

ADVANCED INSTRUMENTATION FOR MICROBIOME STUDIES (AIMS) CORE FACILITY AND EQUIPMENT

Facility: The AIMS core was established and currently maintained through support from the NIH-COBRE funded Center for Transformative Research in Metabolism (Center-TRIM) and the Department of Biological Sciences at the University of Alaska Anchorage (UAA). The AIMS facility measures 248 sq. ft. and located at UAA. This core provides advanced instrumentation and expertise to characterize microbial isolates and communities. AIMS provides key equipment for microbial culturing (incubators, Eppendorf Das-box bioreactor-16), physiological characterization (Biolog), and genomic sequencing (Oxford NanoPore, Illumina MiSeq). AIMS is the only Core providing microbiome services in the Network of IDeA-Funded Core Laboratories (NiCL) that includes organismal analysis to characterize new isolates. AIMS provides a complete pipeline for characterization of microbial communities and isolates, combining multiple modules such as sequencing and bioinformatics, that researchers can plug into at any point along the pipeline or access the full pipeline to characterize either isolates or microbial communities. These core services, the first of its kind in the U.S. based on our knowledge, allows for the generation of directed hypotheses that can be tested with clinical experts, that will advance microbiome research and the characterization of microbial communities and isolates. Through a contract with the State of Alaska, the AIMS Core has conducted work related to COVID-19 including production of the viral transport media used for COVID-19 testing in addition to testing untreated community wastewater to detect evidence of COVID-19. The AIMS Core is working to establish a recharge center that will produce a sustainable core.

The AIMS Core service modules include:

Organismal Analysis, a key service provided by the Core, focuses on analysis of the gut microbiome. AIMS is developing and will maintain an Arctic Ground Squirrel Bacterial Culture Collection that is used to perform a complete phenotypic and genomic characterization, including growth kinetics across temperature and pH conditions as well as nutritional and energy requirements. The Core already maintains 216 isolates. Equipment used by the Core includes 5 incubators with a temperature range of 4-75°C (Figure 2), two shaking incubators with a temperature range of 4-65°C, and other essential equipment to grow and analyze aerobic microbes. The Core also provides equipment and expertise needed to grow microbes requiring anaerobic conditions including a Bactron anaerobic chamber with internal incubator (Figure 3) and a Eppendorf Bioreactor (Figure 4).

Molecular Analysis is needed to understand microbial life especially when pure cultures are not available. The AIMS Core provides specialized library prep and sequencing services specific for the microbiome including genome, transcriptome, metagenomic, metatranscriptomic, and

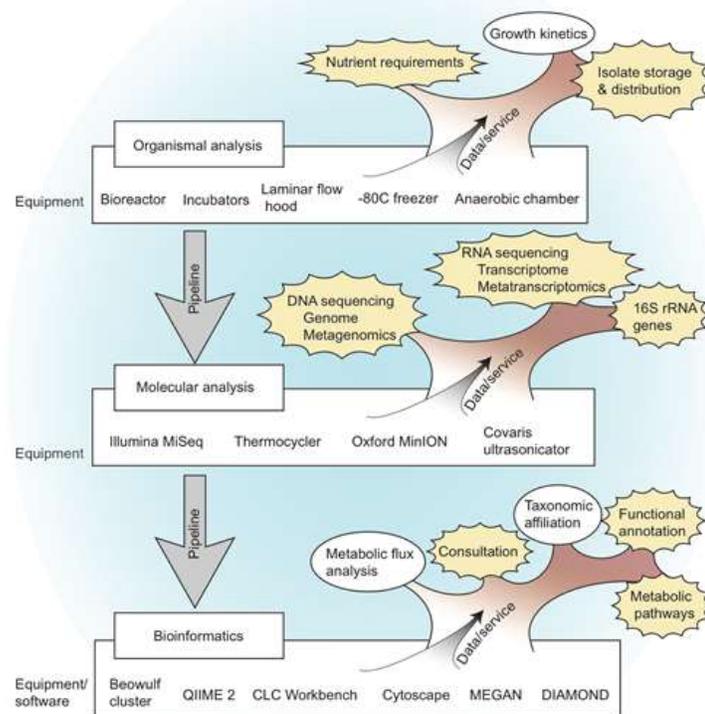


Figure 1. A depiction of the microbiome pipeline with the service modules that are available. Depending on user needs, services can include the full pipeline or start at any of the modules.

amplicon sequencing of the 16S, 18S, and ITS (fungal and plant) rRNA gene sequencing. The equipment required for library prep such as thermocyclers, heat blocks, and a Covaris Ultrasonicator (Figure 5) is available. Sequencing is done using an Oxford Nanopore MiniON and/or an Illumina MiSeq. The MiniON is a portable device that sequences DNA bases on electrical changes caused by nucleotides that pass through a pore. The AIMS Core maintains an Illumina MiSeq that can produce up to 200 million DNA sequences at a length of 600bp (300bp paired end) that are high quality (Figure 6). This level of sequencing is sufficient for sequencing of microbial genomes and transcriptomes of isolates, and metagenomics and metatranscriptomics of microbial communities. All DNA preparation activities occur in the Molecular Clean Room (Figure 7).

Bioinformatics - The AIMS Core collaborates with the INBRE Bioinformatics Core to provide microbiome specific expertise. This collaboration has been successful in providing high-end computing power. The INBRE Bioinformatics Core supports the Beowulf Cluster, which is a 64-core parallel-compute cluster supporting up to 128 parallel execution threads (Figure 8). The Beowulf cluster has 512Gb of RAM and sixteen 1 Tb SATA drives. The AIMS Core also supports the Pogo Linux Workstation with 164 cores (Figure 9). A laboratory manager is on hand to provide training on equipment and to support bioinformatic analysis.

AIMS Core Equipment for Organismal Analysis



Figure 2: Incubators are used to maintain the optimal growth temperature. The AIMS Core has five incubators with a temperature range of 4-75°C and two shaking incubators with a temperature range of 4-65°C.



Figure 3: The Bactron anaerobic chamber allows for culturing microbes in oxygen depleted environments similar to the conditions the microbes would be exposed to in the gut. The chamber also contains an incubator to maintain optimal growth temperatures (between room temperature to 55°C) while under anoxic conditions.



Figure 4: Eppendorf Daxbox Bioreactor-16

AIMS Core Equipment for Molecular Analysis



Figure 5:
Covaris ultrasonicator



Figure 6: The Illumina MiSeq is next generation sequencing that will produce up to 200 million DNA sequences and can be used to sequence the genome of novel microbial isolates, 16S rRNA genes, or metagenomics/transcriptomics of low diversity communities.



Figure 7:
Molecular Clean Room

AIMS Core Equipment for Bioinformatics

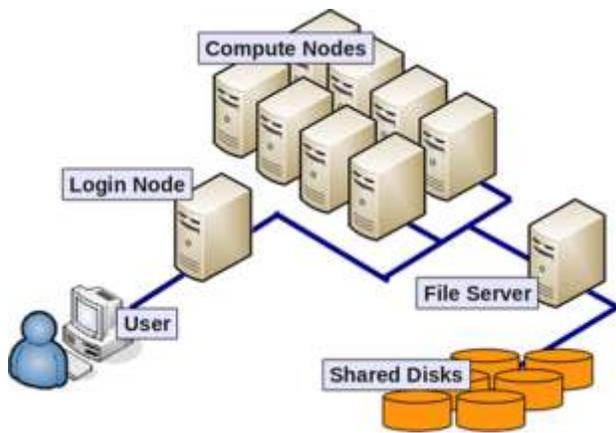


Figure 8: Beowulf cluster, 64 cores



Figure 9: Pogo Linux Workstation, 164 cores



Microbiology suite with laminar flow, UV hoods, and gassing station

Other Key Equipment maintained by AIMS:

- CO₂ incubator
- -80°C Freezer
- Oxford NanoPore MinION
- Three ABI thermocyclers
- MP Biomedicals FastPrep

The infrastructure and expertise provided by the AIMS Core supports the microbiome research being conducted at the University of Alaska as well as attract newly hired junior investigators skilled in microbiology to carry out research aligned with the Center for TRiM and the role of the microbiome in metabolic health.

Center for Transformative Research in Metabolism (“Center-TRiM,” “TRiM,” or “the Center”)

The UA Center for Transformative Research in Metabolism was established in 2020 with a mission to bring together existing research activities related to hibernation, metabolism, and metabolic health through multidisciplinary research teams with the long-term goal of discovering basic mechanisms to reversibly manipulate metabolic, homeostatic, or related processes and to develop therapies and diagnostics to treat metabolic disease such as sarcopenia, diabetes, obesity, and cardiovascular disease to promote healthy aging across the life span.

The Center is housed within the Institute of Arctic Biology with access to administrative services within the Institute as well as other centralized pre- and post-award services within the research infrastructure at the University of Alaska Fairbanks. The Center supports research within its mission by bringing together researchers within and outside of the University of Alaska for journal club and seminar presentations, collaborative projects, student mentoring, investigator mentoring, sharing of resources, and sharing of technical expertise. The Center supports one Administrative Core devoted to supporting research activities for Center faculty and two technical cores, the Health and Metabolism (HaMR) Core and the Advanced Instrumentation in Microbiome Studies (AIMS) Core. The Center offers funding for technique development, developmental projects and pilot projects building on the Center’s theme and resources.

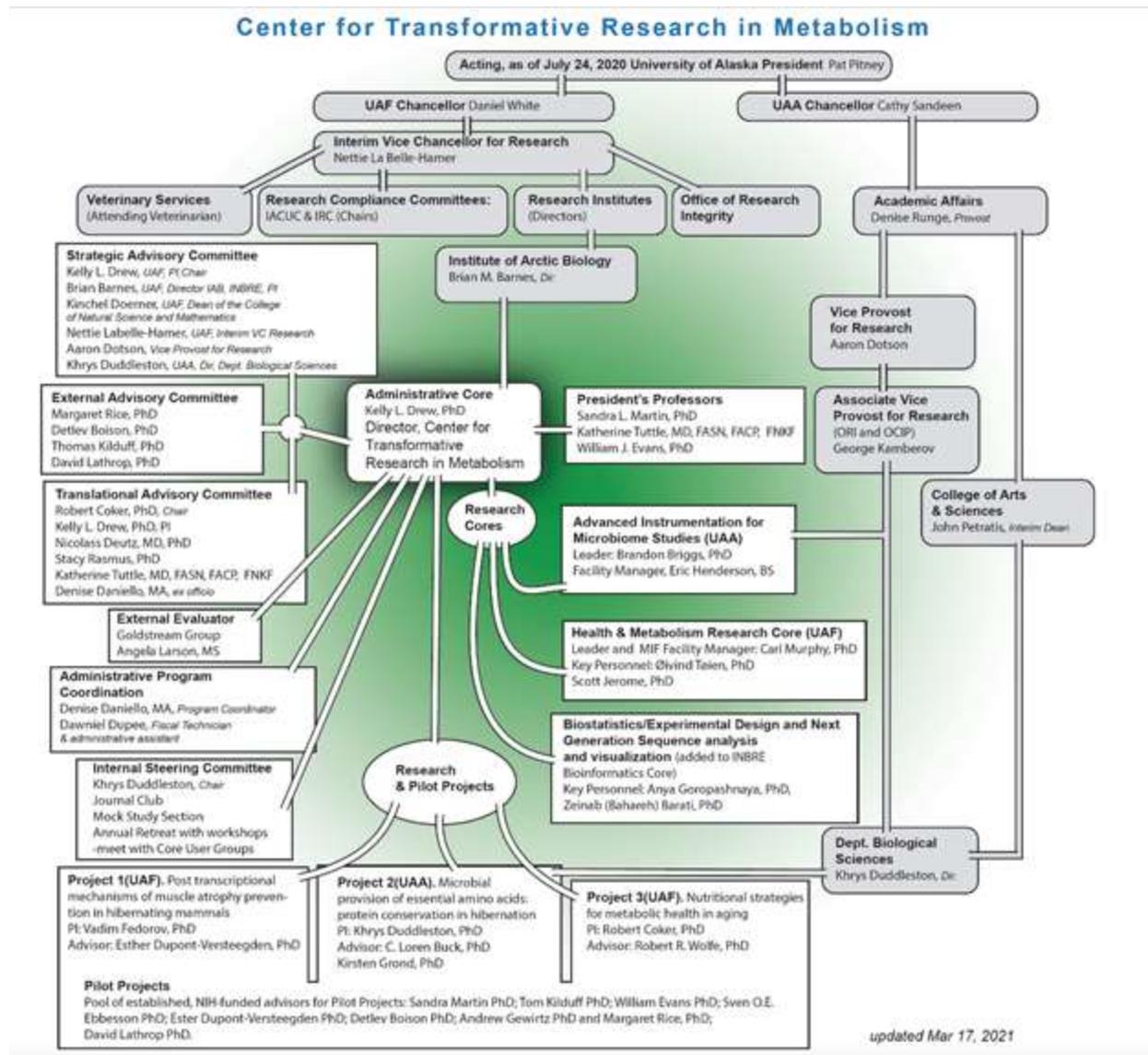


Figure 1: Organizational Structure for the Center for TRiM

Figure 1 shows the broad functional organizational structure of the Center for TRiM. The AIMS Core provides equipment, supplies, and technical support for a high throughput pipeline that characterizes microbial communities and isolates. This is the first service of its kind in the U.S. to offer a complete pipeline for characterization of microbial communities and isolates that will expand microbiological expertise in Alaska.

For more information about the Center for TRiM or the AIMS Core or to request a copy of this document in Word or google doc format, please contact:

- Dr. Kelly Drew, Director, Director, Center for TRiM, kdrew@alaska.edu
- Denise Daniello, MA, Program Coordinator, ddaniello@alaska.edu
- Dr. Brandon Briggs, AIMS Core Leader, bbriggs6@alaska.edu