100 Years of Collecting Biological Materials: The Diversity of the ATCC® Collection

Victoria Knight-Connoni, PhD

Head of Content and Product Development
BioNexus Foundation Principal Scientist

Agenda

1. Introduction
2. The ATCC collection and in vitro derivatives
3. Challenges and opportunities
4. Our services
5. Summary

Introduction

About Us

ATCC® is a global leader in providing authenticated, high-quality biological resources and standards for industry, academia, and government.

- Founded in 1925, ATCC® is a private, nonprofit, global biological resource center and standards organization that provides scientists with the biomaterials and resources they need to conduct critical life science research.
- World's trusted, premier biological materials resource and standards development organization:
  - 4,000 cell lines
  - 70,000 microorganisms
  - Genomic & synthetic nucleic acids
  - Media/reagents
  - Reference genomes
  - Advanced cell models

Our History

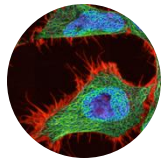
A Century of Scientific Innovation

1925 — ATCC was founded when a committee of scientists recognized the need for a central collection of microorganisms that scientists worldwide can use to conduct their research to advance the science of microbiology.

1927 — The first ATCC catalog was published. During its first 12 years, ATCC grew to house more than 2,000 strains despite the Great Depression.

1938 — Freezing and freeze-drying microorganisms were game-changing techniques for researchers.

1959 — National Cancer Institute proposes a standardized collection of cell lines. ATCC is designated the storage and distribution center, and its collection of cell lines and hybridomas becomes the most extensive in the world.



1981 — ATCC began accepting patent materials from countries that have signed the Budapest Treaty, although ATCC had been accepting patent culture deposits since 1949.

1993 — Dr. Raymond Cypess was named CEO and Chairman. He initiated a strategic transformation of ATCC into the global biological resource center.

1997 — Management of the CDC's reagent facility was awarded to ATCC, making it the company's first repository management contract.

1998 — ATCC occupied several sites through the decades, each providing more space, before building and moving to its current 27-acre headquarters in Manassas, Virginia.

2000 — ATCC was awarded a grant establishing the National Stem Cell Resource to standardize methodology of global stem cell research.

2003 — BEI Resources - established by the National Institute of Allergy and Infectious Diseases (NIAID) and managed by ATCC.

2009 — CDC IRR contract resulted in ability to provide flu kits globally.

IRR™ International Reagent Resource

2010 — ATCC launches major R&D and product development efforts to meet the growing needs of the life science community.

2017 — ATCC expanded its biomaterials storage capability by opening its new biorepository in Gaithersburg, Maryland.

2019 — ATCC supported the global COVID-19 response and responded to the need for credible reference materials.

2022 — ATCC was recognized as a National Resource for global health initiatives in the Congressional Record.

2024 — ATCC received grant from NIH to build new biomanufacturing suite at its Manassas HQ.

2025 — ATCC celebrated its centennial anniversary and appointed Dr. Ruth Cheng as President and CEO.

Our Facilities

Manassas, VA

Headquarters, Repository, and Bioproduction Facility

Gaithersburg, MD

Product Development, Repository, and cGMP Biorepository Facility

Germantown, MD

Product Development and Pilot Plant to support manufacturing modernization initiatives

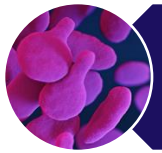
Frederick, MD

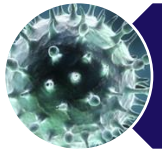
The NCI Central Repository is a government-owned site which is managed and operated by ATCC Federal Solutions

Standards and Controls

Committed to providing trustworthy reference materials and standards to support reproducibility in the life sciences


Pharmaceutical Testing


Mycoplasma Testing


Water Testing


Food Testing


Standards Development

In 2007, ATCC® became the first biological resource organization to become accredited by **American National Standards Institute (ANSI)** as a Standards Development Organization (SDO).

ATCC published the following voluntary consensus standards:

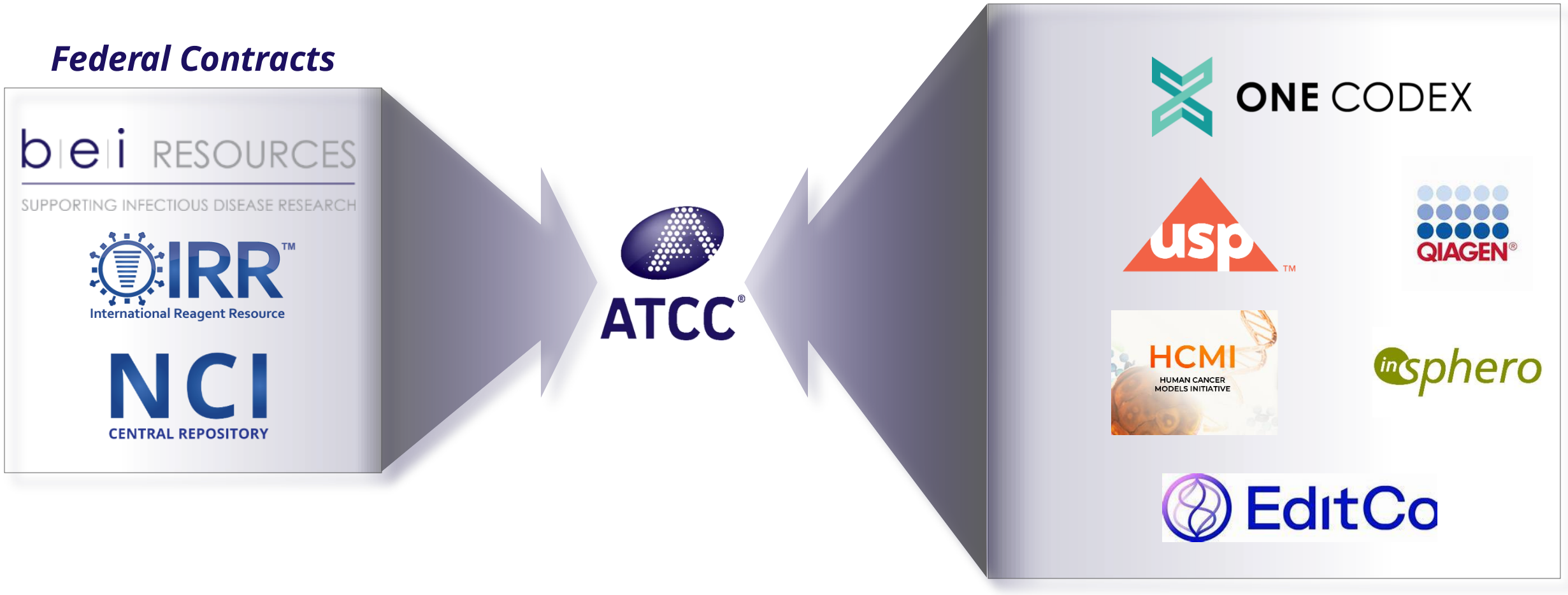
- Standardization of In Vitro Assays to Determine Anthrax Toxin Activities (ASN-0001)
- Authentication of Human Cell Lines: Standardization of Short Tandem Repeat (STR) Profiling (ASN-0002)
- Species-Level Identification of Animal Cells through Mitochondrial Cytochrome C Oxidase Subunit 1 (CO1) DNA Barcodes (ASN-0003)

Leveraging Partnerships

Working together to develop biological products and innovative solutions

Federal Contracts

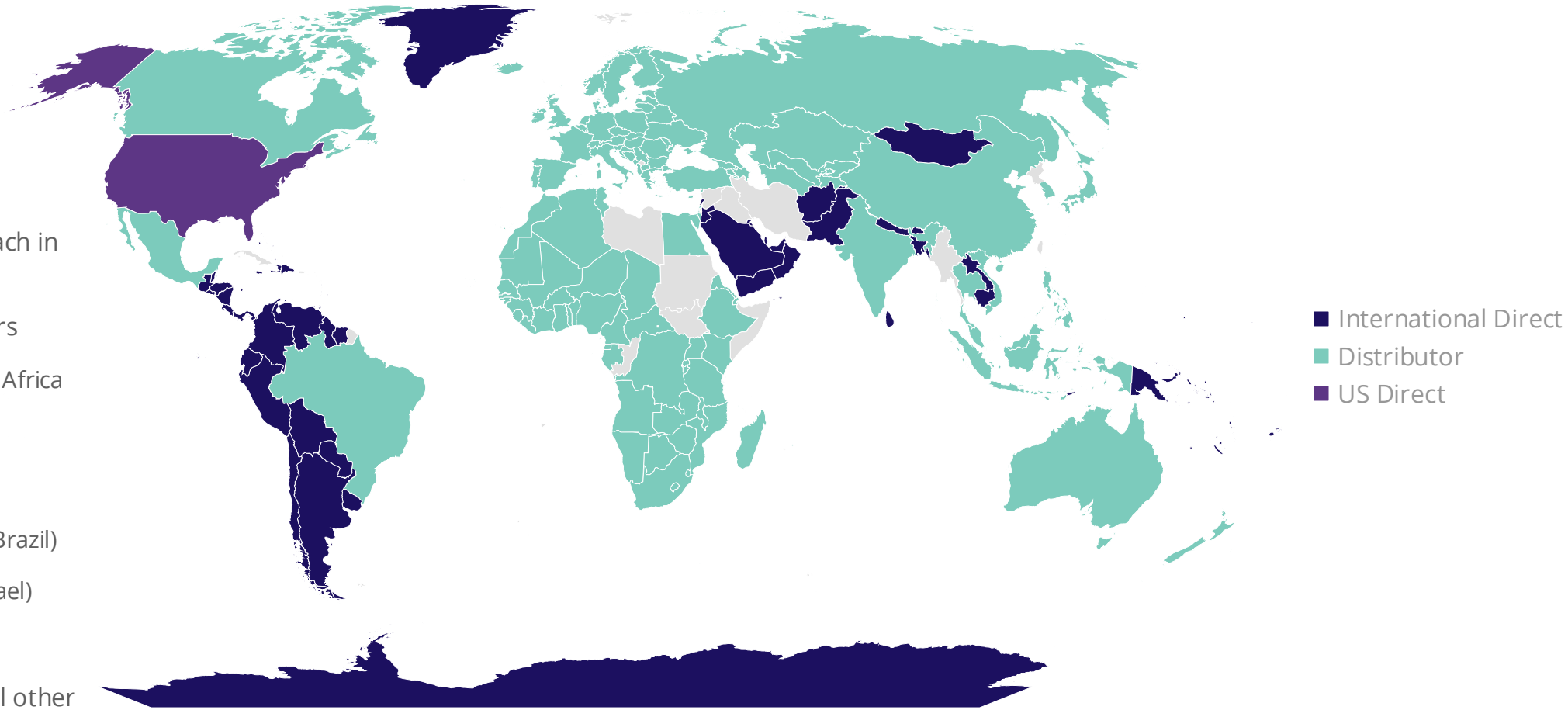
Collaborations



Distributors

Long-standing network of international collaborators, suppliers, & distributors expands worldwide

- Worldwide cold chain reach in >150 countries
- Network of 20 distributors
  - 1 covering UK, EU & Africa
  - 1 in North America (Canada)
  - 2 in Central / South America (Mexico & Brazil)
  - 1 in Middle East (Israel)
  - 15 in APAC
- Direct export model to all other countries



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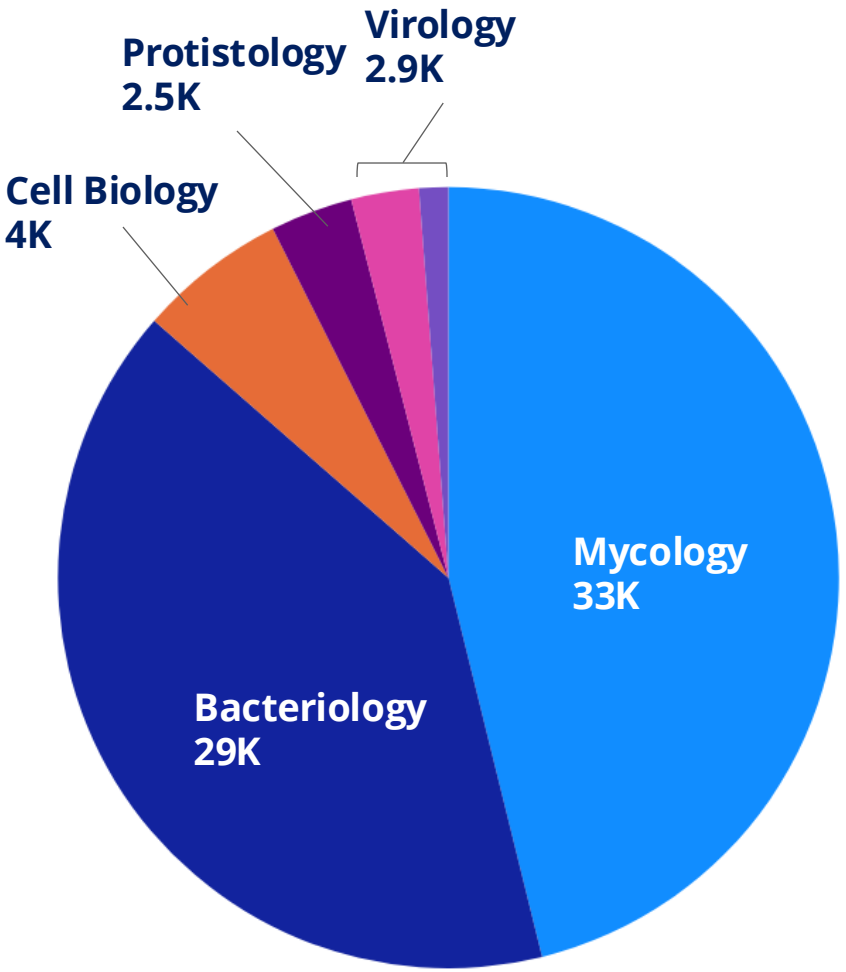
List as of January 2025.

The ATCC Collection

ATCC's Collection Continues to Grow



The most comprehensive, fully authenticated collection:

- 70,000+ bacteria, fungi, viruses, and protozoa
- Over 8,700 microbial type strains
- Over 4000 human and animal cell lines
- Over 1,000 derivatives, such as nucleic acid preparations

Brand recognition:

- Organizations and regulatory agencies specify ATCC cultures - USP, ISO, FDA, CLSI, USDA, ASTM, AOAC, etc.
- Over 475 reference strains recommended for use in quality control

Explore our microbial products

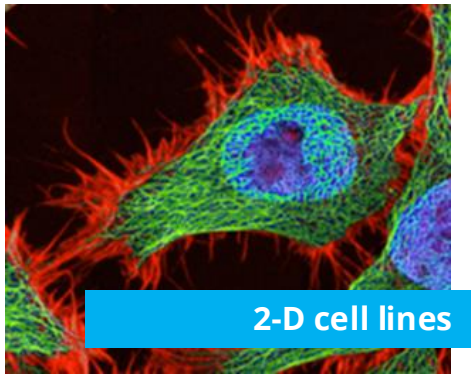
Explore our cell biology products

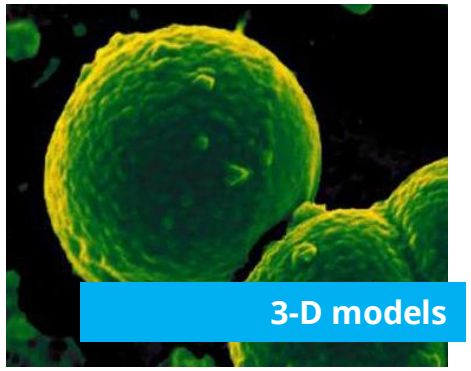
The Value of a Diverse Collection

Classic example: Camembert and Brie cheese fungi

- The French National Center for Scientific Research (CNRS) recently reported that Camembert and Brie cheeses face the threat of extinction due to a decline in microbial diversity
- Among ATCC®'s vast collection are several isolates of *Penicillium camemberti* that were isolated from various cheeses between 1904 and 1984

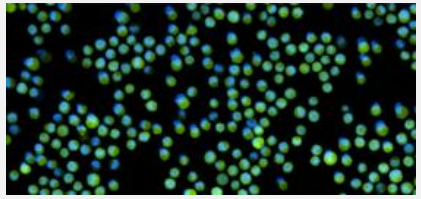
Innovative Products in Cell Biology

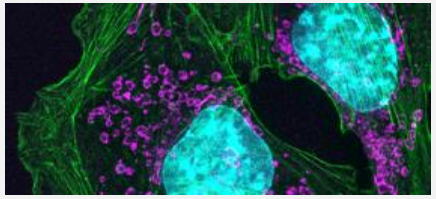




Authenticated and quality controlled

- Over 4,000 cell biology products representing over 150 different species
- Primary cells and immortalized cell lines in 2-D and 3-D formats
- Patient derived cancer models that include clinical and sequencing data
- Cancer cells with molecular profiles
- DNA available from many cell lines
- Supporting culture media and reagents


Human Cell STR Profiling

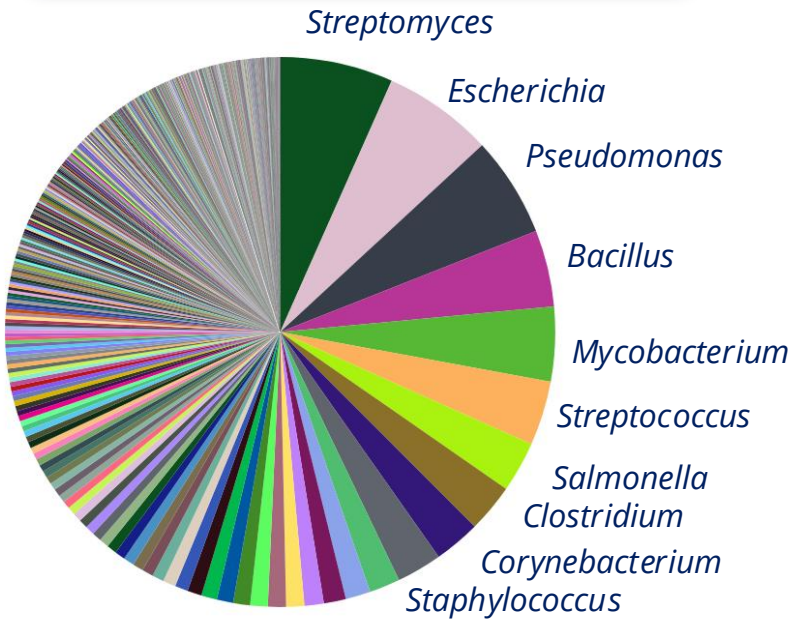

Mouse Cell STR Profiling


Mycoplasma Testing

Bacteriology Collection

The collection includes deposits from more than 1200 institutions worldwide

Bacteriology Collection
1226 Genera

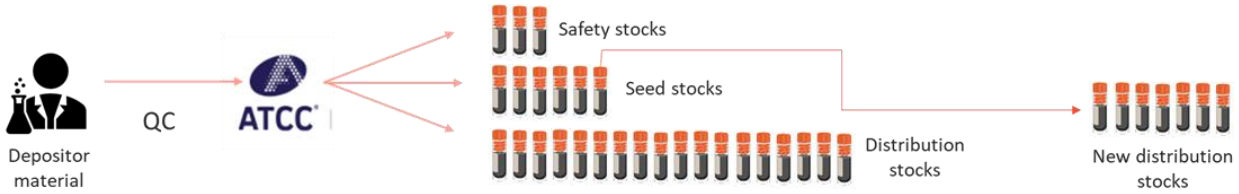


Explore our bacteriology products

Microbial Strain Authentication

ATCC® microbial stocks provide reliable, authenticated material with traceability

- Genotypic & proteotypic analysis
  - Whole-genome sequencing (ATCC® Genome Portal)
  - Marker sequencing (16S rRNA and ITS)
  - MALDI-TOF MS
- Phenotypic analysis
  - Colony morphology
  - Biochemical profiling
- Functional analysis
  - Serotype
  - Antibiotic resistance
  - Virulence



Type Strains

- The International Committee on Systematics of Prokaryotes (ICSP) and International Journal of Systematic and Evolutionary Microbiology (IJSEM) have stipulated that new type strains must be deposited in two or more public culture collections in different countries
- As a recognized culture collection in the United States, ATCC® accepts proposed type strains through our Type Strain Deposit service and makes those essential cultures available to the scientific community
- ATCC® has over 8,700 type strains from more than 2,100 genera

Explore our type strains

Learn about our type strain deposit service

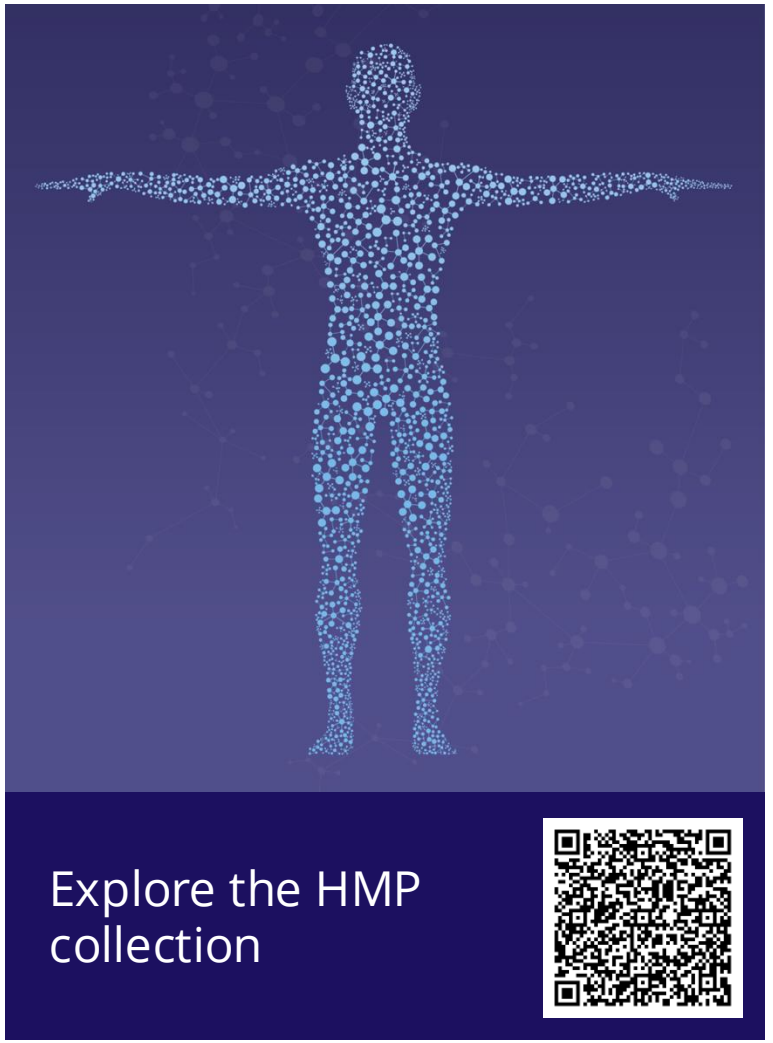
US National Park Service Special Collection

- The US national parks contain a diverse array of environments that are home a variety of microorganisms that can survive in the harshest of conditions
- Through the National Park Service Special Collection, we have made it easy for researchers to access these unique microorganisms
- Our growing collection comprises over 100 bacterial, fungal, and protozoan species including:
  - Thermophiles
  - Alkaliphiles
  - Acidophiles

Explore the NPS special collection

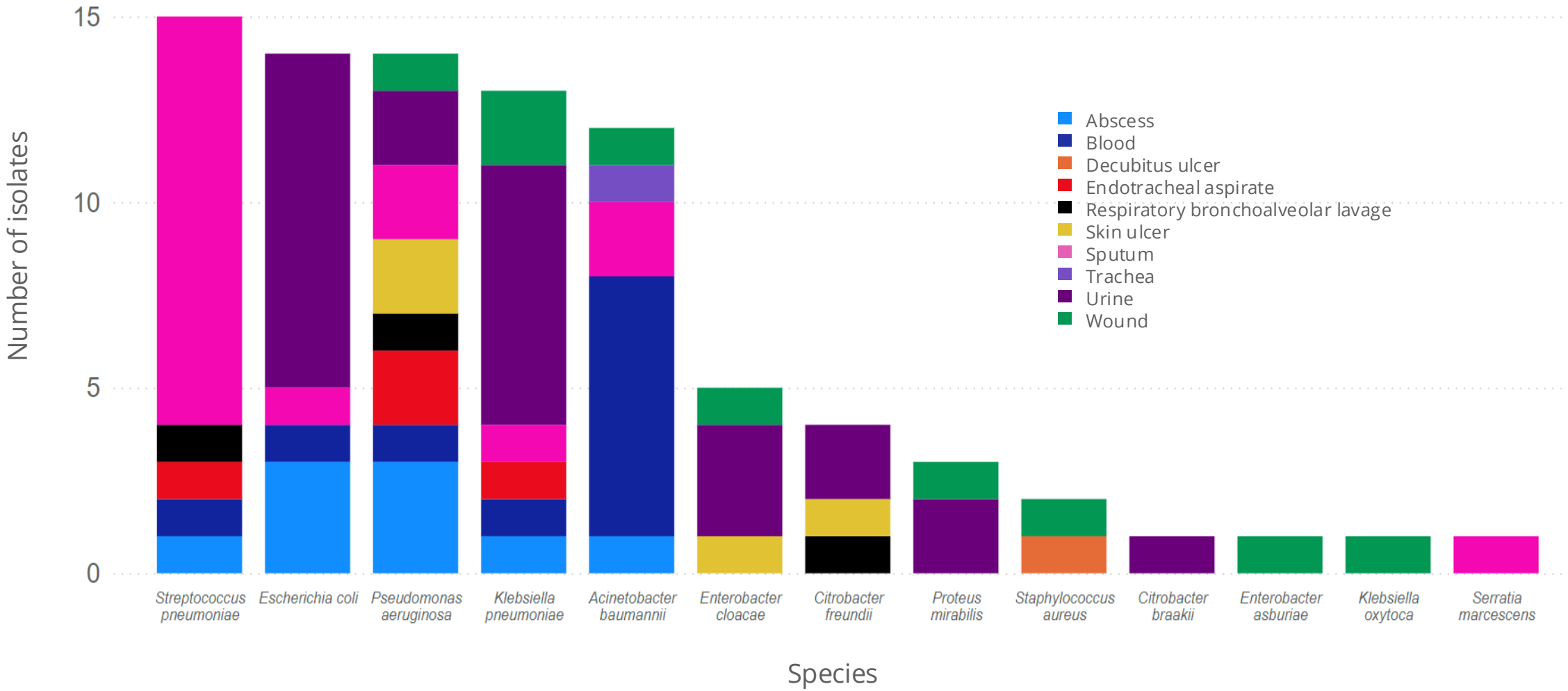
Human Microbiome Collection

- The human microbiome is made up of microbes that naturally reside on our bodies
- These microorganisms are necessary for many biological processes including:
  - Breaking down nutrients in food
  - Producing anti-inflammatory and antimicrobial compounds
  - Influencing our immune system
- The human microbiome project elevated our understanding of the microbiome
- ATCC has more than 50 fully authenticated and sequenced microbial strains isolated as part of this project



Highly Characterized Clinical Isolates

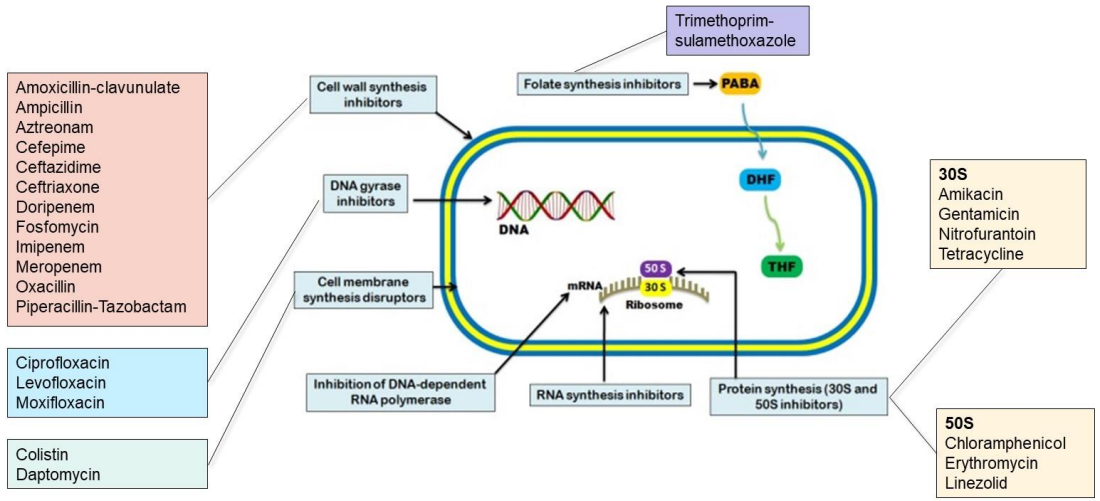
We have a new panel of highly characterized antimicrobial strains that are provided with source information, susceptibility data, whole genomes, and antibiotic resistance genes



Highly Characterized Clinical Isolates

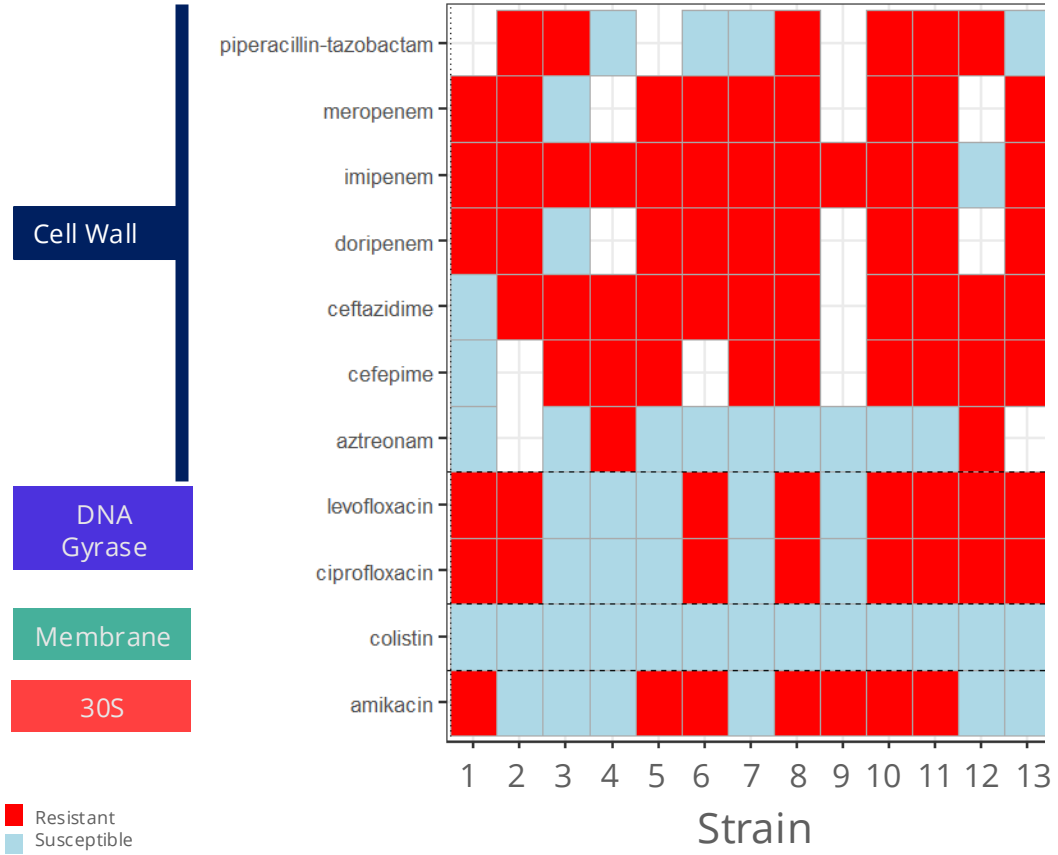
Strains were characterized by WGS and phenotypic analyses

- The clinical isolates were screened against a panel of antimicrobial compounds
- Genomes of the strains are available on the ATCC® Genome Portal (genomes.atcc.org)
- The certificate of analysis lists the sequence for target genes based upon phenotypic profile



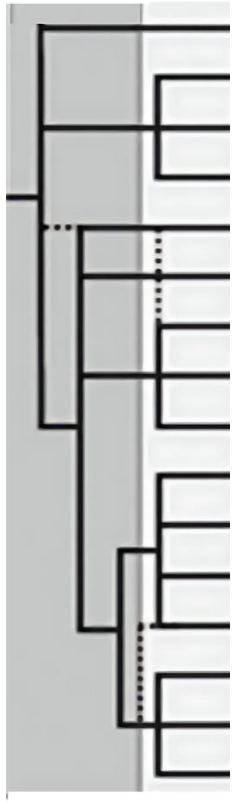
Modified from Uddin TM, et al. J Infect Public Health 14(12): 1750-1766, 2021. PubMed: 34756812

Example profile for *Pseudomonas aeruginosa*



We have a vast collection of fungal isolates

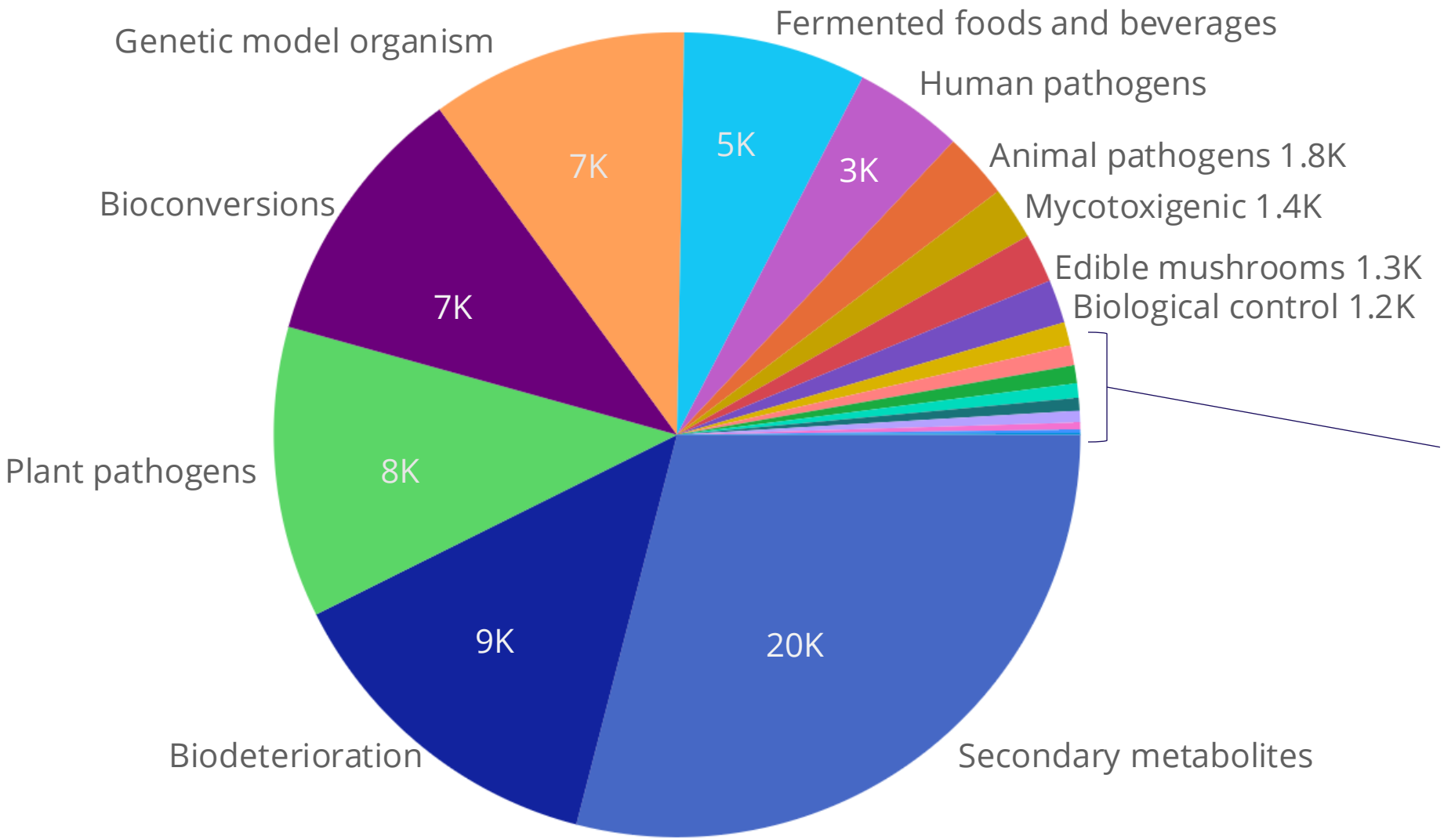
- We have more than 1850 genera in our collection sourced globally from 700 institutions



Phylum	Number of genera
Blastocladiomycota	3
Chytridiomycota	21
Monoblepharomycota	3
Neocallimastigomycota	4
Olpidomycota	0
Basidiobolomycota	1
Zoopagomycota	4
Kickxellomycota	11
Entomophthoromycota	7
Calcarisporiellomycota	1
Mucoromycota	49
Mortierellomycota	4
Glomeromycota	0
Entorrhizomycota	0
Basidiomycota	507
Ascomycota	1225

Explore our mycology products

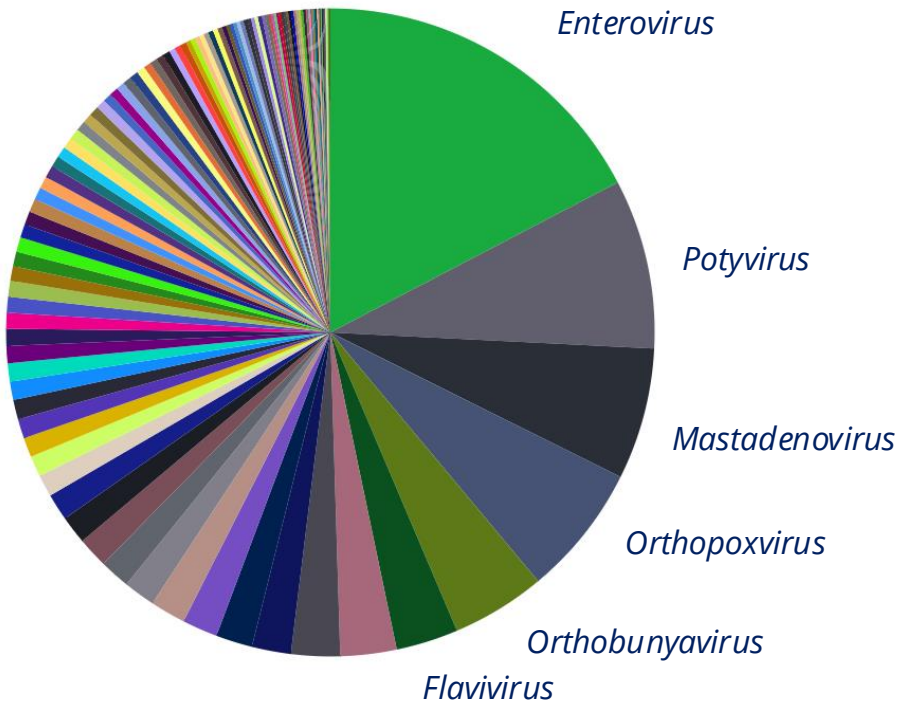
Our mycology collection has many uses in industrial processes



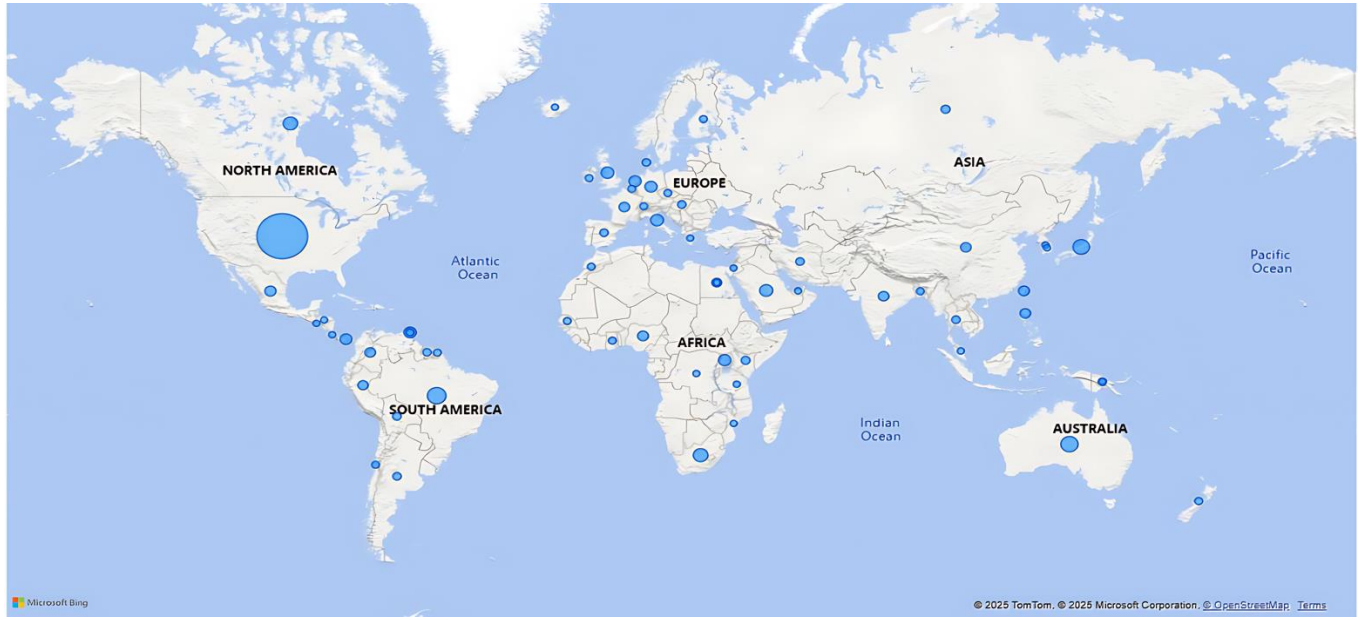
Use	Number
Biopolymers	652
Organic acids	564
Fatty acids	502
Plant growth promotion	405
Enzymes	354
Mycorrhizae	326
Hydrocarbon degradation	198
Food coloring and pigments	92
Pullulan	49
Algal parasite	2

Virology Collection

Virology
150 genera



The collection includes deposits from more than 700 institutions worldwide

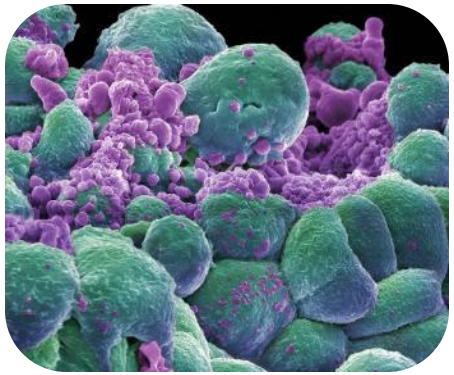


Explore our virology products

In Vitro Derivatives

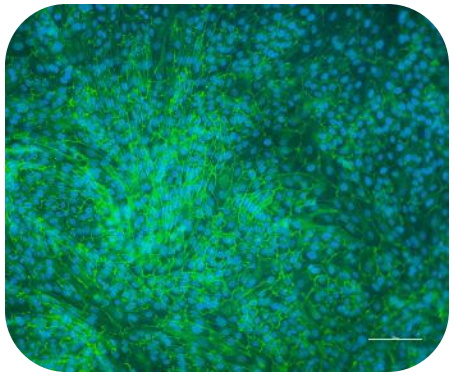
Creating Products for the Future

Innovation in models, formats, and bioinformatics



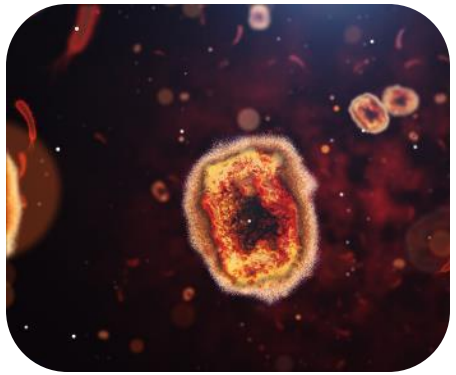
Oncology

A growing portfolio that includes materials and standards for drug screening, tumor mechanisms, cancer immunology, and cancer diagnostics.



Toxicology

Credible cell lines and models for performing standardized, reliable, and reproducible toxicology studies.

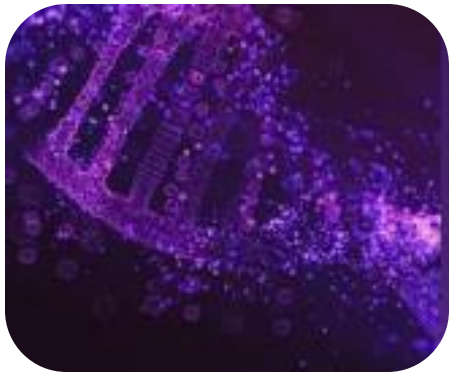


Molecular Diagnostics

Ready-to-use, fully authenticated products to ensure reliable and reproducible results.

Bioproduction

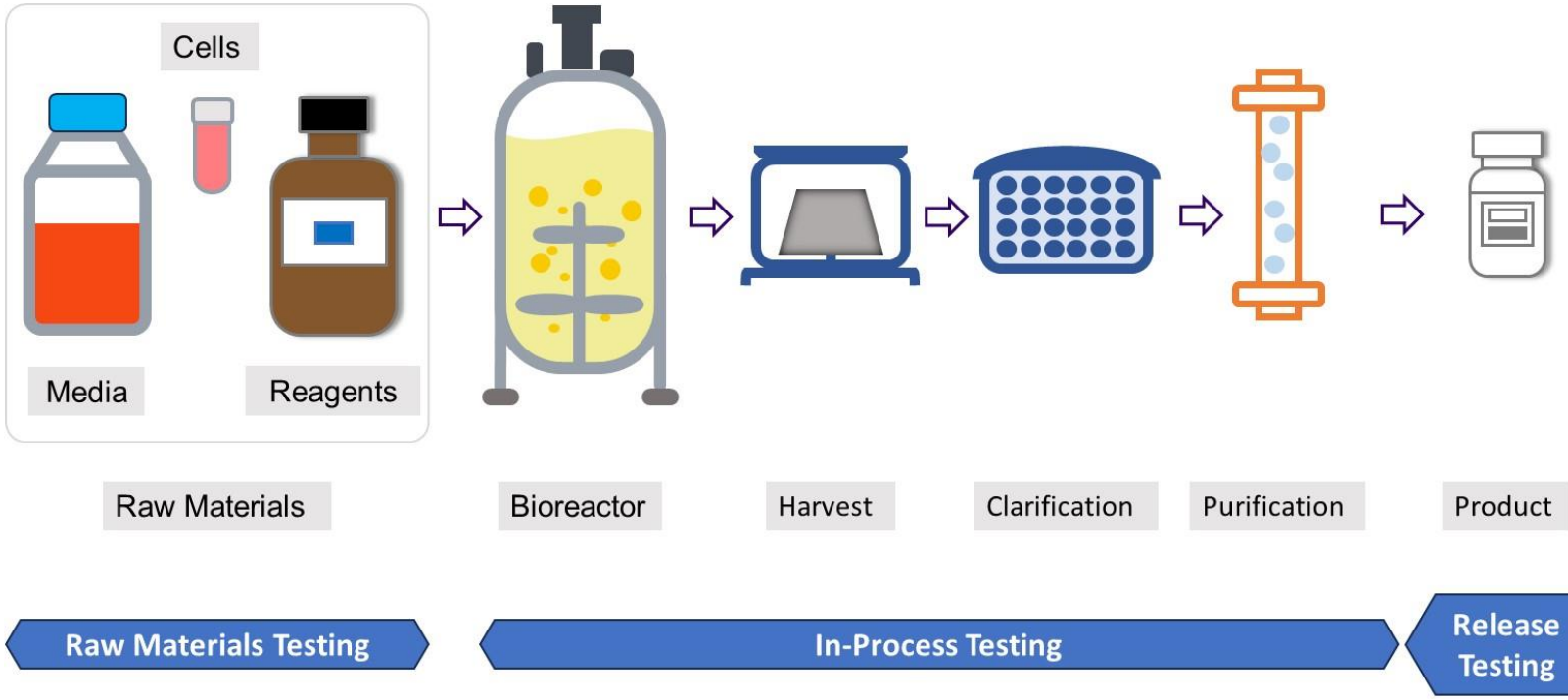
Reliable resources to support scalable and efficient biomanufacturing processes.



Data-driven Solutions

High-quality reference genomes of the authenticated microbial strains in our collection for achieving reliable research results.

Bioproduction Tools



- We have bioproduction cell lines and reference materials for testing for contaminants during bioproduction

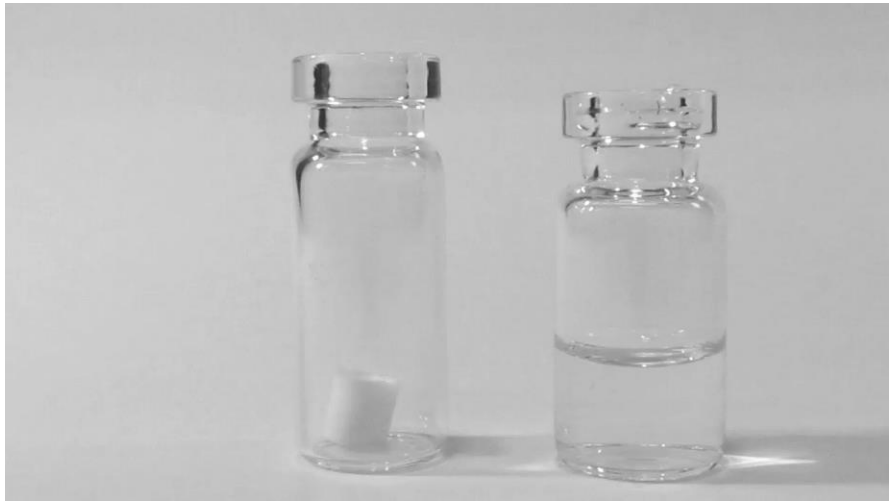
Learn about our tools for bioproduction

MicroQuant™ by ATCC®

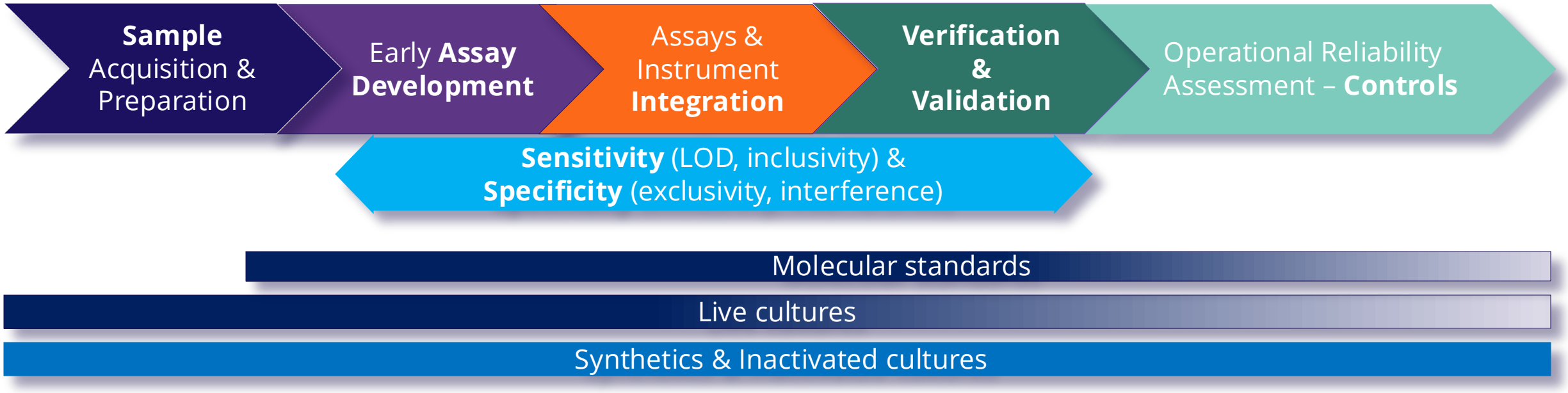
Innovation	Quantitative pellet created by an internally developed proprietary cryopreservation innovation
Value Add	Storage at 2°C to 8°C. Rehydrates rapidly and uniformly at room temperature
Intended Use	Microbial QC testing
Assays	Support for USP monographs: antimicrobial effectiveness testing, bioburden testing, sterility testing, environmental monitoring, growth promotion testing
Format	1 kit containing 10 total vials: 5 vials of cryopreserved pellets (1 pellet per vial), 1 organism per pack 5 vials of rehydration buffer (1 mL buffer per vial)

Learn more at www.atcc.org/microquant

Watch the rapid rehydration of the MicroQuant™ pellet



Molecular Diagnostics Tools



- Each stage of the development pipeline requires different materials for testing and assay validation
- Access to complementary materials allows for rapid assay development

Molecular Standards

Accelerate assay performance testing without the need to grow, extract, or quantify test materials

Genomic Standards	
Authentication	Amplicon sequencing
Integrity	High molecular weight DNA by gel electrophoresis
Genome copy number by ddPCR	1×10^5 to 1×10^6 genome copies/ µL
Fill Volume	100 µL per vial
Format	Frozen

Synthetic Standards	
Authentication	NGS to verify synthetic sequence
Functionality & Identity	qPCR amplification, 3.32 cycles between Cq threshold
Genome copy number by ddPCR	1×10^5 to 1×10^6 construct copies/ µL
Fill Volume	100 µL per vial
Format	Frozen

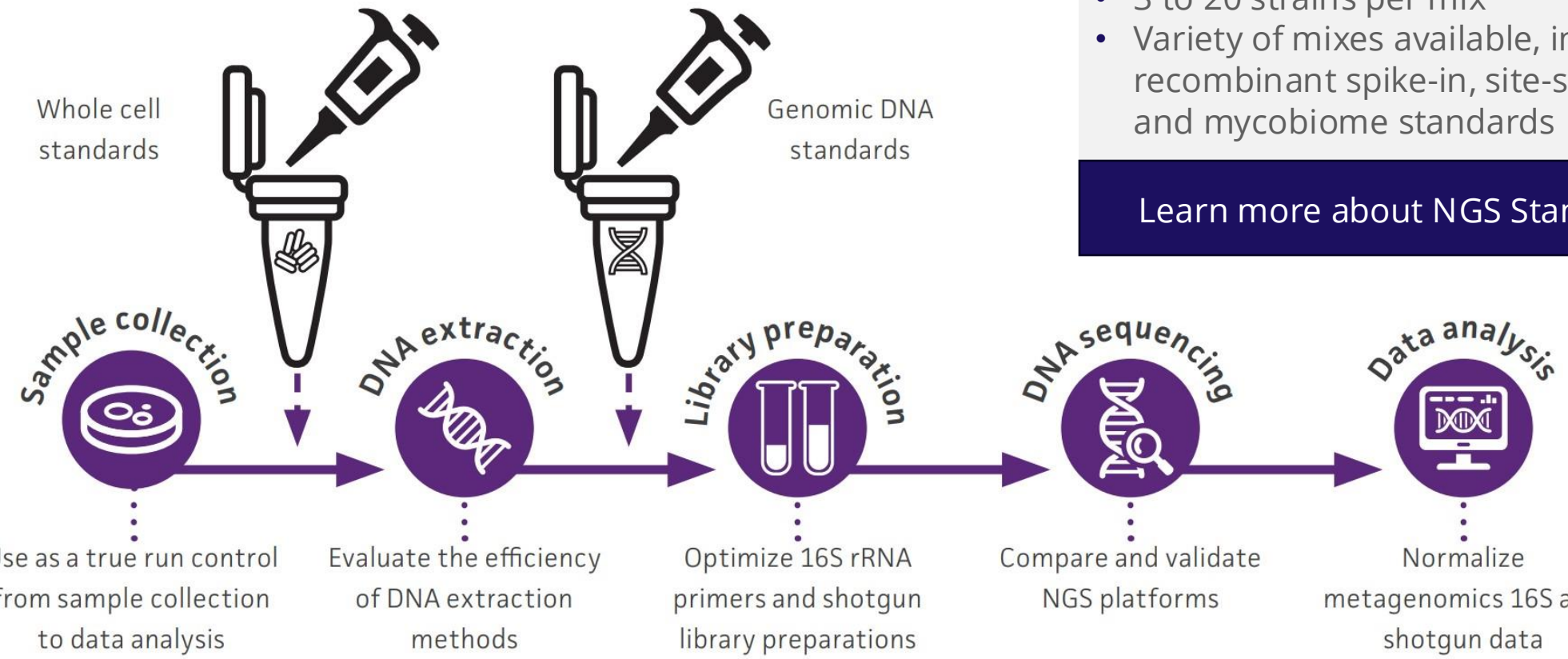
Learn more about our genomic and synthetic molecular standards

Next-Generation Sequencing (NGS) Standards

Whole cell and genomic mock microbial communities

- Whole cell and nucleic acid mixes
- Even or staggered gDNA abundance
- Low, medium, or high levels of complexity
- 3 to 20 strains per mix
- Variety of mixes available, including recombinant spike-in, site-specific, virome, and mycobiome standards

Learn more about NGS Standards



ATCC® Genome Portal

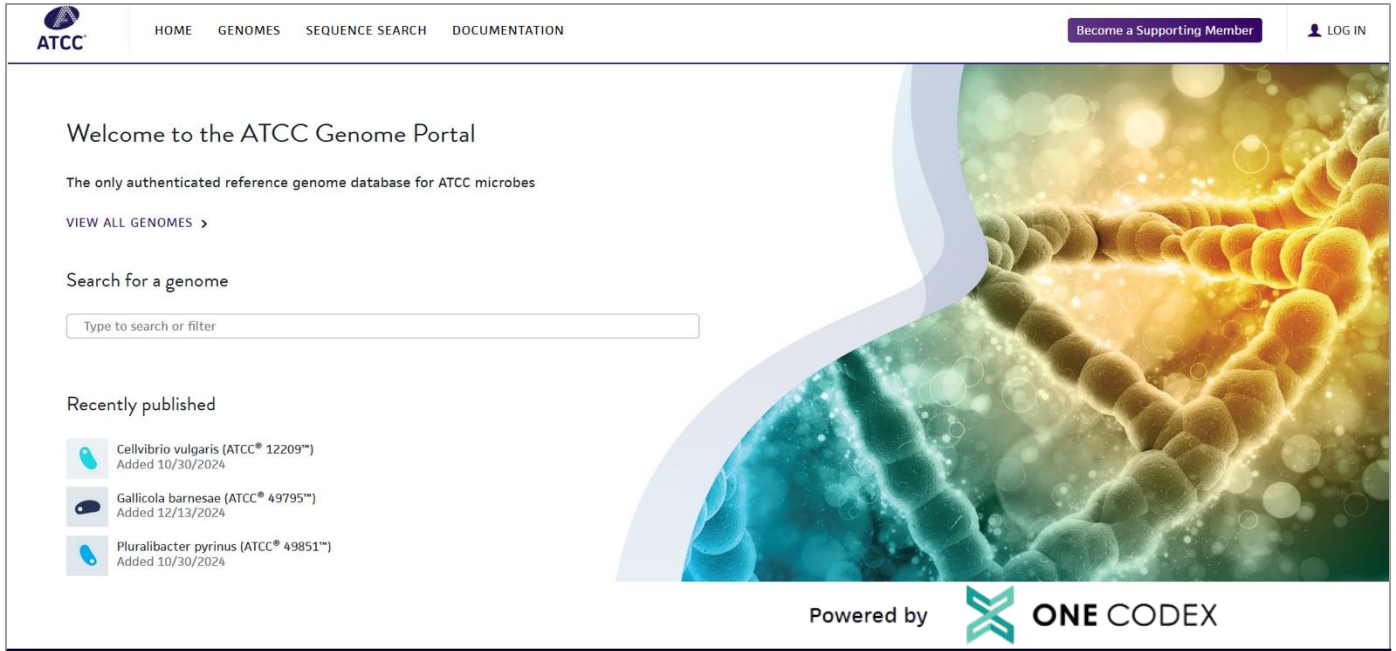
The only authenticated reference genome database for ATCC microbes

The ATCC® Genome Portal (AGP) is a rapidly growing ISO 9001–compliant database of high-quality reference genomes from authenticated microbial strains in the ATCC® collection. Customers can easily access and download meticulously curated whole-genome assemblies for purchased strains and S*upporting Members* have full access to the AGP.

5,500

Available reference genomes
as of March 2025

- Download genome assemblies for ATCC® microbes.
- Search for nucleotide sequences or genes within published genomes.
- Search for genomes by taxonomic name, taxonomic level, isolation source, ATCC® catalog number, type strain status, and biosafety level.
- View genome assembly statistics and quality metrics.
- Identify the relatedness of published genomes by total genome alignment.



Learn about the ATCC® Genome Portal

Visit the ATCC® Genome Portal

New genomes are released at the end of every quarter.

Challenges and Opportunities

Challenge: Metadata

Wrangling a century-old collection

- Metadata curation → needs controlled vocabulary
  - Eg, “Aerobic” vs “100% Air”
- Media types → 1,200 genera in the collection specify ~1,400 different media!
  - Could we grow some of these on common media, increasing production efficiency?
- Diversity and a range of conditions
  - Strength of the collection is the diverse → challenge is the conditions needed to culture and expanded skill set of workforce required

Growth Type	Number	Genera
Anaerobe	4901	575
Air + 5% CO_2	1032	84
Microaerophile	310	27
Other gas mixtures	1863	404
Not listed in catalog	8051	617

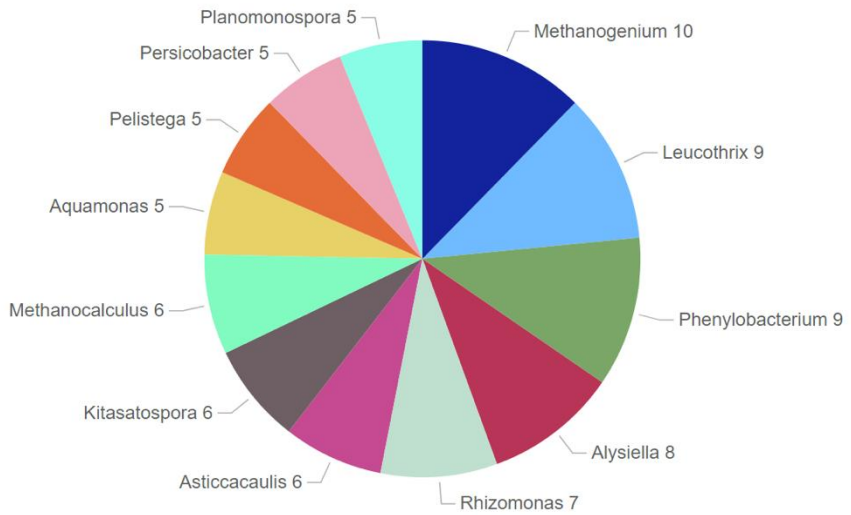
Challenge: Keeping All Products in the Catalog

The long tail challenge

- We have more than 18K products from >3200 genera
- One third have only one representative in catalog
- 50% genera have not distributed in the last 5 years

Most common genera of (A) bacteria and (B) fungi with limited sales

A



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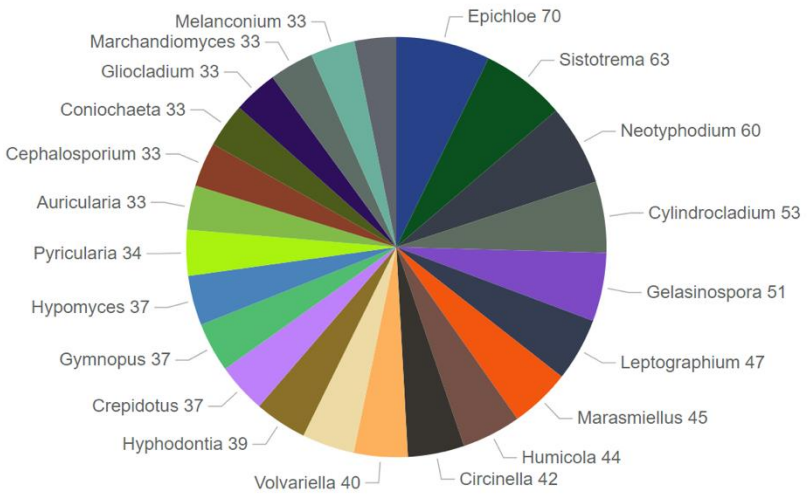


Challenge: Global Distributions of Products

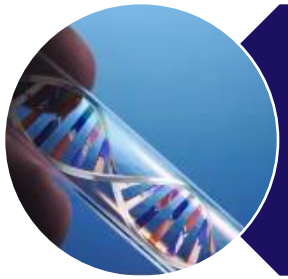
Shipping items globally can be challenging for the following reasons:

- BSL level
- Permission for use including Nagoya Protocol
- Source of animal biproducts for production

Our Services

Innovative Services

Fueling Life Science Research



Depositing with ATCC

cGMP Mammalian Cell Biorepository

Licensing & Patent Deposit

Depositing With ATCC®

- Preservation and long-term storage
- Support for research and collaboration
- Global accessibility and distribution
- Standardization and quality assurance
- Compliance with regulations
- IP protection
- Licensing royalty

Questions should be directed to CAU@atcc.org

Learn more about our deposit service

cGMP Mammalian Cell Biorepository

ATCC® continues to support global health by offering biorepository services for worldwide storage and distribution of biological materials

Service Offerings

- Clients retain all rights to materials stored with biorepository services
- cGMP-compliant
- LN2, -80°C, -20°C, +4°C, and room temperature storage

Facility & Security

- 24/7 temperature monitoring
- Generator backup
- Inventory management system
- Restricted access security
- On-call after-hours personnel

Global Distribution

- Ability to store and deliver cold-chain materials to customers in more than 150 countries
- Adherence to federal regulations worldwide, and compliance with US import and export regulations

Licensing and Patent Deposits

Enabling the Translation of Research from Lab to Market

ATCC®'s genuine, authentic, guaranteed biological materials help companies easily navigate regulatory processes to make incredible discoveries and life-changing products.

Patented

Diverse Customer Base

Life Sciences and Pharmaceutical Markets

Agriculture and Environmental Markets

Food and Beverage Markets

ATCC® is the world's largest International Depository Authority, as recognized by the World Intellectual Property Organization and US Patent and Trademark Office, **with over 40,000 deposits** made by inventors in support of the purposes of patent procedure.

Summary

We offer a range of products to accelerate your R&D Needs

- ATCC® is a Long-time **trusted partner** for high-quality authenticated biomaterials, standards, and services in life sciences
  - Diverse collection of bacterial, fungal, protist, and viral cultures
  - Genomic DNA standards are ready-to-use reference materials eliminating additional costs and time required for cell line expansion, DNA extraction, and quantitation
  - Synthetic standards provide controls for organisms that are difficult to culture or extract
  - NGS standards of whole cell and quantitative DNA from organisms in even and staggered mixtures
- History of **partnerships** with **industry, government, and academia** to improve **human health,** agriculture, veterinary, environment, etc.
- **Invested in R&D** to empower advancements for complex research & innovative science
- What do **YOU** need?
  - ATCC® exists as a resource for the scientific community

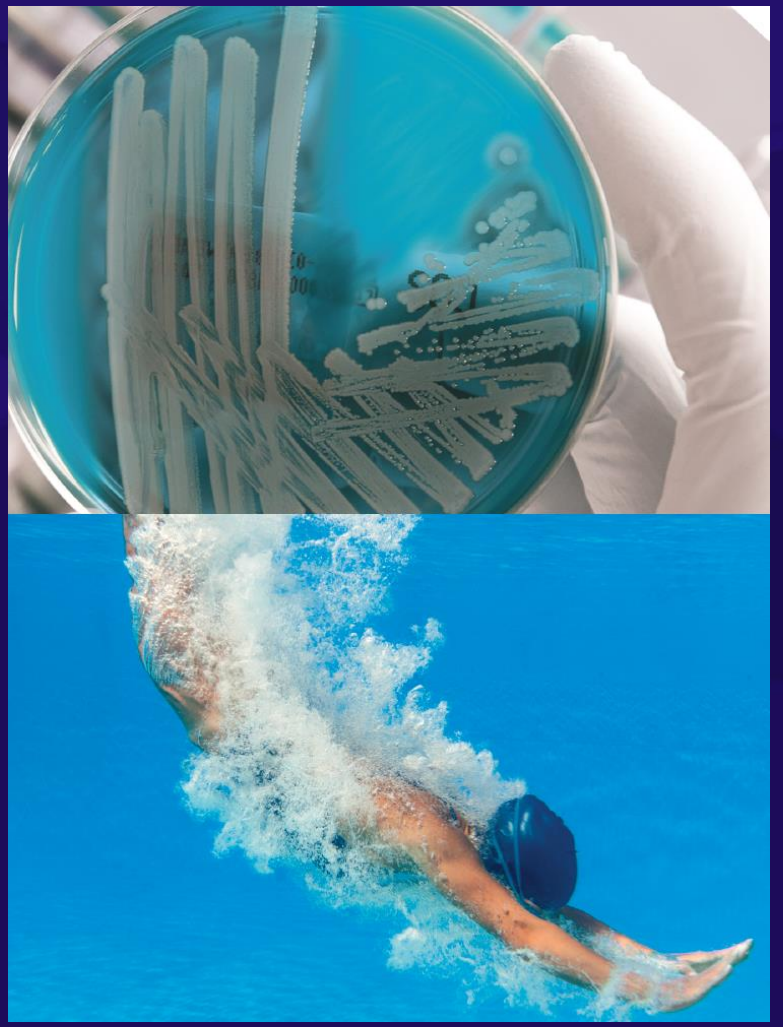
ATCC®

CREDIBLE LEADS TO INCREDIBLE

Questions

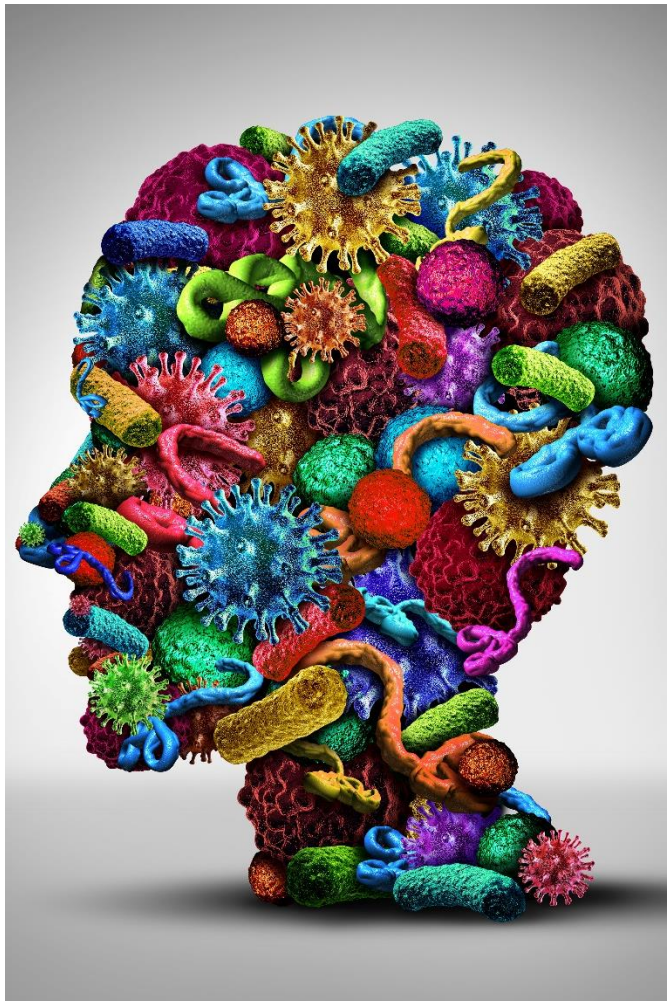
vknight-connoni@atcc.org

ASM Microbe 2025
Booth #1423



Appendix

ATCC® NGS Standards Portfolio

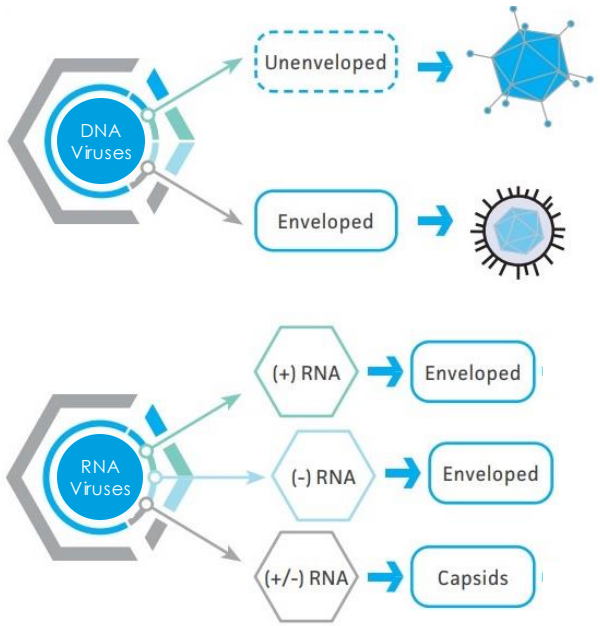


Preparation	ATCC® Catalog No.	Number of Organisms	Composition	Complexity	Utility
Genomic DNA	MSA-1000™	10	Even	Medium	Standards for assay development and optimization
	MSA-1001™	10	Staggered	Medium	
	MSA-1002™	20	Even	High	
	MSA-1003™	20	Staggered	High	
Whole cell	MSA-2003™	10	Even	Medium	
	MSA-2002™	20	Even	High	
Genomic DNA	MSA-4000™	11	Staggered	Medium	NGS-based pathogen detection
Genomic DNA	MSA-3000™	6	Even	Low	Environmental studies
	MSA-3001™	10	Even	Medium	
	MSA-3002™	10	Staggered	Medium	

ATCC® Site-specific NGS Standards

Standard	Preparation	ATCC® Catalog No.	Number of Organisms	Importance
Oral	Whole cell	MSA-2004™	6	• Mock microbial communities representing the oral, skin, gut, and vaginal microbiomes • Comprises normal and atypical flora • Anaerobic and aerobic microbial strains • A combination of Gram-positive and Gram-negative bacterial cultures • Even composition
	Genomic DNA	MSA-1004™		
Skin	Whole cell	MSA-2005™	6	
	Genomic DNA	MSA-1005™		
Gut	Whole cell	MSA-2006™	12	
	Genomic DNA	MSA-1006™		
Vaginal	Whole cell	MSA-2007™	6	
	Genomic DNA	MSA-1007™		

ATCC® Virome Standards

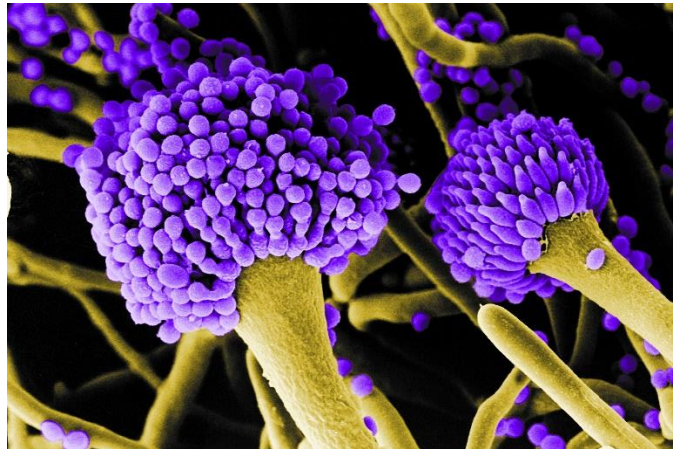


Composition of Virome Analytical Refence Materials
Human herpesvirus 5 strain AD169 (ATCC® VR-538™)
Human mastadenovirus strain F (ATCC® VR-931™)
Influenza B virus strain B/Florida/4/2006 (ATCC® VR-1804™)
Zika virus strain MR 766 (ATCC® VR-1838™)
Reovirus 3 strain Dearing (ATCC® VR-824™)
Human respiratory syncytial virus strain A2 (ATCC® VR-1540™)

Standard	Content	ATCC® Catalog No.	Number of Organisms	Specification (ddPCR)	Applications
Virome	Virus Mix	MSA-2008™	6	2×10^3 genome copies/µL per virus	• Assay development, optimization, verification, and validation. • Reproducibility assessment (routine QC).
	Nucleic Acid Mix	MSA-1008™	6	2×10^4 genome copies/µL per virus	

ATCC® Spike-in and Mycobiome Standards

Standard	Preparation	ATCC® Catalog No.	Number of Organisms	Application
Spike-in	Whole cell	MSA-2014™	3	• Microbiome measurements and data normalization • 16S rRNA and shotgun assay verification, validation, and quality control
	Genomic	MSA-1014™		

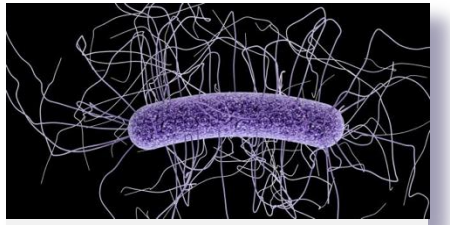


Standard	Preparation	ATCC® Catalog No.	Number of Organisms	Application
Mycobiome	Whole cell	MSA-2010™	10	• Fungal mock community standards for assay development, optimization, verification, and validation; evaluating reproducibility; and use as a daily run quality control
	Genomic	MSA-1010™		

Quantitated Genomic Nucleic Acids

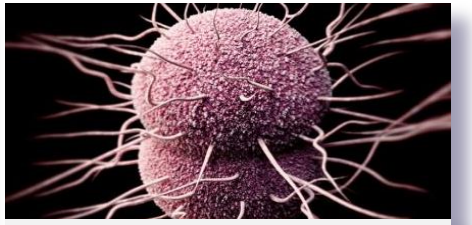
- ATCC® has a portfolio of 270+ quantitated analytical reference materials
  - Supports research on blood-borne disease, gastro-intestinal disease, respiratory disease, sexually transmitted disease, and vector-borne disease pathogens
- Product requirements:
  - Concentration: 1 x 10^5 – 1 x 10^6 genome copies/µL
  - Volume: 100 µL/vial
  - Format: Frozen
  - Stability: 5 years
- Authentication
  - Identity: Amplicon sequencing
  - Integrity: High-molecular-weight DNA by gel electrophoresis

Learn more about our genomic standards



- Astrovirus
- *Cyclospora cayetanensis*
- Hepatitis A and E viruses
- Norovirus GI and GII
- Sapovirus
- *Mycobacterium avium* subsp. *paratuberculosis*
- *Clostridioides difficile*
- *Salmonella enterica* subsp. *enterica* serovar Typhimurium
- *Cryptosporidium parvum*
- Human Enterovirus 71
- Rotavirus A
- *Dientamoeba fragilis*
- *Babesia canis*
- *Giardia lamblia*
- Murine norovirus
- *Legionella pneumophila* subsp. *pneumophila*
- Human enterovirus 71 strain H
- *Entamoeba histolytica*
- *Escherichia coli*

Gastro-intestinal disease



- *Neisseria gonorrhoeae*
- Human immunodeficiency virus 1
- Human papillomavirus 16
- Human papillomavirus 18
- Human papillomavirus 31
- Human T-cell leukemia virus 2
- *Treponema pallidum*
- *Chlamydia trachomatis* LGV I
- *Chlamydia trachomatis* LGV II
- *Chlamydia trachomatis* LGV III
- Human herpesvirus 1
- Human herpesvirus 2
- Hepatitis B virus
- Human herpesvirus 8
- Human herpesvirus 7
- Human herpesvirus 6
- *Mycoplasma genitalium*
- *Staphylococcus saprophyticus*
- *Haemophilus ducreyi*

Sexually transmitted disease

Quantitated Synthetic Nucleic Acids

- ATCC® has a panel of 75+ synthetic molecular standards
- Product requirements:
  - Concentration: 1 x 10^5 – 1 x 10^6 genome copies/µL
  - Volume: 100 µL/vial
  - Format: Frozen
  - Stability: Accelerated stability for 5 years
- Authentication
  - Identity: NGS to verify synthetic sequence
  - Function: qPCR 3.32 cycles between Cq threshold
  - Integrity: High-molecular-weight DNA by gel electrophoresis

Learn more about our synthetic standards

Viruses

African swine fever
Astrovirus
Avian Influenza*
Avian paramyxovirus
Boca virus
BK virus
Bourbon virus
Chikungunya
Dengue virus*
Eastern equine encephalitis
Hepatitis A
Norovirus*
Human metapneumovirus
Sapovirus
SARS-CoV2
HIV*
Human Herpes virus*
Hepatitis*
Human papillomavirus
Human parechovirus 3
MERS
Murine norovirus
Parvovirus*
Powassan virus*
St Louis encephalitis
T-cell leukemia virus
West Nile virus
Yellow fever virus
Zika virus

Fungi

Pneumocystis jirovecii

Protozoa

Babesia canis
Cryptosporidium hominis
Cyclospora cayetanensis
Dientamoeba fragilis
Giardia lamblia
Plasmodium malariae
Plasmodium vivax
Trypanosoma cruzi

Bacteria

Chlamydia trachomatis I
Chlamydia trachomatis II
Chlamydia trachomatis III
Treponema pallidum
Coxiella burnetii
Mycoplasma leprae
Mycoplasma genitalium
Ureaplasma urealyticum

* Multiple standards

Reliable Biomaterials Should be Used as Controls

Types of materials to choose:

Reference Material	Benefit	Disadvantage
Live microbes	Sustainable source, maintains complexity of the intact microorganism, provides entire genome	Difficulty accessing materials, biosafety
Inactivated materials	Ability to access to pathogens in BSL 1 labs	Cells may no longer perform as live microbe
Genomic DNA/RNA	Ease of access, safe to use	May not mimic live microbe
Synthetic oligonucleotides	Easy to design and synthesize, allows access to non-culturable materials	May not resemble complexity of the whole genome

Other things to consider:

- Use fully authenticated materials
- Avoid contamination or misidentification