkit Optimization and Visibility		
1.1.1 OSC tool buildout, verification and validation	Continued OSC 'microbiome' app availability, documentation, visibility; support Microbiome Informatics 'hands-on' course; support trainee-led working groups	Cutting-edge OSC toolkit, functional Microbiome Informatics course, final working groups
1.1.2 Evaluate cloud computing service	Cloud platform tools that can be leveraged as a capability for extramural funding, tools to support fee for service	CoMS custom tool kit in the kit, institutional knowledge on value of the cloud, press coverage for teaming
1.2 Developing low-cost metagenomics services for OSU investigators	Experimental assessment of various scalable plate-based sequencing capabilities to assess multiplexing;	Ultra-low-cost metaG/metaT sequencing capabilities (targeting $10-20 metagenomes, down from >10-fold that cost)
1.3 Fee for service process evaluation	Verified workflows for sequencing and analysis, working group to act as consultants to CoMS investigators	Enabling microbiome science at OSU (aligned to "Aim 3") strategy to add microbiome research
2.0 Demonstration Projects ($171,570)		
2.1 Multi-layer network analytics	Multi-layer network analytics applied to multi-omics datasets to provide next generation analytical capabilities; high-profile paper applying these to marine model system data already in-hand to provide OSU a unique multi-omics capability (notably, such multi-omics data are not yet broadly available, but could be if there were value to it. OSU could be the leader in demonstrating this and through	Microbiome analytics demonstration project

	two DOE User Awards we have the unprecedented data generated)	
2.2 Viral tag and grow	High-profile 'Methods' paper on new Viral Tag and grow high-throughput capture and characterization capability - technology for single viral genomics and characterization to disrupt phage therapy in a transformative way; High-profile 'biology' paper on applying (notably, this has been impossible to fund through NSF, Moore Foundation, and Keck … has 4 years of training to get to this point, and a $500K research grade instrument in place for this; preliminary data suggests it will work now after the instrument's maker visited and trained us) VT+grow to field samples to assess variation in nature, and demonstrate applicability for phage therapy capture and characterization; Provides OSU a unique technological capability; develop tech bulletin/white paper for the technology and new capability (description and benefits) for internal and external communication	Viral tag and grow demonstration project
2.3 Climate change demonstration	High-profile 'microbiome' paper on how thawing permafrosts will affect climate-active gases; trainee-led 'microbiome' working group, technical bulletin or "postcard" for metabolic modeling and applications (e.g., importance and application to health and agriculture) for internal and external communication	Climate change demonstration; 'microbiome' working group
2.4 Byrd-polar "Ice"	High-profile 'microbiome' paper, collaboration with another prominent Center, press-coverage of study	Contribution to field, elevate OSU's status, help determine fee-for service pipelines
2.5 Biomedical Demo	High-profile 'microbiome' paper, presentation to clinical and Col of Med faculty for "how-to" conduct microbiome studies	Contribution to field, elevate OSU's status, help determine fee-for service pipelines
***3.0 Curriculum* ($0)**		
	Workshops, education of internal workforce	Accelerate the science, build community, microbiome, virome, and advanced ecological statistics working groups, complement the recently established 3- to 4-course Microbiome Science Training Track (here) and recent "Data Science Bootcamp"
	Future plans with additional funding include: travel awards, community of practice leadership stipends, and seed awards	

4.0 Travel and Marketing ($ remaining budget, upon approval)		
	Networking and pre-solicitation marketing of CoMS	Build global network, obtain extramural funding

Appendix D - Letters of support for CoMS

Letters of support from Ohio State offices, institutes, and centers (in alphabetical order)

- Byrd Polar Research, Drs. Lonnie G. Thompson and Ellen Mosley-Thompson, sr. research scientists
- Campus Chemical Instrument Center, Dr. Vicki Wysocki, director
- Center for Design Manufacturing Excellence, Mr. Nate Ames, executive director
- Center for RNA Biology, Dr. Juan Alfonzo, director
- Infectious Diseases Institute, Dr. Michael Oglesbee, director
- Office of Research, Dr. Morley Stone, senior vice-president for research
- Ohio Supercomputer Center, Dr. David Hudak, executive director

Letters of support from collaborating academic organizations

- Colorado State University, Soil and Crop Sciences, Dr. Kelly Wrightson, associate professor
- Duke University, Microbiome Center, Dr. Lawrence David, assistant professor and associate director
- Mayo Clinic, Microbiome Program, Drs. Nicholas Chia and Purna Kashyap, associate directors
- University of California, Irvine, Microbiome Initiative, Dr. Jennifer B.H. Martiny, professor, director

Letters of support from non-profit, private organization, and governmental partners

- Air Force Research Lab, 711th Human Performance Wing, Dr. Rajesh R. Nai, chief scientist
- Lawrence Livermore National Lab, Department of Energy, Office of Biological and Environmental Research, Dr. Jennifer Pett-Ridge, lead “Microbes Persist” Science Focus Area
- Microbiome Centers Consortium, Dr. Jennifer B.H. Martiny, lead ** Submitted with UC Irvine Letter
- Ohio Department of Agriculture, Division of Animal Health, Animal Disease Diagnostic Lab, Dr. Yan Zhang, interim laboratory director
- The Tara Oceans Project, Dr. Chris Bowler, director

Letters of support from industry partners

- Amazon Web Services, Sanjay Padhi, head of AWS research, US education
- Illumina, Inc., Kathy Davy, vice president, Global Marketing
- Metabolon, Inc., Rohan Hastie, CEO and president
- Rev1 Ventures, Inc., Wayne Embree, executive vice-president, Investments and Venture Acceleration

THE OHIO STATE UNIVERSITY

Byrd Polar and Climate Research Center

108 Scott Hall
1090 Carmack Road
Columbus, OH 43210-1002

Phone (614) 292-6531
Fax (614) 292-4697
http://bpcrc.osu.edu/

June 29, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State University Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

We, Lonnie G. Thompson and Ellen Mosley-Thompson, are Professors in the School of Earth Sciences and the Department of Geography (respectively) and we are also Senior Research Scientists in the Byrd Polar and Climate Research Center. We are pleased to provide this letter of support for the establishment of the Center of Microbiome Science (CoMS) within the Office of Research at The Ohio State University (OSU). Under the leadership of Dr. Matthew Sullivan and other key faculty in microbiome science, we believe the time has come to establish the CoMS. Over the last five years we have developed a collaborative relationship with Drs. Matt Sullivan and Virginia Rich in which we have developed a program to investigate the bacteria and viruses that are preserved in the ice cores our team has collected around the world. Although bacterial research on ice samples has been conducted in the past, the exploration of viruses is a new area with much potential for future funding. Over the last five years, Matt Sullivan and his colleagues have worked diligently to lay a solid intellectual and operational foundation from which to launch this high impact center, the CoMS. The CoMS will position OSU as a leading institution in this area of critical scholarly and application-based inquiry. It will create exceptional benefits for students, trainees, and faculty, and will provide numerous opportunities for research discoveries that will have global impacts. Below we highlight significant details for our support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially, and it plays a critical role in many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation as well as ice core paleoclimatology. OSU's microbiome group began as a group of investigators engaged in cutting-edge research who, through their collective energies, pushed forward broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. Currently CoMS consists of 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Agricultural and Environmental Sciences / Medicine / Public Health / Veterinary Medicine), two schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. This is an impressive accomplishment for a center established with temporary status. CoMS' initial activities have included a growing a trainee community and a supporting specialized curriculum in computational microbiology, a critically important area of specialization to microbiome science. The microbiome group shares common goals with industry and government partners that are certain to lead to

opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and lead to the development of protocols for delivery impactful solutions. The importance of microbiome science to the current and future health of humanity cannot be overstated. However, to harness and further develop the interdisciplinary strength that OSU's research and student community has in microbiome science, it is essential to move forward now to establish CoMS as an official university Center.

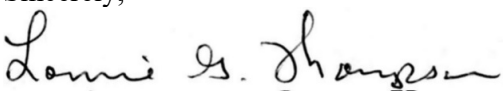
As mentioned above we have maintained a collaborative partnership over the last 5 years with Drs. Matthew Sullivan and Virginia Rich, key CoMS investigators, to explore the nature of microbes preserved in ice cores our team has drilled from the remote ice fields of the Guliya ice cap in far western Tibet. Over the last three years we have shared a post-doctoral fellow, Dr. Zhi-Ping Zhong, who was selected in 2017 as a Byrd Center Postdoctoral Fellow. Dr. Zhong's research has been instrumental in developing microbial studies on ice cores and he is now a post doctorial scholar funded jointly by our team and Dr. Sullivan's team. So why is this collaborative research so important? The cryosphere covers approximately 20% of Earth's land surface and glaciers around the work are rapidly melting and as they do these natural archives are being lost. Glaciers preserve ancient microbial cells, both those deposited from the atmosphere and those growing on the glacial surface before it is buried by future snowfall. These microbial cells contain unique information about Earth's past environmental conditions. These ice core archives offer the potential to study evolution over hundreds of thousands of years. For viral and microbial populations that are shared across time horizons, glacial ice offers a unique opportunity to assess how they evolve and how they mutate through time. Our data show that both bacterial and viral populations can be observed across time strata in Guliya ice cores, and preliminary analyses of recovered viral genomic sequences supports the feasibility of evolutionary analyses.

Through our partnership with Drs. Sullivan and Rich, this collaborative team has spent considerable time perfecting the protocol for extracting microbes from the ice cores stored in the freezers at the Byrd Polar and Climate Research Center (BPCRC). This team effort has already produced two manuscripts, the first on the protocol for the extraction of bacteria from glacier ice cores published in 2018 and a second manuscript on the viral extraction protocol that is currently in preparation (see below). Moreover, this initial research has led to new proposals. One was submitted to NSF in February 2020 and is entitled: *GCR: Collaborative Research: Reconstructing the 20,000-Year Environmental and Ecological History of the Amazon Basin (REEHAB*). This proposal includes a strong focus on the study of the bacteria and viruses preserved in Earth's highest tropical glacier, Huascarán, located in the northern Andes of Peru directly downwind of the Amazon Basin. A second NSF proposal is under development and will utilize the deep ice cores the Guliya ice cap in the western Kunlun Mountains to explore how microbes have evolved and speciated over the last 500,000 years. While this research is in early stages it is already clear that the global archive of ice cores (unique in the world) stored in the freezers at OSU's BPCRC offers the potential of not only ground-breaking research but also wonderful opportunities for inspiring and training the next generation of scientists, including those in microbiome sciences. OSU's CoMS and BPCRC would be in a truly unique position to take a leadership position in global microbial studies through environmental archives from around the world. Considering its ongoing interdisciplinary expertise and well-established international partnerships, CoMS is well positioned to enable cutting-edge research success. It logically follows that the researchers, post-docs, and students in the BBCRC, School of Earth Sciences, and the Department of Geography will benefit by working in partnership with CoMS their partners.

In the future we plan to participate with CoMS through various strategic, high value center activities, including but not limited to workshops, seminars, symposia, and collaborative research projects.

To summarize, we strongly support the establishment of the Center of Microbiome Science at The Ohio State University. This Center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and position OSU as a national and international leader in microbiome science.

Sincerely,



Lonnie G. Thompson, Distinguished University Professor, School of Earth Science
Senior Research Scientist, Byrd Polar and Climate Research Center
614-292-6652 (thompson.3@osu.edu)

Ellen Mosley-Thompson, Distinguished University Professor, Geography (Atmospheric Science)
Senior Research Scientist, Byrd Polar and Climate Research Center
614-292-6662 (thompson.4@osu.edu)

The two papers mentioned in our letter are as follows:

Zhong, Zhi-Ping, N. E Solonenko, M. C. Gazitúa, D. V. Kenny, E. Mosley-Thompson, V. I. Rich, J. L. Van Etten, L. G. Thompson, and M. B. Sullivan. 2018. Clean low-biomass procedures and their application to ancient ice core microorganisms. *Frontiers in Microbiology*, 9:1094. doi: 10.3389/fmicb.2018.01094.

Zhong, Z-P, Solonenko, N.E., Li, Y-F, Gazitúa, M,C., Roux, S,, Davis, M.E., Van Etten, J.L., Mosley-Thompson, E., Rich V.I., Sullivan, M.B., Thompson, L.G. 2020. Glacier ice archives fifteen-thousand-year-old viruses. In revision for *Microbiome*).

THE OHIO STATE UNIVERSITY

Vicki Wysocki, Ph.D.

Director of Campus Chemical Instrument Center
Ohio Eminent Scholar, Protein Engineering

July 6, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

As Director of the Campus Chemical Instrument Center (CCIC), Director of the NIH-funded native mass spectrometry resource, Associate Director of the Foods for Health initiative, and as a chemistry and biochemistry faculty member involved in funded microbiome research, I am pleased to provide this letter of support for the establishment of the Center of Microbiome Science (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status have included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

Several key CoMS investigators are already users of the CCIC with the common goal of obtaining relevant measurements by mass spectrometry and/or NMR (Ahmer, Boyaka, Cooperstone, Gunn, Gur, Jacobs, Jimenez-Flores, Klein, Kumar, Kwiek, Popovich, Rajashekara, Xia, and Wozniak). Through collaborative research projects, I have two shared NIH grants and have published multiple papers with Ahmer and have published with Wozniak. The work with Ahmer involves Kelly Wrighton, who has left OSU, as our computational genomics/transcriptomics expert. It is critical that OSU build strength in computational microbiology to support projects such as the Ahmer Salmonella/inflamed intestine work. The resources afforded through CoMS act as a force multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Campus Chemical Instrument Center • 279 Biomedical Research Tower • 460 W 12th Ave. • Columbus, OH 43210
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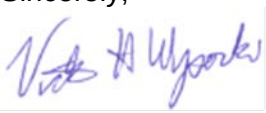
Further, we plan to participate with CoMS through various strategic, high-value center activities, including MS and NMR workshops, symposia (OMSMS), technical working groups (e.g,, coordinated metabolomics at OSU) and communities of practice, access to consulting services, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,



Vicki H. Wysocki, Professor

THE OHIO STATE UNIVERSITY
Center for Design and Manufacturing Excellence
1314 Kinnear Rd., Columbus, OH 43212
cdme.osu.edu

June 11, 2020

RE: LETTER OF COLLABORATION FOR CENTER OF MICROBIOME SCIENCE

Seth Faith, PhD
Strategic Alliance Officer, Infection Disease Institute
Office of Research
The Ohio State University

Dear Dr. Faith,

The Center for Design and Manufacturing Excellence (CDME), within the College of Engineering at The Ohio State University, is pleased and excited to provide continued support to the Infection Disease Institute and the proposed Center of Microbiome Science.

CDME stands as the premier product design and manufacturing organization operated by Ohio State University. The center was created in 2015 to meet the applied research and product commercialization needs of the university's internal and external partners. CDME was initially funded via a $6.8M Department of Defense grant and the College of Engineering to ensure that Ohio State provides a more direct impact in the commercial sector and to society as a whole. CDME's facility is located on Ohio State's west campus, conveniently across the street from OSU's Nanotech West facility. The center's team of program managers, engineers, and technicians use a combined ~425 years of industrial experience to conduct design refinement, prototyping, system integration and manufacturing optimizing services for its customers. CDME has in-house resources for advanced additive manufacturing, electrical/controls, and mechanical design, machining/welding, a mechanical testing laboratories, along with access to other laboratories and services across the University.

CDME looks forward to providing Dr. Faith's team and customers.

- Medical device and product design assistance
- Both waterfall and agile program management for complex multi-disciplinary projects
- Engineering and technician support for laboratory studies prototype modifications and equipment in support of IDI and Microbiome programs
- Labor support for voice-of-the-customer programs and clinical trials

Sincerely,

Nate Ames
Executive Director
College of Engineering | CDME
The Ohio State University
1314 Kinnear Rd, Columbus, OH 43212

THE OHIO STATE UNIVERSITY

Juan D. Alfonzo
Center for RNA Biology, Director
Arts and Sciences
Distinguished Professor
Department of Microbiology
105 Biological Sciences Building
484 W. 12th Ave.
Columbus, OH 43210

June 23, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am the Director of the Center for RNA Biology (CRB), and I am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

The Center for RNA Biology shares the vision and mission of CoMS. We at the CRB believe that given the fact that much of the research involves microbes, there are ample grounds for collaboration and further explore RNA diversity of function and evolution through interactions with CoMS. Furthermore, such collaboration will provide the opportunity to engage with OSU trainees that could enter into our organization's workforce post-graduation. The resources afforded through CoMS act as a force multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, we plan to participate with CoMS through various strategic, high-value center activities, including workshops, seminars, symposia, microbiome-specific curriculum, technical working groups and communities of practice, access to consulting services, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

Best regards,

Juan D. Alfonzo

THE OHIO STATE UNIVERSITY
INFECTIOUS DISEASES INSTITUTE

July 12, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

As the director of the Infectious Diseases Institute (IDI), I am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. For the past seven years, faculty from various disciplines have worked to form a robust, interdisciplinary network focused on microbiome science. In 2017, this network was more formally structured through the establishment of the Infectious Diseases Institute (IDI) and the Microbial Communities Thematic Program, one of six thematic programs in the institute. Under the leadership of Dr. Matthew Sullivan and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged—a center that will position Ohio State as a leading institution in this space.

Over the last decade, microbiome science has grown exponentially, recognition of the fact that the health of humans, animals, plants and the environment is critically dependent on the microbial communities with which they coexist. As such, microbiome science plays critical roles in advancing environmental science and our understanding of the impacts of microbiomes on climate change, medicine, agriculture, and bioremediation. Research support is increasing exponentially, with funding opportunities expected to exceed one billion dollars in the upcoming year. Many institutions are pursuing microbiome science, yet few if any have the capacity to address the *interrelatedness* of human, animal, plant and environmental communities that include engineered systems. This is the perspective that differentiates the IDI and the CoMS, drawing upon the immense breadth of expertise present and the collaborative interdisciplinary culture within and between the Columbus Campus, the Research Institute at Nationwide Children's Hospital, and our Wooster Campus.

The importance of microbiome science to human infectious diseases cannot be overstated. We have evolved far beyond the notion of "one pathogen-one disease". Microbial communities educate our immune systems, protect against our body's invasion by pathogens or may alternatively contribute to disease causing potential of other microorganisms. Human pathogens evolve as they circulate between human and environmental reservoirs. Relevance to the COVID-19 pandemic is evidence in the IDI seed grant investment in *Environmental Surveillance for COVID-19 in Ohio: Understanding Transmission*. The project involves twenty-one faculty from four colleges, incorporating aspects of microbiome science to better understand non-human reservoirs, persistence, and means of spread of the causative coronavirus – SARS-CoV-2.

The proposed center currently has an impressive sixty-four faculty members representing seven colleges, as well as collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. For example, two, multi-million-dollar microbiome focused awards were recently received: a $3M grant from the Department of Energy and a $12.5M grant from the National Science Foundation. In order to further harness the collective strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center. The IDI is invested in the success of the

CoMS, with the IDI Strategic Alliance Office filling a leadership role, the IDI Business Manager providing support for fiscal management, and efforts by the IDI Director to identify shared space that will facilitate operations support for both the IDI and the CoMS. While connectivity to the IDI is an asset, autonomy that comes with the designation of a center is key to ensuring visibility on the international stage – visibility that translates into effective recruitment of top talent and success in securing programmatic grants. Center status also facilitates strategic planning that is germane to microbiome science in terms of vision, mission, goals and strategies to achieve those goals.

The impact of CoMS to the IDI community and its interdisciplinary thematic programs will be substantial. Moreover, the collective strength of the microbiome science community and the application to other units across campus will allow CoMS to form new connections with numerous Discovery Themes (DT), such as the Sustainability Institute, the Translational Data Analytics Institute, and the Foods for Health DT program further enhancing the incredible breadth of resources, talent, expertise, and trainees to apply to microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will be a true differentiator for the university, providing outstanding opportunities for trainees, attracting top talent to the university, and expanding interdisciplinary collaborations. In short, this investment will position Ohio State as a leader in microbiome science.

Sincerely,

Michael Oglesbee DVM, PhD
Director, the Infectious Diseases Institute
Professor of Virology and Comparative Pathology
Department of Veterinary Biosciences

THE OHIO STATE UNIVERSITY

Office of Research

208 Bricker Hall
190 North Oval Mall
Columbus, OH 43210-1321

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research.osu.edu

August 3, 2020

Randy Smith, PhD
Vice Provost for Academic Programs
Office of Academic Affairs
The Ohio State University
203 Bricker Hall
190 N Oval Mall
Columbus OH, 43210

Dear Dr. Smith,

As Senior Vice President for Research, I am pleased to offer my support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Matthew Sullivan, together with other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged – a center that will position Ohio State as a leading institution in this space. The proposed center will create exceptional benefit for students, trainees, and faculty from numerous colleges across campus. The field of microbiome science is highly interdisciplinary and affords opportunities for research discoveries that have global impacts from solutions to climate change and energy production to animal, human and plant health. It is critical for Ohio State to establish this Center and lead research and education in this rising, high-tech biotechnology area.

I have high confidence in the director, Dr. Sullivan, who is a worldwide leader in the study of microbiomes, and has spearheaded an internal group of faculty to develop new courses in microbiome science, novel tools at the Ohio Supercomputer Center, and large multi-investigator grants. In fact, this budding group recently obtained a $12.5M National Science Foundation grant to study the role of microbes in climate change within the framework of educating the next-generation of microbiome scientists. Furthermore, I understand that the microbiome community at Ohio State has grown to 64 faculty across seven colleges and continues to gain momentum aligned with multiple elements of the Office of Research Strategic Plan. Thus, the establishment of a center will serve to solidify this momentum and help elevate their collective efforts.

The Office of Research is pleased to support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and position Ohio State as a leader in microbiome science.

Sincerely,

Morley O. Stone, PhD
Senior Vice President for Research

Ohio Supercomputer Center

Empower. Partner. Lead.

1224 Kinnear Road, Columbus, Ohio 43212 | Phone: (614) 292-9248 | Fax: (614) 292-7168 | osc.edu

June 29, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine), 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

At OSC we support the research computing needs of several CoMS investigators, Matthew Sullivan's group has been using our resources since 2015, with the common goal of empowering researchers with the computing software, expertise and resources needed for inquiry. Through this partnership, we have provided the container technology used by MAVERIC Informatics to easily deploy and share modeling, simulation and analysis tools on our computing systems. The unique ability of the Ohio State's microbiome community to leverage this shared suite of software tools enables a wider community to productively use our resources and reduces the software support workload of OSC staff. We look forward to continuing to work with CoMS to improve the visibility of MAVERIC, to broaden access to the suite and to support the MAVERIC developers.

Additionally, it is essential that we have convergent science drivers such as the high value activities of CoMS to go after large scale instrumentation awards from agencies such as NSF, NIH and others. A center such as CoMS acts as a force multiplier that will advance OSC's mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, we plan to participate with CoMS through various strategic, high-value center activities, including training, workshops, and critically needed bioinformatics tools/pipelines for microbiome science. OSC has already been helping to train CoMS membership through our support of Prof. Sullivan's hands-on 'Microbiome Informatics' course held each fall. The graduate students in the class use OSC throughout the term, and benefit from an OSC staff provided primer during a class period each year.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

David E. Hudak, Ph.D.
Executive Director
Ohio Supercomputer Center (OSC)

Colorado State University
Department of Soil and Crop Sciences
Fort Collins, Colorado
80523-1499 USA

June 25, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

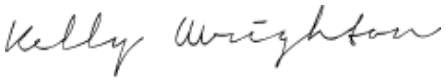
Dear Council Chairs and Members:

I am an Assistant Professor at Colorado State University, Microbiome Initiative Hire in the Soil and Crop Sciences Department, and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

As a former Assistant Professor at OSU, Department of Microbiology (2013-2018), former Director of the OSU Infectious Disease Institute, Microbial Communities thematic program (2017-2018), and now a Microbiome Initiative Hire at Colorado State University, I share the vision and mission of CoMS. I currently work in partnership with multiple CoMS investigators (Brian Ahmer, Joseph Kryzycki, Virginia Rich, Matthew Sullivan, Vicki Wysocki) with the common goal of using microbiome knowledge to profile microbially catalyzed reactions that contribute to critical ecosystem processes. These key partnerships have resulted in four NIH and NSF grants, with two NSF grants pending, and to date have resulted in 8 publications that have been cited 268 times since 2017. The unique interdisciplinary expertise within Ohio State's microbiome community has enabled such success. Had the CoMS existed during my time at OSU, I have no doubt this Center-level organization would have resulted in a greater number of collaborative opportunities and critically, afforded my graduate students with interdisciplinary curriculum opportunities and professional development in microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.
Sincerely,



Kelly C. Wrighton
Assistant Professor
Soil and Crop Sciences
Microbiome Initiative Hire
wrighton@colostate.edu
https://wrightonlab.com

Duke UNIVERSITY

Jun 30th, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am delighted to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State.

I am an active microbiome scientist who investigates the impact that diet has on the human gut microbiome (*e.g.* David et al., Nature 2014). My lab at Duke University pursues this work by combining principles from ecology, engineering, and biomedical research and is support by the National Institute of Health, the Damon Runyon Foundation, and the Office of Naval Research. I also serve as the Associate Director of the Duke Microbiome Center, and have represented my institution as a co-organizer of the inaugural meeting of the Microbiome Centers Consortium, a group now consisting of over 80 academic and industry centers focused on microbiome research.

In my opinion, a robust microbiome center is an integral component of a modern academic research institution. As you well know, microbiome science now spans a variety of fields ranging from agriculture, to environmental science, to medicine, and evolution, to name a few. At Duke, our microbiome center provides a central hub to connect over 50 faculty across our Schools of Medicine, the Environment, Engineering, and the Arts & Sciences. These connections are integral for researchers who have a strong interest in microbiome science, but lack departmental colleagues who can facilitate microbiome research. We seed connections with annual grant competitions whose budgets exceed $100,000 – these investments have since been linked to multiple externally funded awards with budgets exceeding $1M dollars. Our center also provides an opportunity to help coordinate and catalyze microbiome education on campus: center members work together to organize microbiome analysis classes, and lead an NSF-funded graduate training program in microbiome science. Finally, our center provides ample faculty startup funds that we can deploy in partnership with departments on campus to recruit talented microbiome scientists from across the country and globe.

After reviewing the plans for OSU's microbiome center led by Dr. Matthew Sullivan and his colleagues, I believe Ohio State has the potential to become a leading

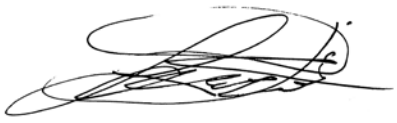
Mail: Box 3382, Durham, NC 27708 • Tel: (919) 668-5388
Email: l.d@duke.edu • Web: www.ladlab.org

Duke UNIVERSITY

institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. OSU is unique in the breadth of complex microbial systems that faculty study across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center's diversity of faculty representing colleges ranging from Arts & Sciences to Dentistry to Food, Ag and to Veterinary Medicine matches, or perhaps even exceeds, the already wide range of research disciplines I see brought together in our microbiome center at Duke. The activities of CoMS since establishing temporary center status, including growing a trainee community and supporting specialized curriculum in computational microbiology, are also precisely the kind of exercises I would expect from a promising microbiome center effort. Additionally, I believe it wise and prudent that OSU's microbiome group is engaged with industry and government partners to explore diverse revenue streams for supporting microbiome research.

Ultimately, from basic science, to applied technology, to clinical therapies – microbiome science is poised to reshape our understanding of living systems and how we deliver impactful solutions. This center at OSU will provide outstanding opportunities for trainees and expand interdisciplinary collaborations. Institutional investment in these efforts is essential to attract top talent to the university, as I have now seen the creation of microbiome centers as becoming a norm across the country. I urge you to consider establishing CoMS as an official university center and positioning Ohio State as a leader in microbiome science.

Sincerely,



_____

Lawrence David, PhD
Assistant Professor, Department of Molecular Genetics & Microbiology
Associate Director, Duke Microbiome Center
Duke University

Mail: Box 3382, Durham, NC 27708 • Tel: (919) 668-5388
Email: l.d@duke.edu • Web: www.ladlab.org

MAYO CLINIC

200 First Street SW
Rochester, MN 55905
507-284-2511

July 3, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

We are delighted to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at the Ohio State University.

We represent the Microbiome Program within the Mayo Clinic Center for Individualized Medicine. The Mayo Clinic Microbiome Program launched in 2012 and enables high-impact translational microbiome research in human healthcare. Since our launch, we have seen remarkable growth in the interest, technology development, and applications of microbiome science across disciplines. We have also worked collaboratively with a number of Ohio State University researchers in the microbiome space over the previous decade.

A robust microbiome center is an integral component of a modern academic research institution, and microbiome-relevant training, curriculum, and research are becoming increasingly critical for scientific workforce development and advances. Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine), 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

Ultimately, from basic science, to applied technology, to clinical therapies – microbiome science is poised to reshape our understanding of living systems and how we deliver impactful solutions. This center at OSU will provide outstanding opportunities for trainees and expand interdisciplinary collaborations. Institutional investment in these efforts is essential to attract top talent to the university, as I have now seen the creation of microbiome centers as becoming a norm across the country. I urge you to consider establishing CoMS as an official university center and positioning Ohio State as a leader in microbiome science.

Sincerely,

Nicholas Chia, Ph.D.
Associate Director, Microbiome Program, Center for Individualized Medicine
Senior Associate Consultant, Department of Surgery
Assistant Professor, Biophysics and Surgery
Mayo Clinic, Rochester, MN

Purna Kashyap, M.B.B.S.
Associate Director, Microbiome Program, Center for Individualized Medicine
Associate Professor of Medicine and Physiology, College of Medicine
Consultant, Department of Internal Medicine, Division of Gastroenterology and Hepatology
Mayo Clinic, Rochester, MN

UCI Microbiome Initiative

July 1, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: The Ohio State Center of Microbiome Science (CoMS) Letter of Support

Dear Council Chairs and Members:

It is my pleasure to give my support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. I am the Director of the Microbiome Initiative at the University of California, Irvine, and the Lead of the Microbiome Centers Consortium (MCC), a network established last year to coordinate more than 50 newly formed academic microbiome centers across the US. I was pleased to hear that Dr. Matthew Sullivan is founding a new microbiome center at Ohio State University, and I look forward to collaborating with him in his efforts.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Microbiome centers form the foundation of the expansion microbiome research in the US, as interest among researchers to include microbiomes in their research has outstripped the capacity of microbiome experts to collaborate with newcomers in the field. Centers have tackled this challenge in different ways, but many facilitate laboratory and analytical services, develop curriculum materials for graduate and undergraduate education, and communicate microbiome science to the broader scientific community, industry, and the public. Centers such as CoMS bring together a diverse range of scholars that naturally bridge across the traditional university structure.

Ohio State is strategically poised to become a leader amongst such microbiome centers. The investigators include individual researchers that are renown in the areas of virome, ecosystem microbiology, and One Health – a unique combination from any other microbiome center. They study microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome

group is also engaged with industry and government partners. These are characteristics of some of the strongest centers emerging in the country.

Microbiome centers depend heavily on faculty members volunteering their time, motivated by a desire to support their colleagues and grow microbiome science. They also require initial, internal support from their academic institutions. By our count, more than 85% of microbiome centers in the US are intiailly supported by short-term, internal funding. However, in my experience these investments are more than worthwhile. The resources afforded to CoMS will act as a force multiplier as the center will benefit students, trainees, and faculty, and afford opportunities for research discoveries that have global impacts. The nature of microbiome science requires a collaborative approach that shared and builds on knowledge from across ecological systems and scientific disciplines.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. I look forward to welcoming CoMS into the MCC network and collaborating to advance microbiome research.

Sincerely,

Jennifer B.H. Martiny
Professor, Ecology & Evolutionary Biology
Director, UCI Microbiome Initiative
Lead, Microbiome Centers Consortium
University of California, Irvine

DEPARTMENT OF THE AIR FORCE
711TH HUMAN PERFORMANCE WING (AFMC)
WRIGHT-PATTERSON AFB OHIO

23 June 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

SUBJECT: The Ohio State Center of Microbiome Science (CoMS) Letter of Support

Dear Council Chairs and Members:

As the Chief Scientist of the 711th Human Performance Wing (711 HPW), Air Force Research Laboratory (AFRL), I am pleased to provide this letter of support for the establishment of the CoMS within the Office of Research at the Ohio State University. The Ohio State University (OSU) has assembled an exemplary quorum of faculty in microbiome science, providing a solid foundation to launch a high-impact center in this field has emerged; a center that will position Ohio State as a leading institution in this microbiome research.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine), 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital.

Even though only a temporary center currently, CoMS has developed a trainee community and supports a specialized curriculum in computational microbiology; an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners, including AFRL, who share common goals. This has the potential to lead to new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and will deliver impactful solutions. In order to harness the interdisciplinary strength that the OSU's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

The vision and mission of CoMS aligns well with the goals of 711 HPW. Specifically, we plan to

collaborate with CoMS to encourage student exchange and recruitment. The proximity of AFRL and OSU facilitates the opportunity to engage, mentor, and develop OSU trainees that could enter into our organization's workforce post-graduation. The resources afforded through CoMS will act as a force multiplier, yielding opportunities to mentor and collaborate with OSU faculty and students to drive towards common mission goals.

Further, the Wing plans to participate with CoMS through various strategic, high-value center activities, including workshops, seminars, symposia, microbiome-specific curricula, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at the Ohio State University. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position the OSU as a leader in microbiome science.

Sincerely,

RAJESH R. NAIK, PhD, ST
Chief Scientist
711th Human Performance Wing

June 22, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am the lead of the DOE Office of Biological and Environmental Research "Microbes Persist" Soil Microbiome Science Focus Area at Lawrence Livermore National Laboratory, and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) under the leadership of Dr. Matthew Sullivan and other key faculty in microbiome science at OSU. The proposed center will create exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from investigators working on broad interdisciplinary efforts in the study of microbial communities across a range of environments and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges, 2 schools, and collaborators at Nationwide Children's Hospital. I understand that the initial activities of CoMS have included: growing a trainee community and supporting curriculum in computational microbiology, and engaging with industry and government partners who share common goals. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, I suggest that this is an ideal time to move forward with the establishment of CoMS as an official university center.

As part of the DOE project I lead, I have worked in partnership with Dr. Matthew Sullivan for the past 3 years with the common goal of understanding the role of viruses in microbial transformations of soil carbon. Through this partnership, we have developed a series of new virus-centric methods and informatics tools and made them available to the public through publications and the DOE's KBase informatics sharing platform. The unique ability of the Ohio State's microbiome community and Dr. Sullivan's long history of environmental microbiome research enabled these successes. As a result of this success, my team has gained insights and access to cutting edge expertise facilitated by the Sullivan lab. In the future, I expect my team will continue to participate with CoMS through high-value center activities, including

workshops, seminars, symposia, developing collaborative research proposals, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

Dr. Jennifer Pett-Ridge
Group Leader, Environmental Isotope Systems Group
Laboratory Research Manager *Microbes Persist* Soil Microbiome SFA Program
Physical and Life Sciences Directorate
Lawrence Livermore National Lab
7000 East Ave, L-231, Livermore, CA 94551
(925) 424 2882, pettridge2@llnl.gov

Ohio | Department of Agriculture
Governor Mike DeWine • Lt. Governor Jon Husted
Director Dorothy Pelanda

Division of Animal Health
Animal Disease Diagnostic Lab
8995 East Main Street, Reynoldsburg, OH 43068
Phone: 614-728-6220 • Fax: 614-728-6310
agri.ohio.gov • animal@agri.ohio.gov

July 2, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members,

I am the Interim Director of the Ohio Animal Disease Diagnostic Laboratory (ADDL) at the Department of Agriculture, and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

The Ohio ADDL shares the vision and mission of CoMS. Specifically, we plan to collaborate with CoMS to perform whole genome sequencing to empower microbiome research at Ohio

State by converging strengths across our campus to make high impact discoveries and train the next generation of scientists. It is essential that we can perform this research with CoMS and/or have the opportunity to engage with OSU trainees that could enter into our organization's workforce post-graduation. The resources afforded through CoMS act as a force multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, we plan to participate with CoMS through various strategic, high-value center activities, including workshops, seminars, symposia, research seed funding, microbiome-specific curriculum, technical working groups and communities of practice, access to consulting services, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

Dr. Yan Zhang, DVM, PhD, DACVM,
Interim Laboratory Director
Ohio Department of Agriculture
Animal Disease Diagnostic Laboratory
8995 E. Main St. Building #6
Reynoldsburg, OH 43068
614-728-6220 | yan.zhang@agri.ohio.gov

Paris, June 21 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: The Ohio State Center of Microbiome Science (CoMS) Letter of Support

Dear Council Chairs and Members:

We, Eric Karsenti and Chris Bowler, directors of the *Tara* Oceans program, are happy to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew B. Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact Center in this field has emerged — a Center that will position Ohio State as a leading institution in this space. The proposed Center will create exceptional benefit for students, trainees, and faculty, and will afford opportunities for research discoveries that have global impacts. Below we highlight significant details underlying our support for the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Our own work through *Tara* Oceans has made a significant contribution by generating major omics-based resources from the ocean that currently represent the gold standard in marine sciences. We are aware that Ohio State's microbiome group arose organically from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed Center currently has an impressive 64 faculty members representing seven colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine), two schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting a specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science

IBENS Institut de Biologie de l'Ecole Normale Supérieure

EMBL European Molecular Biology Laboratory

will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university Center.

Within the *Tara* Oceans consortium we have worked in partnership with Prof. Matthew B. Sullivan, one of the key CoMS investigators, for more than ten years. Through this partnership, we have collectively generated the most complete description to date of a single planetary biome. With specific reference to the work of Prof. Sullivan within *Tara* Oceans, our knowledge of the ocean virome has increased from 39 known types of marine viruses prior to *Tara* Oceans to more than 200,000 in 2020. To date, we have published sixteen highly cited papers together, ten of them in Cell, Nature and Science. The unique ability of the Ohio State's microbiome community in terms of interdisciplinary expertise and well-established international partnerships have been instrumental in enabling such success. As a result, *Tara* Oceans scientists have much to gain by continuing to work with CoMS in the future to further exploration of *Tara* Oceans datasets, to link them with other emerging resources in microbial oceanography, and to explore interfaces with the research community focusing on terrestrial and human microbiomes. We also relish the opportunity to engage with OSU trainees that could enter into our organization's workforce post-graduation. The resources afforded through CoMS act as a force multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, we will be happy to participate with CoMS through various strategic, high-value center activities, including workshops, webinars, symposia, technical working groups and communities of practice, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, we strongly support the establishment of the Center of Microbiome Science at Ohio State. This Center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

Dr. Eric Karsenti, EMBL, Director of *Tara* Oceans from 2008-2020
CNRS Gold medal 2015, member of Académie des Sciences 2017

Dr. Chris Bowler, IBENS, future Director of *Tara* Oceans from 2021
CNRS Silver medal in 2010, member of Académie d'Agriculture de France 2018

Amazon Web Services, Inc. ▪ 410 Terry Avenue N. ▪ Seattle, WA 98109

July 6, 2020

Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
190 North Oval Mall
Columbus, OH 43210

Re: The Ohio State Center of Microbiome Science (CoMS) Letter of Support

Dear Council Chairs and Members:

Amazon Web Services, Inc. (AWS) is very pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at the Ohio State University (Ohio State). Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts.

AWS offers commercially available, web-scale computing services that help organizations avoid much of the heavy-lifting typically associated with launching and growing successful applications. These services are based on Amazon's own back-end technology infrastructure and incorporate over a decade and a half of experience building one of the world's most reliable, scalable, and cost-efficient web infrastructures. The use of AWS will provides our customers with access to expertise in large-scale distributed computing and operations and will enable their applications to be robust and scalable.

AWS values and appreciates the opportunity to work with Ohio State on this effort and we look forward to a long and productive partnership. If you have any questions, or require additional information, please contact Christopher Griffin, AWS Account Manager at griffiam@amazon.com or 757-876-6779.

Respectfully,
Amazon Web Services, Inc.

DocuSigned by:
Sanjay Padhi
5B70B47D0A0E4A0...

Sanjay Padhi
Head of AWS Research, US Education

LETTER OF SUPPORT

illumina

23rd July 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am the Vice President of Global Marketing at Illumina, Inc. and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that can position Ohio State as a leading institution in this space. The proposed center will create opportunities for research discoveries that can have global impacts. Below I highlight details for Illumina's support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Illumina has worked with Ohio State's microbiome group for the past 3-5 years and seen the group excel in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The microbiome group engages with government and industry partners, like Illumina, who share common goals. From basic research to applied technologies, microbiome science can reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, we advocate for the establishment of CoMS as an official university center.

There are now more than 5000 scientific publications per year in microbiology, metagenomics, and microbiome using our core technology, and growing at a rate greater than 20%. This field is moving at a fast pace and Ohio State is poised to make major contributions in this field. Given the robust microbiome community within CoMS we look forward to opportunities to collaborate with Ohio State on new microbial genomics applications and methods. We will strive to provide quotes and other supplementary materials to support applications for extramural funding. Further, Illumina would welcome opportunities to work with CoMS on seminars, webinars, and other valuable training opportunities in microbiome, genomics, and bioinformatics.

In conclusion, I support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees and can help attract top talent to the university, expand interdisciplinary collaborations, and position Ohio State as a leader in microbiome science.

Sincerely,

Kathy Davy
Vice President of Global Marketing at
Illumina, Inc

REVIEWED BY LEGAL
Initials: DML
Date: 7/23/2020
ILLUMINA

Metabolon

June 25, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am the CEO of Metabolon and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

Metabolon shares the vision and mission of CoMS. Specifically, we plan to collaborate with CoMS to support all global untargeted, targeted and lipid metabolomics projects to ensure the Centers growth in integration of multi-omic data sets into their research. It is essential that we can perform this research with CoMS and have the opportunity to engage with OSU trainees that could enter into our organization's workforce post-graduation. The resources afforded through CoMS act as a force

Metabolon, Inc.
617 Davis Drive, Suite 100, Morrisville, NC 27560

multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, we plan to participate with CoMS through various strategic, high-value center activities. These include workshops, seminars, symposia, microbiome-specific curriculum, technical working groups and communities of practice, access to consulting services, and critically needed metabolomic profiling services for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

DocuSigned by:
Rohan Hastie
DC4C8E8214C8458...

[Signature]
Rohan Hastie

Title
CEO + President

Organization
Metabolon

Metabolon, Inc.
617 Davis Drive, Suite 100, Morrisville, NC 27560

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

8 July 2020

RE: The Ohio State Center of Microbiome Science (CoMS) Letter of Support

Dear Council Chairs and Members:

I am the, Executive Vice-President for Investment & Venture Acceleration at Rev1 Ventures, Inc., and am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

Rev1 Ventures is a Columbus-based investor/startup studio that maintains a close collaboration with The Ohio State University, having advised and invested in over 50 spin out companies and guiding dozens of faculty innovators across the university through the startup journey. We work closely with OSU's Corporate Engagement Office, Office of Research, The Drug Development Institute and Office of

the Chief Financial Officer. We support the vision and mission of CoMS, viewing their work as having high potential for commercial application and alignment with Rev1's programs and services.

Further, we hope to participate with CoMS through various strategic, high-value center activities, including workshops, seminars, symposia, microbiome-specific curriculum, technical working groups, access to consulting services, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I strongly support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

Wayne Embree
Exec VP Investments & Venture Acceleration
Rev1 Ventures, Inc.

wayne@rev1ventures.com
614-484-5030

The Procter & Gamble Company
Mason Business Center
8700 Mason-Montgomery Road
Mason, OH 45040

LETTER OF SUPPORT

September 21, 2020

The Ohio State University
Office of Academic Affairs
Council on Academic Affairs
203 Bricker Hall
CAMPUS

RE: **The Ohio State Center of Microbiome Science (CoMS) Letter of Support**

Dear Council Chairs and Members:

I am the Vice President of Research & Development, Corporate Function, Global BioScience. I am pleased to provide this letter of support for the establishment of the Center of Microbiome (CoMS) within the Office of Research at Ohio State. Under the leadership of Dr. Matthew Sullivan, and other key faculty in microbiome science, a solid foundation to launch a high-impact center in this field has emerged — a center that will position Ohio State as a leading institution in this space. The proposed center creates exceptional benefit for students, trainees, and faculty, and affords opportunities for research discoveries that have global impacts. Below I highlight significant details for my support of the formation of CoMS.

Over the last decade, microbiome science has grown exponentially and plays a critical role across many fields, including environmental science and climate change, medicine and health, agriculture, and bioremediation. Ohio State's microbiome group arose from cutting-edge investigators through broad interdisciplinary efforts and interests in the study of microbial communities across environments including animals, plants, humans, soil, water, built environments, and engineered systems. The proposed center currently has an impressive 64 faculty members representing 7 colleges (Arts & Sciences / Dentistry / Engineering / Food, Ag and Environmental Sciences / Medicine / Public Health / Veterinary Medicine) 2 schools (Environment and Natural Resources, Earth Sciences), and collaborators at Nationwide Children's Hospital. Initial activities of CoMS since establishing temporary center status has included growing a trainee community and supporting specialized curriculum in computational microbiology, an area of specialization of critical importance to microbiome science. The microbiome group is also engaged with industry and government partners who share common goals, which will lead to opportunities for new revenue streams in support of the research. From basic research to applied technologies, microbiome science

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8700 Mason-Montgomery Road
Mason, OH 45040

will undoubtedly reshape our understanding of living systems and how we deliver impactful solutions. In order to harness the interdisciplinary strength that Ohio State's research and student community in the microbiome field possess, now is the time to move forward with the establishment of CoMS as an official university center.

My Organization is supportive and aligned to the vision and mission of CoMS. Specifically, P&G Corporate R&D plan to explore collaboration with CoMS to extend the scientific understanding of the microbiome. Research collaboration with CoMS will provide the opportunity to engage with OSU trainees that would enter into potential P&G organization's workforce post-graduation. The resources afforded through CoMS act as a force multiplier that will advance our mission in significant ways and will yield opportunities that would otherwise be difficult to seek without a solid cohort of interdisciplinary collaborators.

Further, P&G R&D will plan to participate with CoMS through various strategic, high-value center activities, including workshops, seminars, symposia, technical working groups and communities of practice, access to consulting services, and critically needed bioinformatics tools/pipelines for microbiome science.

In conclusion, I support the establishment of the Center of Microbiome Science at Ohio State. This center will provide outstanding research opportunities for trainees, attract top talent to the university, expand interdisciplinary collaborations, and will position Ohio State as a leader in microbiome science.

Sincerely,

09/23/20

Dr. Ninah Enane-Anderson
Vice President
R&D, Corporate Function

Appendix E – Landscape assessment and benchmarking

To benchmark the Ohio State Center of Microbiome Science (CoMS) an international landscape assessment was performed. A total of 76 microbiome programs, centers, institutes or initiatives were identified; 58 were in the United States, and 18 were international universities (Table 1). Eleven highly regarded organizations were selected for a deep dive benchmarking assessment (noted by an asterisk). The summary of each institution is provided following the Table 1, and intended as supplement to the *Proposal to Establish The Ohio State University Center of Microbiome Science* part VI.C.

Table 1 – List of microbiome programs, centers, institutes, or initiatives comparable to the Ohio State Center of Microbiome Science.

Institute or Organization	Country	Title
Argonne National Lab	United States	Microbiome Center
Arizona State University	United States	Alkek Center for Fundamental and Applied Microbiomics (CFAM)*
Baylor College of Medicine	United States	Texas Children's Microbiome Center*
Baylor College of Medicine	United States	Center for Metagenomics and Microbiome Research*
Bigelow Laboratory	United States	Bigelow Laboratory Single Cell Genomics Center
Boston University	United States	Boston University Microbiome Initiative
Brigham and Women's	United States	Massachusetts Host Microbiome Center
California Institute of Technology	United States	Center for Environmental Microbial Interactions (CEMI)*
Chan Zuckerberg	United States	Chan Zuckerberg Biohub Microbiome
Cleveland Clinic	United States	Center for Microbiome and Human Health
Colorado State University	United States	Microbiome Network*
Cornell University	United States	Cornell Institute of Host-Microbe Interactions and Disease
Department of Veteran Affairs	United States	Military and Veteran Microbiome: Consortium for Research and Education:
Duke University	United States	Duke Microbiome Center*
Emory University	United States	Emory Microbiome Research Center

George Mason University	United States	Microbiome Analysis Center
John Hopkins University	United States	Microbiome Forum*
Lawrence Berkeley National Lab	United States	Microbes to Biomes*
Lawrence Berkeley National Lab	United States	National Microbiome Data Collaborative
Mayo Clinic	United States	Microbiome Program
Medical College of Wisconsin	United States	Center for Microbiome Research*
Medical University of South Carolina	United States	Program for Human Microbiome Research
MIT and Mass General	United States	The Center for Microbiome Informatics and Therapeutics (CMIT)
Mount Sinai	United States	Microbiome Translational Center
Northern Arizona University	United States	The Pathogen & Microbiome Institute
Oregon State University	United States	Oregon State University Microbiome Initiative
Pacific Northwest National Laboratory	United States	Microbiomes in Transition
Pennsylvania State University	United States	Penn State Microbiome Center*
Rutgers University	United States	Center for Nutrition, Microbiome, and Health
Stanford University	United States	The Center for Human Microbiome Studies
Texas A & M	United States	Core for Integrated Microbiota Research (CIMR)
TGEN	United States	Clinical Microbiome Services Center
University of Buffalo	United States	UB Microbiome Research Center
University of California, Berkeley	United States	JBIMS
University of California, Davis	United States	Microbiome Special Research Program*
University of California, Irvine	United States	UCI Microbiome Initiative
University of California, Los Angeles	United States	UCLA Microbiome Center
University of California, Riverside	United States	UCR Microbiome Initiative

University of California, San Diego	United States	UC San Diego Center for Microbiome Innovation
University of Chicago	United States	The Microbiome Center
University of Colorado, Boulder	United States	Center for Microbial Exploration
University of Colorado, Denver	United States	The Microbiome Program
University of Connecticut	United States	Center for Microbial Systems, Ecology and Evolution
University of Connecticut	United States	MARS: Microbial Analysis, Resources and Services
University of Hawaii	United States	Center for Microbiome Analysis through Island Knowledge & Investigation
University of Massachusetts	United States	UMass Center for Microbiome Research
University of Michigan	United States	Michigan Microbiome Project (MMP)
University of Oregon	United States	BioBE Center
University of Oregon	United States	Microbial Ecology and Theory of Animals (META) Center for Systems Biology
University of Pennsylvania	United States	The PennCHOP Microbiome Program
University of Pennsylvania	United States	Center for Host-Microbial Interactions
University of Pittsburgh	United States	University of Pittsburgh Center for Medicine and the Microbiome
University of South Florida	United States	Initiative on Microbiomes
University of Texas Southwestern	United States	Microbiome Research Laboratory
University of Washington	United States	Center for Microbiome Sciences & Therapeutics (CMiST)
University of Wisconsin	United States	Microbiome Hub
Vanderbilt University	United States	The Vanderbilt Microbiome Initiative (VMI)
International Entities	Country	Title
University of Queensland	Australia	Australian Center for Ecogenomics
AMICI	Austria	Austrian Microbiome Initative
Medical University of Graz, Austria	Austria	Center for Microbiome Research

University of Vienna	Austria	Centre for Microbiology and Environmental Systems Science
Ghent University	Belgium	Center for Microbial Ecology and Technology
Dalhousie University	Canada	Integrated Microbiome Resource
Lawson Health Research Institute	Canada	Canadian Centre for Human Microbiome and Probiotic Research
McGill	Canada	Microbiome Disease and Tolerance Center
University of Calgary	Canada	International Microbiome Center
University of Waterloo	Canada	Waterloo Centre for Microbial Research
Helmholtz Zentrum Munich	Germany	Research Unit for Comparative Microbiome Analyses
Kiel University	Germany	Metaorganism Research Center
University College Cork	Ireland	APC Microbiome Ireland
Leiden University	Netherlands	Center for Microbiome Analyses and Therapeutics
Institute of Agricultural and Food Biotechnology	Poland	Institute of Agricultural and Food Biotechnology
Karolinska	Sweden	Centre for Translational Microbiome Research (CTMR)
Kings College London	United Kingdom	Center for Host Microbiome Interactions
Quadram Institute	United Kingdom	Quadram Institute
Other Entities	Country	Title
Metageneopolis	France	Metageneopolis
German Research Foundation	Germany	Intestinal Microbiota – a Microbial Ecosystem at the Edge between Immune Homeostasis and Inflammation
Bioaster	France	Bioaster Microbiology Technology Institute
AGA	United States	AGA Center for Gut Microbiome Research & Education
India Ministry of Science and Technology	India	Institute of Microbial Technology (IMTECH)
Janssen	Global	Janssen Human Microbiome Institute

Arizona State University (ASU) Biodesign Institute – Center for Fundamental and Applied Microbiomics (CFAM)
https://biodesign.asu.edu/fundamental–and–applied–microbiomics

Center Director: Ferran Garcia–Pichel, PhD

Mission
To develop a thorough understanding of the functional and structural basis of complex systems of microbes, and their relevance for human, animal and plant biology, the environment, and man–made systems. To help create and advance the discipline of microbiomics by developing novel techniques and an integrated systems understanding of microbiomes, so as to establish general functional principles that are not only explanatory, but also predictive, and thus applicable and translatable, of the behavior of communities of microorganisms.

Overview
- Part of the ASU Biodesign Institute
- Initial academic support of the College of Liberal Arts and Sciences, the Fulton Schools of Engineering, the College of Nursing and Health Innovation, and the College of Health Solutions.

Technology
These shared facilities are available to ASU faculty and external investigators to serve as a valuable asset for the entire Arizona research community.
- Microbiome Analysis Lab
    - Provides analysis of microbiomes important for environmental biotechnology processes.
    - metagenomics sequencing, 16S, 18S, or ITS regions can be isolated and sequenced as relevant and are sequenced on the MiSeq instrument, allowing researchers to characterize and study microbial communities from various environments such as soils, freshwater, seawater, waste water, and host–microbe associations.
- DNASU Genomics Core
    - A powerful suite of services and bioinformatics tools are available, serving both the activities of the Center for Personalized Diagnostics and the broader scientific community. Center researchers have been fortunate to work with many bioinformaticists and programmers, combining their varied talents in order to write programs and design databases that track all of the samples in the lab (FLEXGene), automatically analyze sequencing results (ACE), store data and track plasmid samples (DNASU and the Storage Tracking Systems), track and help design NAPPA experiments (NAPPA Tracking Database), automatically annotate shRNAs (Annotation and Curation), and do comprehensive literature searches and analysis (MedGene and BioGene). Additionally, their leading edge facility provides sequencing for purified DNA and glycerol stocks.

Research
- 15 faculty associates focusing on the following areas related to microbiomes:
    - Human pathogens, evolutionary microbiology, ecosystem microbiology, virology, water contaminants, genomics, plankton ecology, host–pathogen interaction, geochemistry, health in women and children, microbial communities, and gut microbiome

Baylor College of Medicine – Texas Children's Microbiome Center
https://www.bcm.edu/research/labs–and–centers/research–centers/texas–childrens–microbiome–center

Center Director: James Versalovic, MD, PhD

Overview
The Texas Children's Microbiome Center, part of the Human Microbiome Project Consortium, translates new knowledge about the human microbiome in different areas of medicine by pursuing metagenomic and microbiome research related to the care of women and children.

As part of Human Microbiome Project Consortium and in collaboration with the Bioinformatics Research Laboratory, the Human Genome Sequencing Center and the Alkek Center for Metagenomics and Microbiome Research, it is strategically placed to partner with a variety of departments and centers at Texas Children's Hospital as well. The Microbiome Center provides complete service and support from initial study design and sample collection to final metagenomic analysis.

Focus Areas
- Multi–omics
    - DNA sequencing
    - 16S ribosomal RNA sequencing
    - Mass spectrometry
    - Bioinformatics
    - Metabolomics
    - Metatranscriptomics
- Bioinformatics
    - Metagenomic and Metatransciptomic analyses
        - Microbial diversity and relative abundances
        - Functional diversity
    - Bacterial genomes
        - Sequencing, assembly, annotation, comparative genomics
- Antimicrobial Resistance
    - Antimicrobial resistance is a growing health problem. Treatment of bacterial infections with an ineffective antimicrobial agent can lead to increased pathogen growth and spread, thus leading to higher rates of mortality.
    - Use new techniques such as selected reaction monitoring (SRM) to determine susceptibility or resistance of an organism to a particular antimicrobial.
- Diabetes, Nutrition, and Metabolism
    - Examine novel biomarkers of disease using metabolomics and proteomic approaches, microRNAs and exosomes in order to understand the pathways that result in complications of obesity, metabolic syndrome and diabetes.
- Microbial Ecology
    - Study of microorganisms (e.g., bacteria, archaea, fungi, and viruses), their interaction with the environment, and their interactions with one another.
- Structural Biology

    - Model structures of target proteins, including genome wide homology models of new microbial genomes to understand protein function and biological processes.
- Therapeutic Probiotics
    - Promising agents for microbiome manipulation, and could be applied as a means to prevent or treat a variety of pediatric illnesses ranging from acute infections to chronic immune disease.
- Visual Analytics
    - Used to visualize biomedical data that is traditionally noisy, allowing easier easier recognition of multivariate correlations and underlying biological processes.

Education

- Home to several students and post docs, and the faculty members work with students, fellows, and other trainees from across the Texas Medical Center and affiliated medical centers. Training topics include:
    - Biobanking
    - Conventional microbiological techniques
    - Clinical laboratory regulatory standards
    - Metagenomics applications of next–generation sequencing
    - General molecular techniques
    - Metabolomics and proteomics
    - Bioinformatics
    - Biostatistics
- Therapeutic Microbiology Fellowship
    - Program is intended to merge the clinical and research aspects of microbiology.
- Bioinformatics Workshops on Microbial Community Characterization and Metagenomics
    - Workshops are geared toward graduate students, post docs, and investigators who are interested in learning to analyze their own sequence data.

Clinical Studies

- Clinical studies in the gut microbiome.

Baylor College of Medicine – Alkek Center for Metagenomics and Microbiome Research (CMMR)
https://www.bcm.edu/research/labs–and–centers/research–centers/alkek–center–for–metagenomics–and–microbiome–research

Center Director: Joseph Petrosino, PhD

Overview
In 2011, the Center for Metagenomics and Microbiome Research (CMMR) was established at the Department of Molecular Virology and Microbiology at Baylor College of Medicine. Here, they leverage various 'omics' technologies, microbial genetics, a variety of pre–clinical models and cell and molecular biology to enable understanding of the human microbiome and its impact on health and disease.

The Alkek Center for Metagenomics and Microbiome Research (CMMR) offers:

- **Discovery and Innovation:** Offer safe, innovative approaches and new horizons for the study of the microbiome.
- **Federal Policy and Public Education:** Initiate educational outreach programs to help collaborators understand the microbiome for healthcare implementation.
- **Biological Interactions:** Provide a market–leading platform for large cohort studies that identify organisms associated with human health and disease.
- **Next Generation of Scientists:** Create curricula that supports cross–disciplinary microbiome research for scientists to accelerate scientific excellence around the world.
- **Therapeutics and Diagnostics:** Develop models that predict microbiome functions for therapeutic applications and diagnostics implementation.
- **Commerce and Industry:** Partner with pioneers and entrepreneurs who are expanding and investing in personalized medicine within the new microbiome industry.

Facility Resources Available

- lumina NovaSeq 6000 Sequencing System
- Illumina HiSeq 3000 Sequencing System – designed for processing more samples in greater
- Illumina HiSeq X Sequencing System
- Illumina NextSeq 550 Sequencing System
- Illumina MiSeq Sequencing System
- Illumina MiSeqDX Sequencing System
- Illumina iSeq 100 Sequencing System
- PacBio SMRT Sequencing System
- Labcyte Echo 525 Acoustic Liquid Handler
- Automated Liquid Handling
- Biomek Liquid Handler
- Fragment Analyzer
- TapeStation Automated Electrophoresis
- Pippin HT System
- Fast Real–Time PCR cycler
- PCR working station
- Cold Storage – cryogenic refrigerators

Services

- 16S sequencing
- ITS sequencing
- Metagenomics WGS sequencing
- Virome sequencing
- Microbial RNASeq

California Institute of Technology – Center for Environmental Microbial Interactions (CEMI)
http://microbiology.caltech.edu/index.html

Center Director: Victoria Orphan, PhD

Mission
Launched in 2012, CEMI's mission is to enable Caltech researchers to tackle important problems involving microbes in bold and innovative ways.

Programs and Events

- Pilot Grants: CEMI awards grants to a student or postdoc to test an exciting interdisciplinary research idea (at an early stage in the development of the project) that involves a collaboration between two or more Caltech PIs with complementary expertise. These awards are meant to help labs take risks, and, if successful, generate preliminary results that can be used to apply for longer–term support from other funding agencies.
- Facilities Training Grants: CEMI supports Facilities Training grants for students/postdocs to learn a new technique.
- Visiting Faculty Fellowships: CEMI Visiting Faculty Fellowships allow distinguished scientists from other universities to spend time at Caltech (usually 1–2 quarters) enriching the Caltech community via their interactions.
- CEMINAR Series (formerly MicroMornings): CEMI organizes the monthly "CEMINAR" seminar series, a stimulating and supportive forum in which students and postdocs from diverse CEMI laboratories have the opportunity to present their research to each other.
- CEMI Workshops: CEMI occasionally supports training courses at Caltech that provide members of the CEMI community with an opportunity for intensive training in a particular area.
- Travel Awards: CEMI supports Travel Grants for students/postdocs to enable participation in scientific meetings, workshops, or advanced summer training courses.
- 1st Year Graduate Student Fellowships: CEMI awards small "recruiting" bonuses to offset relocation expenses for top admitted graduated students with an interest in microbiology.
- Social Events – Poster sessions, Winter Lecture Series, Evening Gala

Related Facilities

- Environmental Analysis Center
- Caltech Microanalysis Center
- Beckman Resource Center for Transmission Electron Microscopy (BRCem)
- CLARITY, Optogenetics and Vector Engineering Research (CLOVER) Center
- Programmable Molecular Technology Center (PMTC)
- Proteome Exploration Laboratory
- Millard and Muriel Jacobs Genetics and Genomics Laboratory

Academics

- Undergraduate summer research opportunities
    - Amgen Scholars – national program aimed at increasing research opportunities for students committed to pursuing careers in the sciences.
    - WAVE – ims to foster diversity by increasing the participation of underrepresented students in science and engineering Ph.D. programs and making Caltech's programs more

visible and accessible to students not traditionally exposed to Caltech. WAVE Fellows receive an award of $6,420 for 10–weeks and a $580 housing/travel allowance.
    - Summer undergraduate research fellowship (SURF) – students have had the opportunity to conduct research under the guidance of experienced mentors working at the frontier of their fields. SURF is modeled after the grant–seeking process (define/develop a project, write a research proposal as part of the application, faculty review proposals and recommend rewards, students carry out research over 10 weeks in the summer).
- Several discipline graduate options for microbiology (Biochemistry and Molecular Biophysics; Bioengineering; Biology; Chemical Engineering; Chemistry; Environmental Science and Engineering; Geological and Planetary Sciences
- Several microbiology graduate and postdoctoral fellowships
- Microbiology, Biochemistry and Molecular biophysics, Bioengineering, Biology, Chemical Engineering, Geological and Planetary Sciences courses included as part of the Center

Research

- 39 labs focusing on the following areas related to microbiomes:
    - Protein engineering and protein structural biology, chemical and physical properties of DNA, immune recognition and viral pathogens, multiplex super–resolution imaging of gene regulatory networks, genome sequencing and synthesis, genetic circuits – cell signaling, decision making and communication, metabolisms and molecular biology of extant organisms, chlorophyll fluorescence and metabolism, neurological diseases, environmental science and water treatment, diagnostics for antimicrobial susceptibility, magnetic fields, molecular ecology physiology and diversity of microbes, symbiotic bacteria, entomology, electrons and redox reactions in biology, nanoscale physics and systems, geobiology/geochemistry, bioinformatics

Colorado State University – Microbiome Network
https://www.research.colostate.edu/microbiome/

Network Coordinators: Jessica Metcalf, PhD; Zaid Abdo, PhD

Overview

- The Microbiome Network supports and engages a CSU–wide group of scholars interested in understanding the functional and structural basis of microbiomes, and their ecological relevance and applications to human, animal, plant and soil biology, and environmental systems.
- 10 microbiome experts
- 30+ million in funded research
- 20+ collaborative affiliates

Research

- Aerobiome Discovery Network
    - Converge previously unlinked expertise in atmospheric science, infectious diseases/pathogens of plants, animals, people, and ecology, epidemiology, and microbiome/genomic sciences at CSU to explore the fascinating field of aerobiology.
    - A series of seminars, panels and workshops to identify the most relevant questions about this underexplored phenomenon.
    - Goal to seek external funding in this field
- Engineering and Modeling Microbiomes
    - Dr. Joshua Chan developed an algorithm to predict the composition and metabolism of the gut microbiome using genome–scale metabolic models (GEMs) that capture the metabolic capabilities of representative microbes in the microbiome.
- Environmental Microbiome
    - The Hall lab is interested in how different cues affect the biomass composition of bacterial populations and communities. One way to evaluate biomass composition is to evaluate the ratios of elements (i.e., stoichiometry) that compose a microbe's biomass.
- Plant Microbiome
    - Using a multi–omics approach scaled across individual organisms and ecosystems, encompassing integrated metabolites, genomes, and proteomes, to elucidate microbial biodegradation enzymes for condensed tannins.
- Animal Microbiome
    - Interdisciplinary approach to investigate the differences between air vs water chilling of chickens with the goal of improving shelf–life and shelf–life prediction, meat quality, and energy usage.
- Human Microbiomes
    - Microbial clock to estimate time since death.
    - Uncovering novel pathways for methylated amine utilization in the gut.
    - Dietary interactions with human microbiomes across the lifespan.
    - Microbial metabolism of Rice Bran for colon cancer control and prevention.

Academics

- Several microbiome courses offered each semester

Events

- Microbiome network meet ups – seminar–style events

Duke Microbiome Center (DMC)
https://sites.duke.edu/microbiome/

Center Director: John Rawls, PhD

Mission
Cultivate and support microbiome science at Duke University. We do so by providing an intellectual and educational environment that fosters collaboration and discovery, and by creating and supporting necessary resources at Duke University for research in the microbiome sciences.

Events
- Bi–weekly Microbial Seminars
- Computational Biology and Bioinformatics Seminars
- Symposia

Education
- Graduate Training – DMC investigators are members of the following Duke Graduate training programs: Department of Molecular Genetics & Microbiology, University Program in Genetics and Genomics, Program in Cell and Molecular Biology, Program in Computational Biology and Bioinformatics, Program in Biomedical Engineering, and the Biology Graduate Program.
- Workshops – several workshops on unique topics offered 1–2 times a year
- Related Courses – several microbiome–related courses offered each semester from a variety of disciplines.

Research
- Over 50 faculty included as part of the Center in the following areas:
    - human gut/urinary/neuronal/epithelia microbiota and circuits
    - microbial communities and pathogens
    - host–microbiome interactions
    - immunology and cancer
    - Earth's ecosystems and microbial ecology
    - marine microbiology
    - genomics
    - cell biology – signaling, communication, organization
    - statistical and computational modeling
    - engineered bacteria

Resources
- DMC Bioinformatics Group – provides expertise and training in algorithmic, statistical, and mathematical techniques to solve problems of interest to biology, biotechnology, and biomedicine.
- Duke Core Microbiome Research Core Facilities:
    - Duke Microbiome Shared Resource – centralized resource hub to enhance the existing interactions with the Duke Microbiome Center, Duke Cancer Institute, and Genomic and Computational Biology shared resources to address the role of microbial systems in human healthcare, food production and environmental restoration.
    - Duke Gnotobiotic Core – offers germ–free mice as well as services and resources for germ–free and gnotobiotic experiments.

    - Duke Substrate Services & Biobanking – developed in 2014 to serve as a centralized processing core and storehouse for research samples for large clinical, consortium–based collaborations and for basic, discovery science.
    - Duke Sequencing & Genomic Technologies Core Resource – offers the full range of genomic technologies, making it much simpler for researchers to find the right service for their needs.
    - Duke Proteomics & Metabolomics Core Resource – services include protein identification and protein quantitation from a wide variety of sample types, from simple mixtures like gel spots and bands to complex mixtures like protein complexes, cell lysates, and plasma.
    - Duke Data Service – provides a secure, central data store that allows researchers to use their own hardware (e.g. laptops, workstations, and mobile device) to have local access to their data. DukeDS provides a web interface for designated research team members to administer fine–grained user access, upload and download files, manage project contents, and much more!
- Guidelines for Human Subjects Protection and Microbiome Research – for individuals considering collecting human samples, research with samples that have already been collected, or research with microbes cultured or isolated from human samples.

Funding

- Duke Microbiome Center Rolling Voucher Program – vouchers to provide its investigators access to these shared resources, particularly for microbiome projects that are not yet externally funded.
- Center Development Grants – The objective of the DMC Development Grant program is to support interdisciplinary and collaborative research projects in the microbiome sciences at Duke University

Johns Hopkins University – Microbiome Research
https://www.hopkinsmicrobiome.com/

Research Community Leaders: Cynthia Sears, MD, Steven Salzberg, PhD, Jennifer Pluznick, PhD

Microbiome Research Vision
The Center's primary short–term goal is to provide opportunities for interaction and collaboration among the microbiome research community at all of the Johns Hopkins University campuses. Their long–term goal is to foster basic and translational microbiome research to advance the prevention and treatment of human diseases.

Research – Community Leaders
- Sears' Lab – Primary interest is understanding 'if, how and which' bacteria or bacterial consortia contribute to the pathogenesis of colon cancer. Secondary interest is projects involving patients with pediatric and adult inflammatory bowel disease, Clostridium difficile and the impact of the microbiota on the accelerated atherosclerosis observed in individuals with HIV infection.
- Salzberg Lab – Computational biology lab that develops novel methods for analysis of DNA and RNA sequences. Research includes software for aligning and assembling RNA–seq data, whole–genome assembly, and microbiome analysis.
- Pluznick Lab – Focused on how interactions between gut microbial metabolites (SCFAs) and host receptors (Gpr41 and Olfr78) can influence blood pressure regulation.

The Microbiome Forum Seminar Series
- Weekly forum series with invited speakers

Facilities
Germ–free
- Mouse Core Facility – supply germ–free mice for an investigator to study microbiome impact in a variety of fields

Core Facilities
- Sequencing
    - JHMI Deep Sequencing and Microarray Core – Illumina HiSeq and MiSeq Next Generation Sequencing (NGS) and Third Generation Sequencing (PacBio Single Molecule Real–Time (SMRT)) sequencing platforms. Other available techniques include DNA and RNA extraction from tissue samples, library preparation.
    - Genetic Resources – Illumina HiSeq and MiSeq Next Generation Sequencing (NGS) and 'traditional' Sanger or pyrosequencing (Qiagen) sequencing platforms. Other available techniques include DNA and RNA extraction from biologic and FFPE samples. DNA library preparation, Exome, and custom capture sequencing are offered.
    - Next Generation Sequencing Center – Illumina HiSeq and MiSeq, SOLiD 5500 and Wilfire instruments and integrates computational analytical services. This Core provides microbial whole genome sequencing and RNASeq as available applications, among a number of custom and flexible microbiome and metagenomics applications.
- Metabolomics – Targeted metabolomics analysis of endogenous small molecules and development of custom targeted mass spectrometry–based metabolomics assays as well as identification of drug metabolites.

- Proteomics – mass spectrometry–based proteomics to identify, quantify or characterize proteins and their post–translational modifications in gel bands or spots, or in complex protein extracts from cells, tissues or body fluids.
- Computational Biology Consulting Core – The core offers comprehensive analysis of sequencing data for a variety of genomics and other sequencing based experiments. This includes 16S rRNA, RNA–seq and metagenomic sequence analysis among others.

Researchers in Network

- Applied Physics Lab
- School of Medicine
- Bayview Medicine
- Bloomberg School of Public Health
- John's Hopkin's University
- Core Facilities

Lawrence Berkeley National Lab – Microbes to Biomes (M2B)
https://www.lbl.gov/about/

M2B Lead Scientist: Eoin Brodie, PhD

Overview
Microbes to Biomes is a Lab–wide initiative designed to explore and reveal the interactions of microbes with one another and with their environment – interactions that are vital to the Earth's future.

Strategic investments by the Department of Energy Office of Science have produced transformative technologies, from genomics to multi–scale environmental and biological imaging and high performance computation, that have already increased our understanding of microbial potential.

To jumpstart the discovery process, Berkeley Lab's Microbes–to–Biomes initiative is targeting two key systems: the soil–plant biome and the gut microbiome.

Research

Soil–Plant Biome

- Food and Fuel Production – Gain fundamental knowledge of how microbes interact with their environment can lead to solutions to growing food and fuel needs. Initial research targets microbes with the ability to enhance nutrient supply to plants. Phosphorus (P) is a critical plant nutrient for which the US will increasingly be reliant on foreign reserves to meet the growing demand of fuel and food production.
- Carbon Management – Interactions between plants, soil minerals, microbes and other living creatures dictate the flux of C through soil. These interactions are modulated by external factors such as rainfall and temperature, as well as human factors like land–use change and fertilization. Some of the first steps in understanding the fate of C in soils involves knowledge of how microbes break down plant polymers into simple compounds for energy. This same information and microbial functional potential can also be harnessed to improve the breakdown of plants for the production of biofuels.
- Environmental Stewardship – Microbes in soils, sediments, surface water and groundwater are key to water quality, they can regulate the flux of nutrients from terrestrial systems that cause eutrophication, or when nutrient loadings are excessive, other toxin–producing microbes can bloom, resulting in significant health risks. Microbes can immobilize heavy metals and radionuclides preventing the spread of contamination from legacy activities, but in some circumstances microbes may actually stimulate the release of toxic metals such as Arsenic. These examples highlight the need to understand microbes in the context of their biomes, that is the heterogeneous physical, chemical and biological environment in which they reside.

Gut Microbiome

- Imbalances in the body's microbial communities – which compete for space and resources — have been directly associated with such diseases and disorders as obesity (metabolic), asthma (inflammatory) and autism (neurologic). Some have suggested that the significant rise in these illnesses and a corresponding decline in infectious diseases are being influenced by such key environmental interactions as toxicant exposure, diet and patterns of early life microbial

exposure. What is certain at this point is that microorganisms have the potential to regulate the development of the immune system and to mitigate or worsen the effects of toxicants or dietary components in ways that we have only begun to perceive.

Capabilities

- Genomics – DOE Joint Genome Institute – The JGI provides integrated high–throughput sequencing and computational analysis that enable systems–based scientific approaches to the challenges targeted in M2B. Challenges such as uncovering the metabolic potential of microbes important to carbon transformation and plant nutrient supply.
- Multi–scale Imaging – Leverages investments and expertise in imaging across a wide range of scales from nanometers to many meters in biological, chemical and physical sciences. These approaches are facilitated by world class user facilities such as the Advanced Light Source, the Molecular Foundry and the National Center for Electron Microscopy in addition to new developments in metabolic, radiochemical and geophysical imaging. M2B interacts closely with the Berkeley Lab BioImaging Initiative.
- High Performance Computing – The M2B initiative takes advantage of the National Energy Research Scientific Computing Center (NERSC). NERSC is the primary scientific computing facility for DOE's Office of Science and a world leader in accelerating scientific discovery through computation and data analysis. More than 5,000 scientists use NERSC to perform basic research across a wide range of disciplines, including climate modeling, high energy physics, new materials, simulations of the early universe and a host of other scientific endeavors. Within M2B, HPC activities include complex biogeochemical model simulations and analysis of multi–dimensional and complex biological systems data from 'omics and imaging workflows.

Medical College of Wisconsin – Center for Microbiome Research (CMR)
https://www.mcw.edu/departments/center–for–microbiome–research

Center Director: Nita H. Salzman, MD, PhD

Mission
The Center is dedicated to providing specialized resources for translational and basic research endeavors on the microbiome. Our goal is to promote education on the microbiome and its impact on human health.

A microbiome is defined as, "the totality of microorganisms and their collective genetic material present in or on the human body or in another environment." This ecological community consists of bacteria, viruses, fungi, yeasts, and protozoa. Each body site has a distinct microbiome, but the vast majority of the microbiota reside in the GI tract. The precise composition of a physiological microbiome is affected by host diet, age, genetics, exposure to drugs, and other environmental factors. Disrupted microbiomes have been correlated with a number of disease states including obesity, diabetes, asthma, eczema, heart disease, celiac disease, colitis, neuropsychiatric disorders, and some cancers.

Collaborative Research Areas
- Cardiovascular Disease
- Inflammatory Bowel Disease
- Adolescent Obesity
- Asthma Pathogenesis and Progression
- Development and Progression of Type 1 Diabetes
- Xenobiotic Disruption of Phage–Microbe Networks with Consequences on Host Metabolism
- Enterococcal Colonization Dynamics and Antibiotic Resistance
- Total Parenteral Nutrition and Liver Disease
- Microbial Exposure and Development of Chronic Pain in Sickle Cell Disease
- Pediatric Non–Alcoholic Fatty Liver Disease (NAFLD)

Services
- Consultation
    - experimental design and grant applications
- Training and Protocols
    - Microbial sample collection and processing
    - Bacterial nucleic acid extraction and QC
    - qPCR and RT–qPCR
- Fee–for–Service: Bench Services
    - Molecular processing of collected samples
    - Bacterial nucleic acid extraction
    - Nucleic acid concentration measurement
    - qPCR and RT–qPCR
    - Coordination of offsite 16S rDNA sequencing
    - Sample storage and inventory management
- Fee–for–Service: Gnotobiotics
    - Axenic and gnotobiotic mice
    - Axenic mouse colony

    - Defined microbiota mouse colony
    - Choice of semi–rigid isolators or individually ventilated iso–caging for gnotobiotic experiments
- Bioinformatics and biostatistics
    - 16S rDNA data preparation and OTU assignment, diversity analysis
    - Other analytics techniques
- Intramural pilot awards

Events

- Seminar series co–sponsored by the Department of Microbiology and Immunology

Pennsylvania State University – Microbiome Center
https://www.huck.psu.edu/institutes-and-centers/microbiome-center

Center Director: Carolee Bull, PhD

Overview
Houses within the Huck Institutes of Life Sciences, the goal of the Penn State Microbiome Center is to support transformative, interdisciplinary research in microbiomes by fostering long–term working relationships while simultaneously providing infrastructure and resources needed for increasing diversity and breadth of interdisciplinary microbiome research at Penn State. This will include structured and tacit educational opportunities unique to Penn State.

Research
- mBiome Fellows Program
    - Focus on manipulating microbiomes across the agricultural chain and through interdisciplinary projects, we aim to:
        - understand the mechanisms that constrain our ability to manipulate microbiome composition and function
        - add applied microbiome–based solutions to the agricultural management toolbox
- Phytobiomes – Research into understanding the role of phytobiomes in plant health, productivity and response to pathogens, pests and environmental stresses.
- Microbial Migrations – A geographic survey of inter–species bacterial ecologies in Central Pennsylvanian communities.

Education
- Graduate Programs – PhD and MS fellows can apply to the mBiome graduate research assistantships with Center faculty from a variety of participating graduate programs from a variety of disciplines (e.g. biochemistry, computer science, anthropology, mathematics, entomology, plant biology, etc.)
- Student Funding Opportunities – students can apply for assistantships in the following areas:
    - Human Gut Microbiome Causes and Consequences – understanding the complex relationship between the host and the microbiome.
    - Harnessing the Microbiome to Mitigate Drought Impact in Agriculture – investigate the effects of plant genotype on root microbiome assembly and function, with a specific focus on microbial functions enhancing plant tolerance to drought.
    - Soilborne Disease Metagenomics – research focus on fungal and oomycete soilborne pathogens that infect specialty crops such as potato or berries and identifying shifts in root microbial diversity and function.
    - Entomology – examine the effects of biotic and abiotic stress in mediating endophytic colonization by the fungal insect pathogen, M. robertsii in field, greenhouse, and laboratory-based studies
    - Roots of Success: Legumes and Nitrogen-Fixing Rhizobia – students will develop a research project on the evolutionary ecology of plant-microbe-climate interactions.
    - Soil Microbiomes – interdisciplinary approaches to probe the active fraction of soil microbiomes and understand their contribution to soils emergent properties.
- Recommended microbiome courses

Facilities

Facilities are part of the Huck Institutes and include:

- Automated calorimetry facility
- Cryo-electron microscopy facility
- CSL Behring fermentation facility
- Flow cytometry facility
- Genomics core facility
- High-field magnetic resonance imaging facility
- Proteomics and mass spec core facility
- Transgenic mouse facility
- X-ray crystallography facility

University of California Davis – Microbiome Special Research Program
https://microbiome.ucdavis.edu/

Center Director: Jonathan Eisen, PhD

Mission
The mission of the UC Davis Microbiome Special Research Program (SRP) is to promote, grow, and transform microbiome related research and training throughout the UC Davis community.

Overview
Program is virtual and does not have a physical location. Program target areas include:

- Interdisciplinary Innovation
- Training and Education
    - Several microbiome–related courses listed across several disciplines
    - Graduate student research funding
- Infrastructure and Resources
    - Bioinformatics Core, Genome Center
    - Biorepositories Core Resource, UC Davis Health
    - California Animal Health and Food Safety Laboratory System
    - California National Primate Research Center
    - Comprehensive Cancer Center – Shared Resources, UC Davis Health
    - Clinical and Translational Science Center, UC David Health
    - Foundation Plant Services
    - Host Microbe Systems Biology Core
    - Mouse Biology Program
    - Mouse Metabolic Phenotyping Center
    - Phaff Yeast Culture Collection
    - Proteomics Core, Genome Center
    - Real–time PCR Research and Diagnostics Core Facility, Veterinary Medicine
    - TILLING (Targeting Inducted Local Lesiion IN Genomes) Core, Genome Center
    - Veterinary Center for Clinical Trials, Veterinary Medicine
    - Yeast One Hybrid Services Core, Genome Center
- Community Building
    - Past Events Include – Seminars, symposia, workshops, conferences
    - Blog with scientific field updates, program updates

Research

- Over 50 faculty, from a variety of disciplines including microbiology, nutrition, medicine, plant pathology, plant biology, veterinary medicine, food science and technology, chemistry, animal science, law, genomics, soil microbial ecology, entomology, environmental toxicology, engineering, and others.

Funding

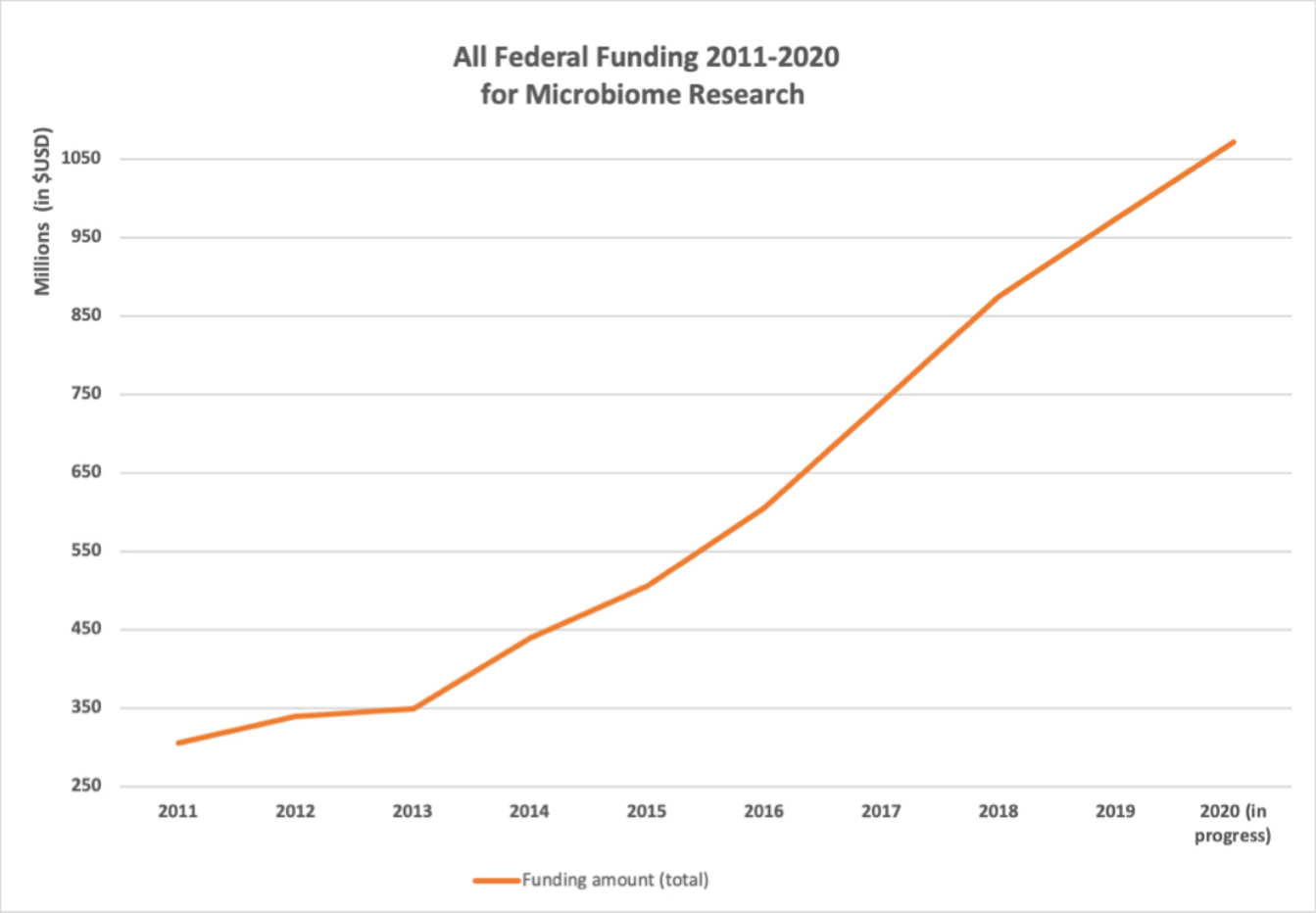
- Microbiome Seed Grant Program – aims to facilitate interdisciplinary and innovative research in microbiome science at UC Davis through creating and fostering collaboration and communication

between researchers interested in microbiome science. The seed grant is intended to create new research collaborations centered on microbiome–focused research at UC Davis.

- Graduate Research Awards – aims to support the next generation of microbiome scientists by providing graduate students with funds needed to carry out their innovative microbiome research projects. With the Microbiome Graduate Research Awards, students are able to offset some of the costs associated with their research such as sample collection, core services and even publication costs as long as it related directly with their microbiome research.

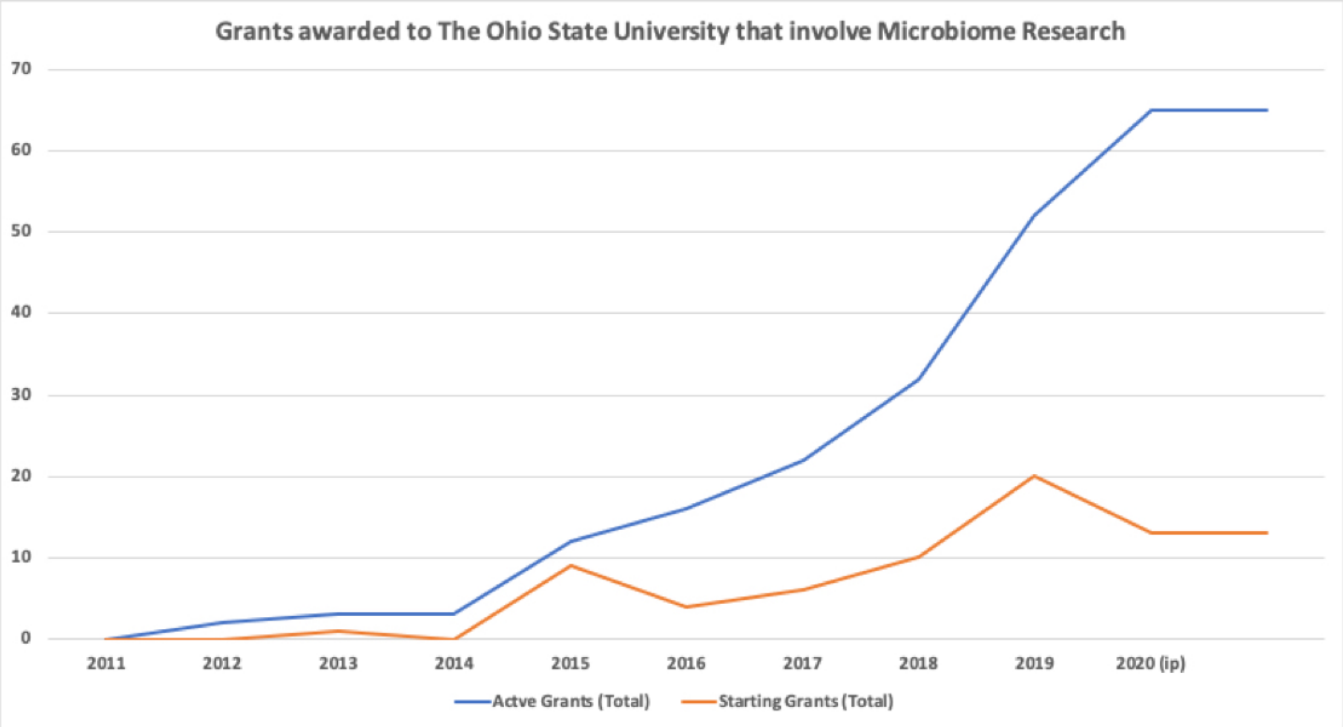
Appendix F - Supporting Data for Extramural Funding

For the long-term sustainability of the Ohio State University Center of Microbiome Science (CoMS), a landscape analysis was performed for federal and foundation extramural support aligned with microbiome research and training opportunities. The supplementary data below supports section IV.C of the University Center proposal (July 2020).



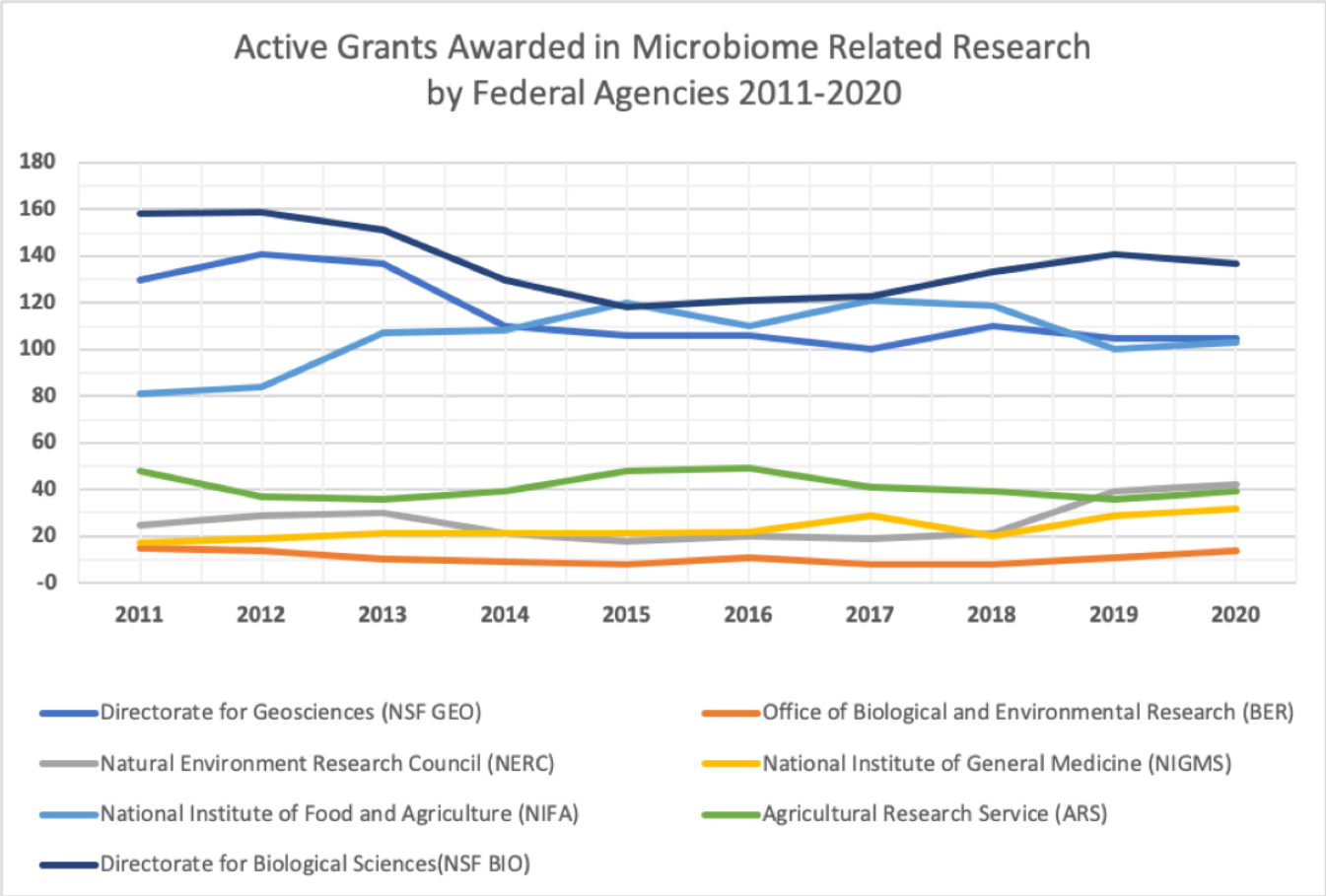
Source: https://app.dimensions.ai
Exported: July 1, 2020
Criteria: Text - 'microbiome' in full data.

Figure 1 - US federal funding related to microbiome research, 2011-2020



Source: https://app.dimensions.ai
Exported: July 1, 2020
Criteria: Text - 'microbial ecology OR microbiome OR virome OR metabolome' in full data; Active Year is 2019; Research Organization is The Ohio State University

Figure 2 - Microbiome grants awarded to Ohio State University, 2011-2020



Source: https://app.dimensions.ai
Exported: July 1, 2020
Criteria: Text - 'microbial ecology' in full data.

Figure 3 - Active grants awarded in microbiome related research by select federal agencies 2011-2020

Table 1 - Foundations actively supporting microbiome research

Foundation	Focus	Link to Opportunity
Merck	Investigator Initiated Programs (Focus areas: Infectious Disease, COVID-19, Vaccines)	http://engagezone.msd.com/misp.php
Juvenile Diabetes Research Foundation	Role of microbiome in Type 1 Diabetes	https://grantcenter.jdrf.org/rfa/the-role-of-the-microbiome-in-type-1-diabetes-pathogenesis-and-therapeutic-utility/
Global Probiotics Council	Gastromicrobiota research, annual opportunity)	https://probioticsresearch.com/grant-program/
Cystic Fibrosis Foundation	Infection Research Initiative (Mycobacteria, bacterial, fungal, viral infections)	https://www.cff.org/Research/Researcher-Resources/Awards-and-Grants/Funding-Opportunities/
Burroughs Wellcome Fund	Interface of human and microbial biology	https://www.bwfund.org/grant-programs/infectious-diseases/investigators-in-pathogenesis-of-infectious-disease
Global Grants for Gut Health	Research into the human gut microbiota	https://www.guthealth-grants.com/
American Gastroenterological Assoc Grants	Gut health, gastrointestinal microbiome, autoimmune disorders	https://gastro.org/research-and-awards/apply-for-awards/
Crohn's & Colitis Foundation	gut health as it relates to disease incidence	https://www.crohnscolitisfoundation.org/research/grants-fellowships

Appendix G – Microbiome Science Training Track

- **M5155 Environmental Microbiology** (Autumn, 3 credits)
  - This course covers a wide range of microbiology topics ranging from the microbiology of landfills, drinking water, waste water, and pesticides, in addition to tools, monitoring techniques, bioremediation, and applications to bioenergy.
  - Graduates with little exposure to microbial communities will benefit from this lecture-based conceptual overview.
- **M5161 Bioinformatics and Molecular Microbiology** (Spring, 3 credits)
  - In this course, you will learn how the genome sequencing technology has revolutionized biology and provided a foundation for new developments in science and medicine. You will become familiar with computational tools that are necessary to analyze genomic data and you will find out what biological questions can be answered by genomic approaches. We will use prokaryotes as the main material for genomic studies, but the core principles that you will learn are also applicable to eukaryotes including humans.
  - This course provides generalizable and foundational informatics tools for gene- and genome-based bioinformatics for undergraduate and graduate students. It is a pre-requisite for the hands-on Microbiome Informatics course.
- **M6155 Topics in Microbiome Science** (Spring, 3 credits)
  - This graduate-level reading course prepares students for intensively reading the primary literature, with a focus on understanding 'microbiomes' or microbial communities in the oceans, soils and humans. We will explore essential methods and concepts, and ongoing ‘unknowns’ in the field, while also establishing basic experimental design principles and helping set the stage for understanding the kinds of questions and methods that are unique to Microbiome Science and studying microbes in complex communities.
  - This course provides valuable and generalizable graduate-level training in studying microbiomes. It is a pre-requisite for the hands-on Microbiome Informatics courses.
- **M8161 Microbiome Informatics** (Autumn, 3 credits)
  - This hands-on course provides the foundational skillsets needed to study microbiomes and microbes in complex communities. This course teaches trainees how to interpret and analyze community genomic datasets with an aim to develop skills in processing and organizing datasets, extracting the function, structure, and evolutionary history of genes in these datasets, and discerning community structure and ecological drivers in metagenomic data. It also introduces modern taxonomic approaches and other 'omics data types including viral metagenomes, metatranscriptomes, metaproteomes, metabolomes, and more. As large-scale datasets are increasingly available, graduates of this course will be ideally positioned to utilize such datasets to maximize diverse research endeavors where the 'microbiome' might play a key role, and in a way that is currently unique in the world due to the updated microbial content and inclusion of viruses.

Other Courses

- **ANIMSCI 5090 Gut Microbiology** (Spring, 2 credits)
    - A study of the major microorganisms of the gastrointestinal tract of animals and humans, their microbial metabolism and functions, interactions with each other and with hosts, and impact on host nutrition and health. Prereq: Micrbio 4000.01 or 4000.02 or 4100, and Biochem 4511, and GPA 2.0 or above in Biochem and Micrbio coursework; or permission of instructor. Class Notes: Connects to Wooster students via Zoom.
- **BMI 8050.01 Applications of Machine Learning and Artificial Intelligence in Biomedical Informatics** (Spring, 3 credits)
    - Artificial Intelligence (AI) and Machine Learning (ML) provides an unprecedented opportunity to accelerate and revolutionize human health and the pace of clinical and translational science. The purpose of this course is to train the next generation of the translational medical workforce by teaching them the primary ML and AI algorithms used in bioinformatics and computational biology. We will cover the theoretical underpinnings of the methodology along with an explanation of how to use practical implementations (in R or python) of how to apply the methods to real bioinformatics data sets. An important goal of the course is to introduce students to more advanced algorithms that are not covered in other classes in BMI. Examples include modern regression techniques (including ridge regression, lasso, and elastic nets), deep learning (CNN, RNN, GNN using TensorFlow), non-linear dimension reduction (including t-SNE and ISOMAP), directed and undirected graphical models, and association rules. It is noteworthy that the class will have a special emphasis on the fundamentals and applications of deep learning and provide a conceptual understanding of deep learning with a holistic view and latest developments in the field. By the end of the course, students will have had practice applying all of these methods to actual data sets.
    -
- **ENVENG 5120 Bioremediation** (3 credits)
    - An overview of biotechnology methods for remediation of groundwater and soils. Overview of theory and bio-remediation component design. Includes a study of the role of key microbial groups capable of transforming common contaminants in subsurface media with a particular emphasis on molecular genetic biotechnology methods to identify and document their ecology and metabolic condition. Prereq: A course in Micrbio; or Grad standing; or permission of instructor. Not open to students with credit for CivilEn 818.
- **BSGP 7030 Introduction to Data Science in Biomedical Science Research** (Summer, 2 credits)
    - We will meet every Tuesday and Thursday at 9:00-11:00 AM. It is expected that each student will work 3 h per week outside of class in order to pass. Each student enrolled in BSGP 7030 will participate in small group assignments focused on developing the necessary skills to apply data science to biomedical and biological research problems. To demonstrate these skills students will perform and independent project during the last 4 weeks of the class where they will build and test an end-to-end analysis pipeline. Students are encouraged to build a pipeline related to their own research or

they can opt to build an RNASeq analysis pipeline. Students are allowed to work in groups, share ideas and collaborate freely on ways to solve problems but the final graded project must demonstrate the students individual work.

- **M5270 / PHR 5270 Antibiotics and Microbial Natural Products** (Spring, 3 credits)
    - Microorganisms represent the largest trove of genetic and metabolic diversity in the world. They are responsible for producing a vast array of chemically diverse natural product small molecules. The unique biological and chemical properties of many of these compounds have afforded many valuable applications throughout medicine, agriculture, and biotechnology. Most critically, microbial natural products represent the largest source of antibiotics in use today. Here, we cover the biology behind the chemistry of these molecules and their role in human medicine.
- **PHR 8194 Introduction to the Structure, Analyses and Interpretation of Genomic Data Studies** (Spring, 2 credits)
    - There is a need to train biomedical researchers to undertake cutting-edge cellular experiments that apply genomic-based approaches coupled with computational and statistical analsyes to reveal novel biological understanding. Meeting this training need has several hurdles. Biomedical training frequently focuses on the historical competencies of molecular biology and biochemistry, whereas genomic analyses requires bioinformatic approaches that are often outside of training programs. Bioinformatic approaches leverages biological understanding, statistical insight and computational skills. PHR 8194 was designed to develop bioinformatic skills and abilities in graduate students who have either little or no previous experience in computational science and statistics
- **PLNTPTH 8300 Current Topics in Plant Pathology: Plant-associated microbiomes and their applications** (Spring, 2 credits)
    - This course will provide an introduction to the study of associations between plants and microbial communities, from the perspective of beneficial interactions. The course will highlight aspects from both the microbial and plant host perspective, including diversity of plant-associated microbes, examples of beneficial plant microbe interactions, introduction to methods for microbiome research and plant components leading to microbiome establishment and function. These plant-microbial associations will be presented from a perspective of applications in agriculture.
- **PUBHEHS 7375** Quantitative Microbial Risk Analysis Modeling (Spring, 3 credits)
    - This course will outline the fundamental sciences and their application in microbial risk modeling. Students will engage in lectures and project-based learning culminating in a functioning microbial risk model.Prereq: Grad level Stat course, or permission of instructor.

Statistics Courses

- **MOLGEN 5650 Analysis and Interpretation of Biological Data** (3 credits)
    - Methods of analyzing biological data including: sampling, descriptive statistics, distributions, analysis of variance, inference, regression, and correlation. Emphasizes practical applications of statistics in the biological sciences. Prereq: Math 1149 or 1150 (150) or equiv, and 10 semester cr hrs at the 3000-level (or 300 level in the

quarter system) or above in Agricultural or Biological Sciences. Not open to students with credit for 650.

- **PUBHBIO 6210 Design and Analysis of Studies in Health Sciences I** (3 credits, available in person and online)
    - Theory and application of basic statistical concepts for design of studies in health sciences, integrated with statistical software applications. Prereq: Grad standing in PubHlth, or enrollment in MS Pharmacology program, or permission of instructor. Not open to students with credit for 701.
- **PUBHBIO 6211 Design and Analysis of Studies in Health Sciences II** (3 credits)
    - A second course in applied biostatistical methods with an emphasis on regression methods commonly used in the health sciences. The focus is on linear regression and ANOVA. Integrated with use of computer statistical packages. Prereq: A grade of B- or above in 6210 (701), or permission of instructor. Not open to students with credit for 702.
- **STAT 8810 Advanced Topics in Statistics I: Statistical inference in Network Data** (Spring, 1 credit)
    - The course is intended to introduce the field of statistical inference in network data. The course will have a good mix of theory, methods and applications. The primary audience of the course is PhD students and senior Masters students in Statistics and Biostatistics, there will be elements which are of interest to students from other departments interested in research on network analysis.

Appendix H – Communities of Practice/Working Groups Chair Guidelines

Purpose

- The goal of establishing Center of Microbiome Science Working Groups is to build trainee-led communities around cutting-edge microbiome analytical methods. Leading a working group is an opportunity that includes elements of planning, teaching, mentoring, and reporting. A larger goal of these working groups is to build toward developing short workshops (e.g., 2-3 days) around a specific topic or set of skills.

Details

- Three working groups will be supported at a time, including a:
  - Microbiome / Metagenome Working Group (assembly, MAGs, etc.)
  - Advanced Ecological Statistics Working Group (microbial community analysis)
  - Virome Working Group
- Trainees are welcome to "co-chair" a working group.
- Chairs are expected to facilitate each working group meeting, and should, at minimum, prepare a 30 minute lecture at least once a month on a relevant topic of their choice. Besides the once-a-month lecture, meetings may vary between lectures, demos, hands-on lessons, or Q&A sessions around specific topics. Topic selection will be made by chairs and can incorporate input or lessons from attendees.
- Chairs should plan to spend an average of 3 hours per week on working group duties.
- Chairs can contact Matt Sullivan (Sullivan.948@osu.edu) on a monthly basis to check in for advice on topics, demos, teaching, etc.

Eligibility

- Working group chairs should be students or postdoctoral researchers at The Ohio State University or Nationwide Children's Hospital, and should have at least one year of training remaining at the time of application.
- Working group chairs should be members of the Center of Microbiome Science. (Join **here**.)

Requirements

- Working groups must meet at least once a month. Meetings can be in person or online. (Currently, due to the COVID-19 pandemic, all meetings should be online.)
- Report outs: Prepare a tweet (280 characters max) once per month highlighting the current activities of the working group. Include a photo, if available. Email to **microbiome@osu.edu** with the subject line "Working Group Tweet."
- Once a quarter (every three months), prepare a brief (~one paragraph) summary of working groups activities and email to **microbiome@osu.edu** with the subject line "Working Group Report." The report may include responses to the following questions:
  - How often and in what format did the group meet?
  - Topic(s) addressed by the working group in the previous three months
  - Strengths and weaknesses of the working group
  - Provide specific examples of how the working group has changed, created, or improved an analysis, experimental design, or collaboration? (Feel free to survey group members.)
  - What – if anything – you would change in the future for the working group?
  - What – if anything – does the working group need to be more successful?
  - Can you envision creating a two-three day workshop out of some of the topics you've covered in your working group, and if so, what would be the topic of the workshop, and what do you need to make it happen?