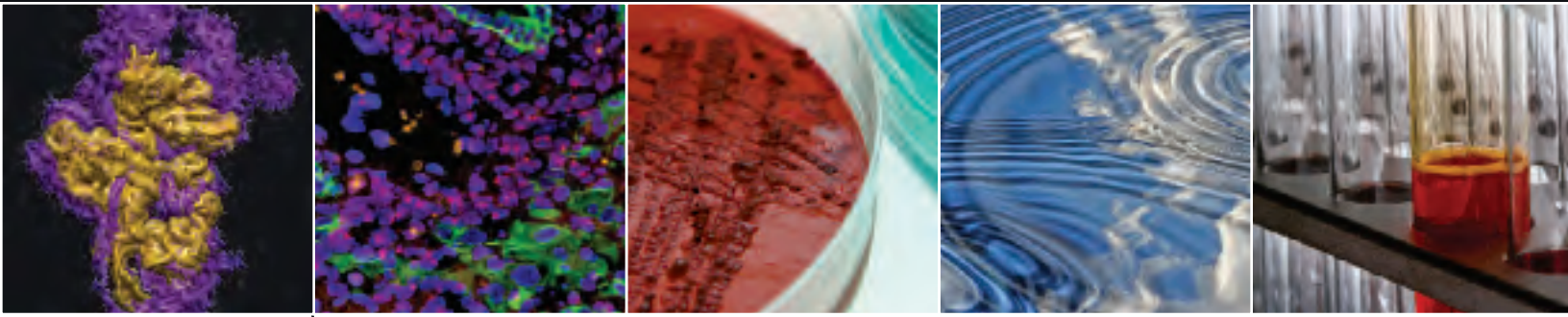




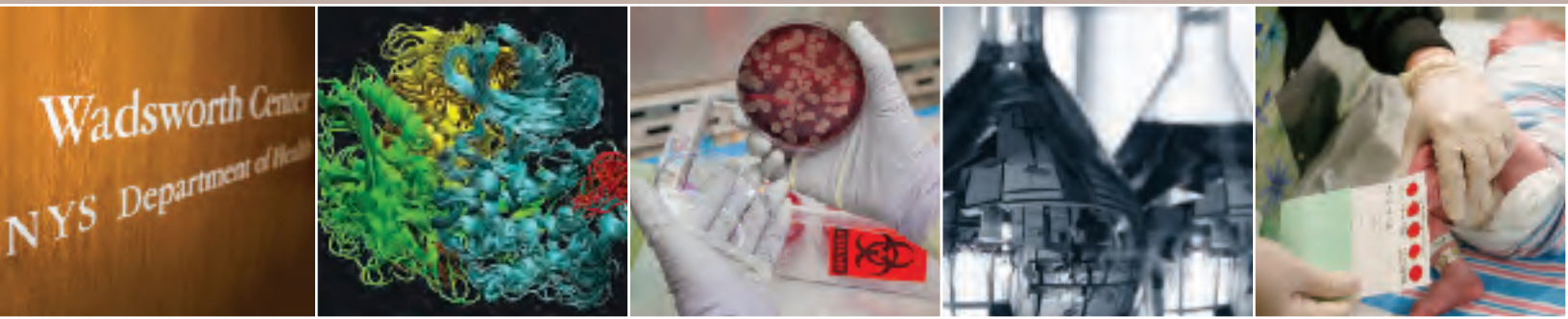
**Department  
of Health**

**Wadsworth  
Center**



**Science in the Pursuit of Health®**

The Wadsworth Center laboratories stand at the forefront of biomedical and environmental sciences and their interplay.



[www.wadsworth.org](http://www.wadsworth.org)

The Center serves a vital role in the New York State Department of Health's efforts to protect and promote the health of New York's citizens.



Innovative, multidisciplinary research. Complex diagnostics and novel detection methods. High-tech instrumentation and state-of-the-art laboratory services. All are components of the dynamic scientific community that is the Wadsworth Center of the New York State Department of Health.

Building on more than a century of excellence as the state's public health laboratory, the Center continues as a premier biomedical institute that merges clinical and environmental testing with fundamental, applied and translational research.

Today, Wadsworth Center scientists use both classical and contemporary approaches to study environmental and biological questions related to human health and disease. They develop advanced methods to identify microbial or chemical threats; study drug resistance, emerging infections, and environmental exposures; manage the country's most comprehensive diagnostic and environmental testing laboratory permit program; oversee extramural research programs on stem cells, breast cancer and spinal cord injury; and train the next generation of scientists through undergraduate, graduate, postdoctoral and visiting scientist programs. Their efforts embody *Science in the Pursuit of Health*.®

# Landmarks and Achievements

1900

1910

1920

1930

1940

1950



**1901**

State Antitoxin Laboratory established to standardize and manufacture antitoxin for diseases such as diphtheria



**1941**

Syphilis test standardized with the chemically defined antigen, cardiolipin (Dr. Mary Pangborn)



**1914**

The Antitoxin Laboratory designated the Division of Laboratories and Research; Augustus B. Wadsworth named director



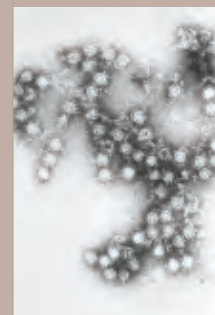
**1950**

Nystatin discovered: the first safe and effective antifungal antibiotic (Drs. Elizabeth Hazen and Rachel Brown)



**1926**

First *Standard Methods of analysis for public health testing* published



**1948**

Coxsackie virus isolated and characterized

1960



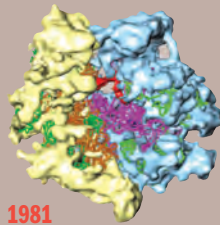
**1965**  
The country's first state clinical laboratory permit program launched

1970



**1978**  
Studies on arboviruses begin and over time expand to include eastern equine encephalitis, dengue, West Nile, chikungunya and Zika viruses

1980



**1981**  
Electron microscopy and computer processing used to analyze the 3D structure of large biomolecules, eventually becoming a new standard in structural biology

1990



**1991**  
Brain-computer interface system developed; goal is to restore communication and control to people severely paralyzed by ALS, strokes or other devastating neuromuscular disorders

2000



**2001**  
Sensitive biomonitoring analytics used to detect low levels of environmental toxins in human samples

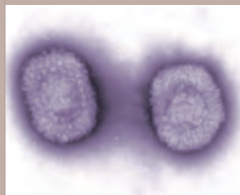
2010



**2012**  
Applied Genomic Technologies Core breaks record for bases sequenced on Ion Torrent™ PGM™ Sequencer with 316 chip: 785 million bases of *Salmonella* DNA sequenced in a single run



**1978-80**  
Sophisticated methods developed to assess toxicity of complex environmental mixtures



**1983**  
Vaccinia virus used as a vector to express selected genes from pathogens to make safer vaccines



**2006**  
Whole genome studies defined genes associated with Parkinson's disease, allowing genetic testing for disease susceptibility

**2013**  
New prototype brain mapping technique licensed. Improves safety and reduces duration of neurosurgical procedures

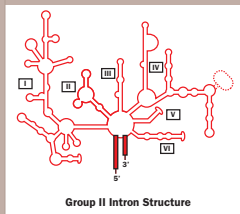
**2013**  
First state in the country to screen newborns for adrenoleukodystrophy (ALD)



**2015**  
The National Center for Adaptive Neurotechnologies opened. Research conducted to improve diagnosis and treatment of stroke, spinal cord injury, traumatic brain injury, and other devastating neurological conditions



**1965**  
A model newborn screening program established and new assays developed, allowing detection of more treatable conditions



**1984**  
Mobile genetic elements known as introns discovered in bacteria

**2006**  
HIV tropism assay developed to predict disease progression



**2008**  
First demonstration that brain activity recorded from the scalp can control a computer cursor

**2015**  
First state public health laboratory to use whole genome sequencing for outbreak investigation, applied to *Legionella* outbreak

**2016**  
First state public health laboratory to perform whole genome sequencing on clinical TB samples



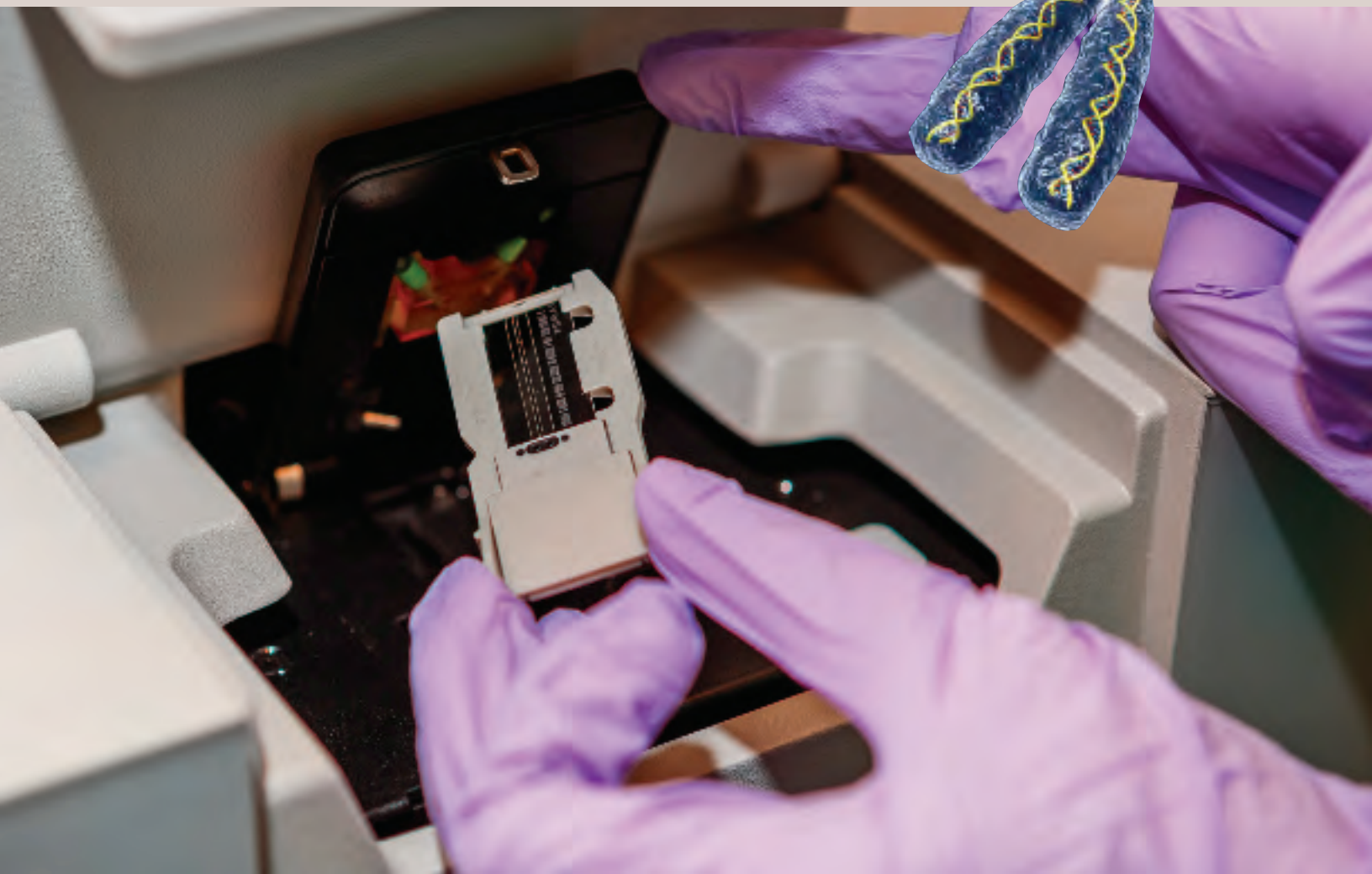
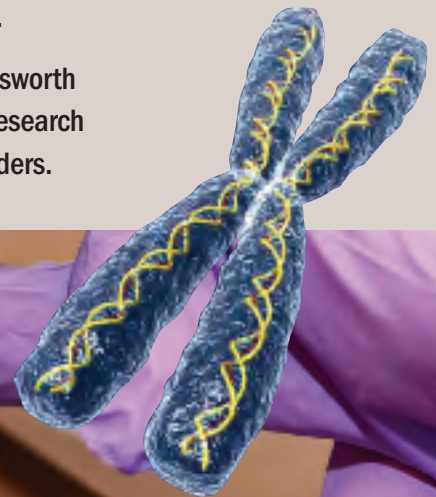
**2017**  
Dr. Joachim Frank awarded Nobel Prize in Chemistry for pioneering work in cryo-electron microscopy



## Public Health Genomics

Completion of the Human Genome Project in 2003 made headlines, created great expectations and laid the groundwork for precision medicine. It also spurred tremendous technological advances, such as next-generation sequencing. Individuals already benefit from the identification of mutations that cause disease as well as genes and gene variants that impact drug metabolism and effectiveness of treatment. Yet, the translation of genetic discoveries into widespread clinical applications has just begun.

Population health, a domain of public health, has also benefitted. At Wadsworth Center, new genomic technologies play a major role in both clinical and research programs, in disciplines ranging from infectious diseases to genetic disorders.

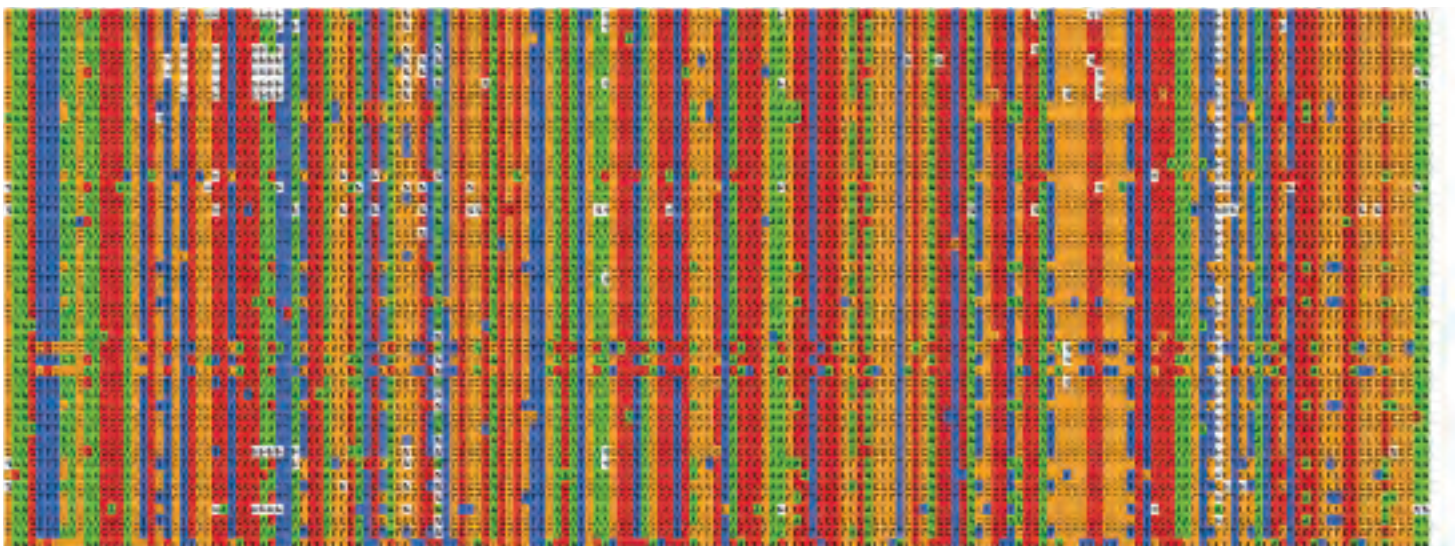


## SEQUENCING APPLIED

- The Biodefense Laboratory is continually improving methods to detect and characterize biothreats, and today uses sequencing in the surveillance of select agents, such as *Clostridium botulinum*, which causes botulism.
- Foodborne disease outbreaks, which sicken one in six Americans each year, are tracked more precisely and rapidly with DNA sequencing. Since 2012, in collaboration with the Food and Drug Administration, the Wadsworth Center has fully sequenced many genomes of the bacterium *Salmonella*, a frequent cause of food-borne illness.
- Newly emerging pathogens are more readily identified, and known infectious agents, such as *E. coli*, influenza, West Nile virus and *M. tuberculosis*, are being more closely studied.
- The pioneering Newborn Screening Program is employing DNA sequencing technologies to determine the genetic basis of diseases detected in infants, and to identify novel genetic causes of birth defects.

Next-generation sequencing technologies continue to accelerate this progress, and are now routinely employed in our testing laboratories.

Wadsworth Center's extensive experience with sequencing, along with robust computing capabilities and bioinformatics expertise applied to analysis of genomic data, has led to partnerships with federal and state agencies, and academic and research centers. Advanced molecular technologies promise to transform clinical diagnostics, patient care and the tracking of public health threats, including hospital-acquired infections and drug-resistant pathogens.



At Wadsworth Center, genomic technologies have played a major role in both diagnostic and research programs.



Newborns' blood specimens collected from a heel prick onto filter paper forms are "punched" to remove samples for processing

## Newborn Screening: By the Numbers

New York's smallest citizens get off to a healthy start thanks to a comprehensive program that screens all infants for detectable, treatable conditions. An acknowledged leader in newborn screening, Wadsworth Center capitalizes on technological and medical advances, making newborn screening the Center's largest program.

- Around **245,000** infants screened and over **11** million results reported annually
- **47** conditions screened using **5** methodologies
- **63** staff operating **10** hours each weekday
- Over **2,500** screen positives referred each year
- **70** specialty treatment centers to which infants are referred
- Average of **350** case updates per month
- Over **2,200** phone calls monthly related to referrals and follow-ups with physicians or the public
- Approximately **150** questions e-mailed to the program monthly



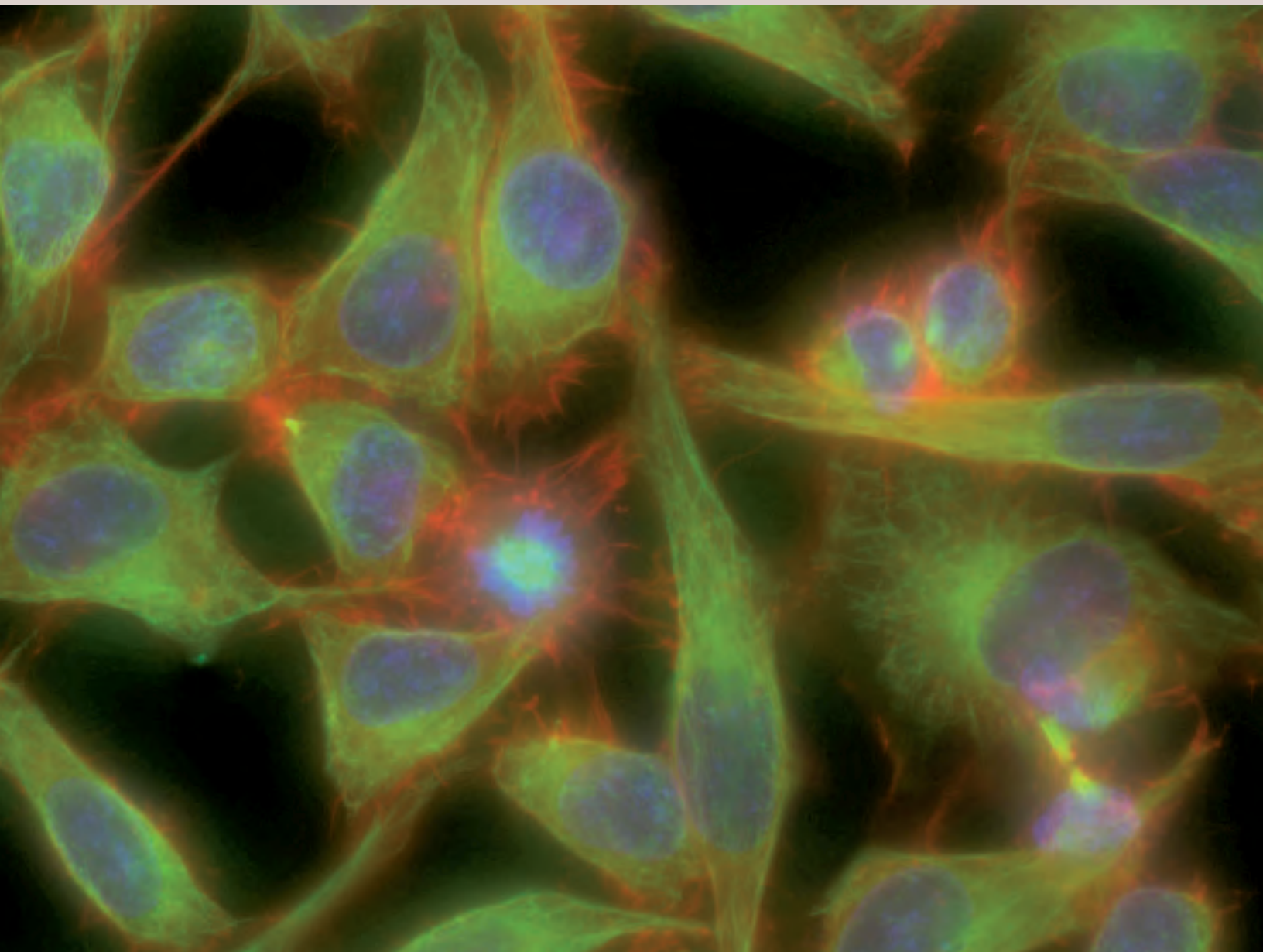
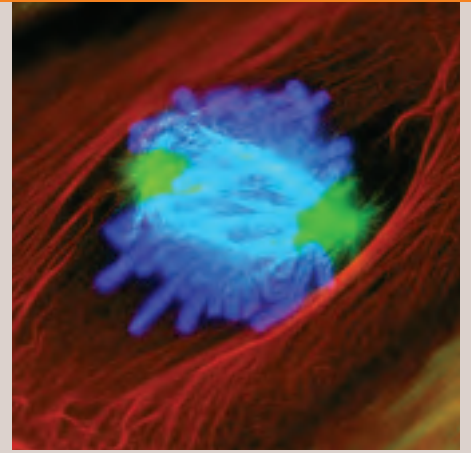


## MOLECULAR GENETICS

Control of gene expression is critical to the normal functioning of an organism. Novel computational approaches devised by Wadsworth Center scientists are uncovering DNA and RNA sequences that regulate gene expression in diverse organisms, dictating when, where and how much protein to manufacture. Molecular geneticists build on this regulatory information as they investigate cellular processes that cause genomes to alter or adhere to genetic instructions. Knowledge about genome evolution and conservation informs studies of normal development, inherited disorders and cancer. Similarly, an understanding of non-coding DNA reveals how these sequences create diversity within and among species, while retaining a blueprint for development and function.

# Cellular and Molecular Structure Analysis

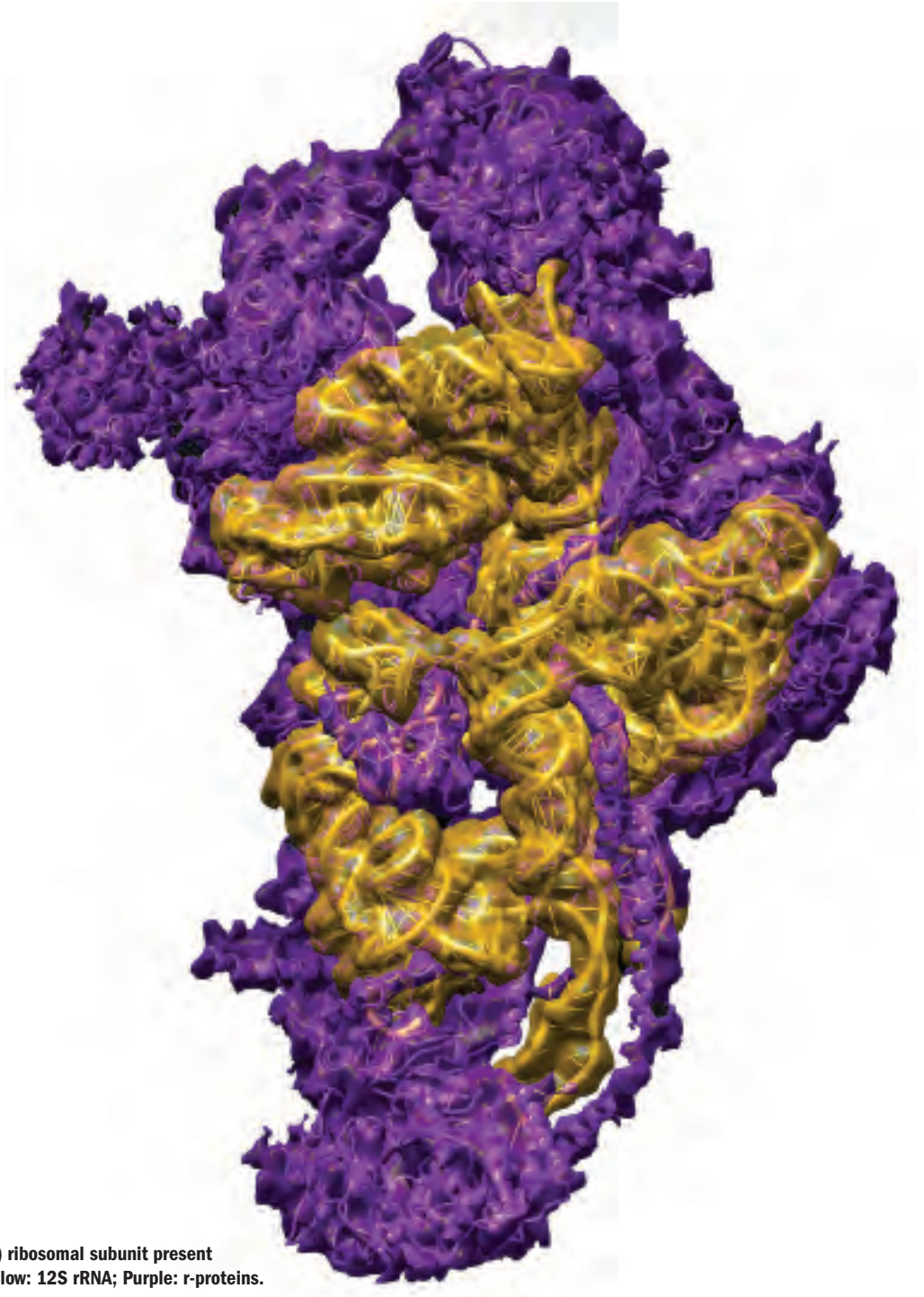
While the majority of attention in recent years has focused on genes and genomes, ultimately it is a cell's macromolecules (proteins and RNA) that do the actual work, including everything from regulating cell growth and division, to maintaining cellular energy supplies and cell structure. Most of these macromolecules function only as part of larger and more complicated structures, such as membranes, filaments and ribosomes, the complex molecular machines that fabricate proteins.



### TODAY'S RESEARCH, TOMORROW'S SOLUTIONS

Using cutting-edge structural and biological techniques to study these fundamental cellular processes in normal and diseased conditions, Wadsworth Center researchers elucidate molecular details of interactions between cellular components involved in cell division, locomotion, muscle contraction, mechanical sensing, gene expression and cancer.

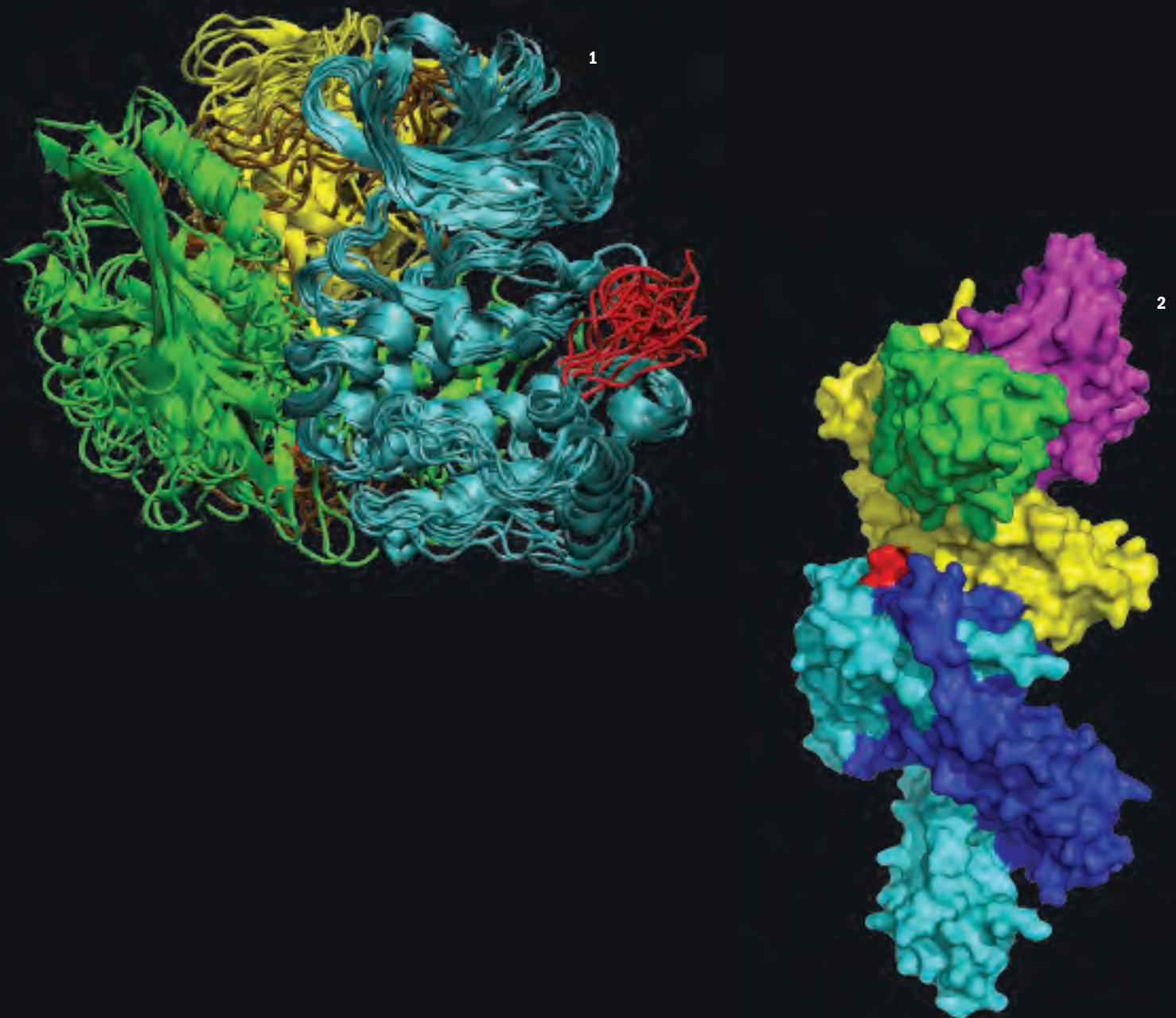
The goals are to not only understand how disease develops in humans, but also to identify novel drug targets and mechanisms of drug resistance in pathogens.

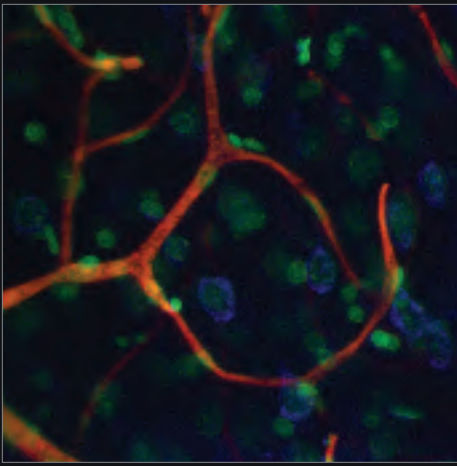


**3D cryo-EM structure of the small (28S) ribosomal subunit present within the mammalian mitochondria. Yellow: 12S rRNA; Purple: r-proteins.**

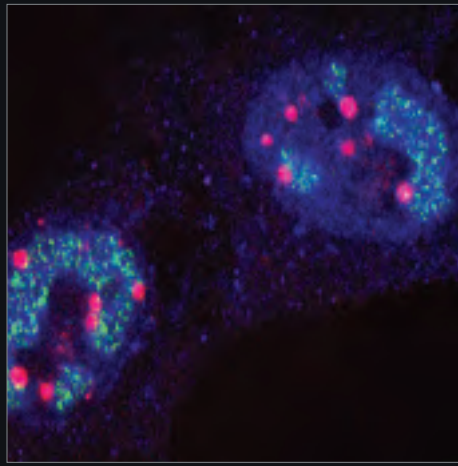
## Life Science as Art

Image isn't everything, but for some scientists, visualizing their pathogen, protein or process of interest can yield new insights. At Wadsworth Center, cell biologists, structural biologists and other life scientists produce data that are visually arresting as well as scientifically meaningful. Using sophisticated instrumentation, they generate representations of cells and biomolecules to better understand their function – pathogens invading host cells, cells caught in the act of dividing, organelles mapped in three dimensions, or proteins and nucleic acids bound in macromolecular complexes. These colorful, information-rich images have won international awards, been featured on note cards, and graced the covers of textbooks and prestigious journals, including *Science*, *Cell* and the *Proceedings of the National Academy of Sciences*.

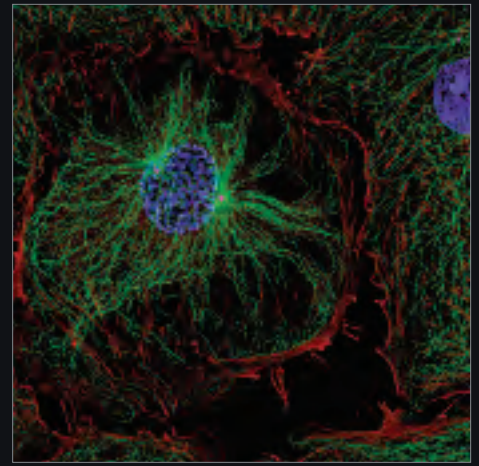




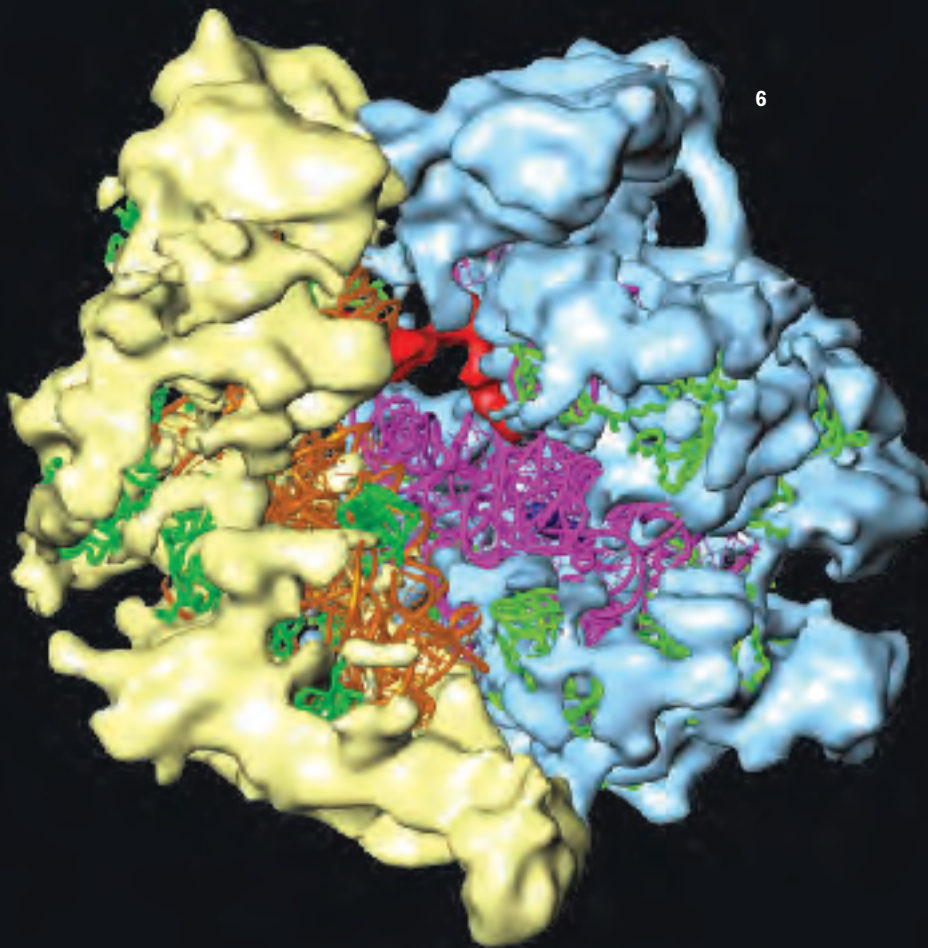
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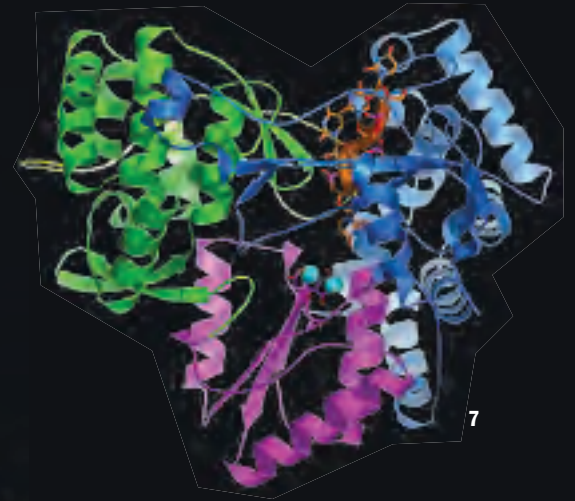
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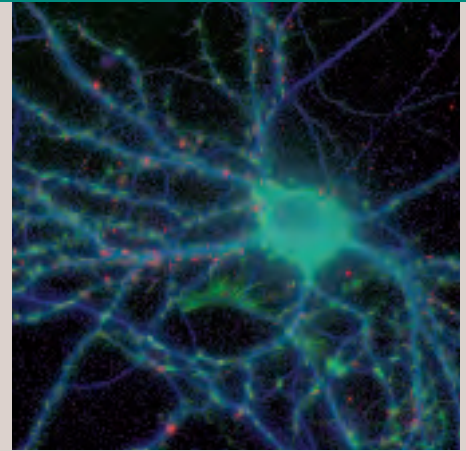
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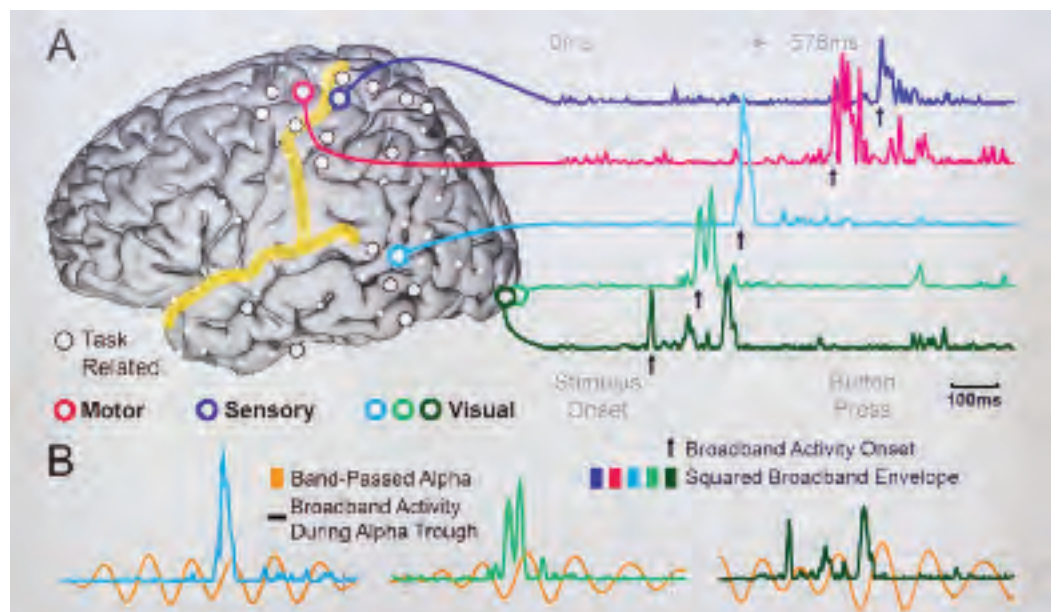
- 1 Cell signaling enzyme dynamics predicted by simulation
- 2 Structure of super antigen-immunoreceptors ternary complex
- 3 Confocal image of neurons in cerebral cortex
- 4 Relocation of chaperone proteins in herpes virus-infected cells
- 5 Vertebrate somatic cell initiates cell division (prophase)
- 6 Mammalian mitochondrial ribosome by 3D cryo-electron microscopy
- 7 X-ray structure of hepatitis C virus RNA polymerase substrate complex

# Neuroscience and Neurotechnology



Recent advances have transformed neuroscience research. Wadsworth Center scientists and engineers are augmenting and exploiting these advances in many different areas. Using sophisticated tools and animal models, researchers study the genetic, anatomical, physiological, and immunological bases of neurodevelopmental, neurodegenerative, environmental, and traumatic disorders such as autism and epilepsy.

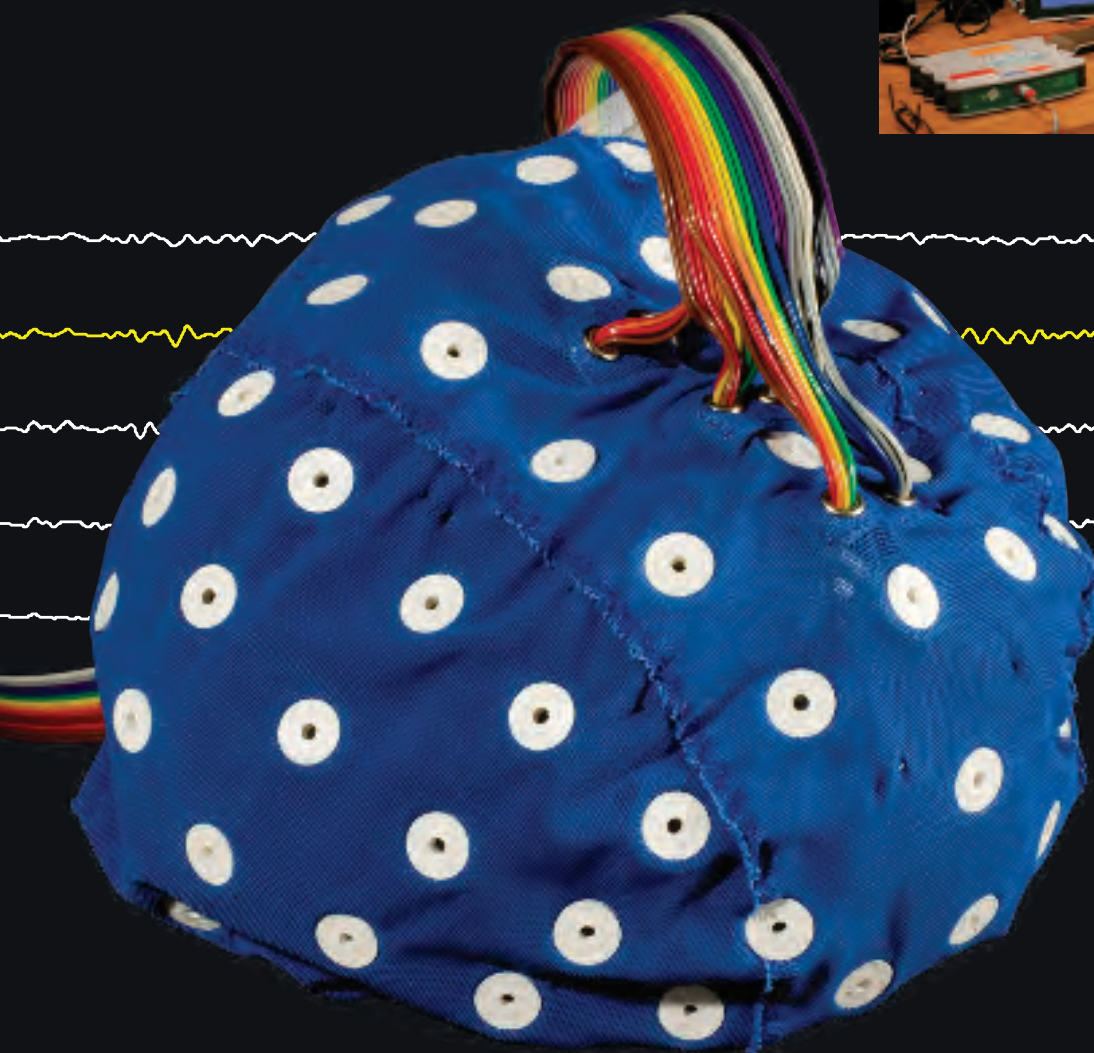
The recent realization that activity-dependent plasticity occurs across the entire central nervous system (CNS) throughout life, and that new technology can support complex, real-time adaptive interactions with the CNS to induce and guide this plasticity, represents a major breakthrough. This plasticity enables investigators to develop powerful new research tools and therapeutic methods that can restore useful function to people disabled by injury or disease. Yet another approach employs sophisticated software to translate the brain's electrical activity into control of a computer cursor or robotic arm. Strong emphasis is placed on translating basic scientific advances achieved in the laboratory into clinical studies in humans and eventually into clinical practice.



## You Think. You Can.

By simply thinking, severely disabled users of a brain-computer interface (BCI) pioneered at Wadsworth Center can compose and send e-mails, converse using a voice output utility, and control their environment, by turning on a light for example. The award-winning BCI system translates electrical signals detected from the scalp into users' commands, giving keyboard-like control of computer-based functions.

The non-invasive system consists of an electrode cap that detects electroencephalographic (EEG) activity from the scalp, an amplifier that records key brain waves, a computer and sophisticated software. The research project has moved from laboratory to living room, with the development of a portable, affordable system useful for everyday tasks for the target population, the most severely disabled. The first home-based user, a working neuroscientist with ALS (Lou Gehrig's disease), used BCI to communicate by e-mail with his research team.



# Infectious Disease and Host Defense

Public health and basic research programs converge on infectious agents, with Wadsworth Center scientists seeking to improve detection of disease-causing organisms and understand their fundamental properties. Staff develop and validate tests to identify pathogens in order to monitor and manage disease outbreaks. While not abandoning traditional methods, they embrace modern molecular technologies that rapidly determine the source of disease transmission.

At the same time, researchers dissect the lifestyles of bacteria, viruses, parasites and fungi to understand how these infect and interact with their human host. For example, detailed knowledge about key proteins and the cellular machinery that pathogens require for virulence can aid in the development of novel drugs or vaccines that interrupt the disease process.







**Zoonotic diseases transmitted directly to people from vertebrate hosts such as bats, or by mosquitoes, ticks and other vectors, account for many emerging diseases.**

**Above: *Ixodes scapularis*, a tick capable of transmitting the causative agent of Lyme disease and other organisms.**

**Below: *Aedes aegypti* mosquito during a blood feeding.**

## VIROLOGY

Wadsworth Center scientists probe the mechanisms that viruses use to hijack a human host's replication machinery, causing diseases from AIDS to Zika. They examine viral proteins that help assemble genetic material into infectious particles and analyze how changes in these proteins allow the SARS coronavirus and other pathogens to adapt to new hosts. Arbovirus researchers concentrate on the ecology and evolution of mosquito-borne viruses, such as West Nile, Zika, chikungunya and their insect vectors, while clinical virologists test for the presence of these viruses in patients.

The clinical program also conducts outbreak investigations, performs surveillance, develops tests for emerging pathogens and collaborates with the World Health Organization and the Centers for Disease Control and Prevention (CDC) to detect the earliest appearance of new strains of influenza. Other Wadsworth Center laboratories chart the prevalence in and spread of viruses to other hosts, including rabies in bats and other animals.

## ZOONOTIC AND VECTOR-BORNE DISEASES

Zoonotic diseases constitute the majority of emerging diseases due to climate and environmental changes and the rise in international travel and commerce. Surveillance studies show clear evidence of the spread of tick-borne diseases northward, and similar trends are observed for diseases transmitted by mosquitoes. Zoonotic and vector-borne diseases are therefore priority focus areas.

Highly unique facilities and resources, such as the Griffin insectary, are available to researchers who possess a broad range of expertise in ecology, cell biology, molecular biology, molecular genetics, structural biology, biochemistry and immunology.

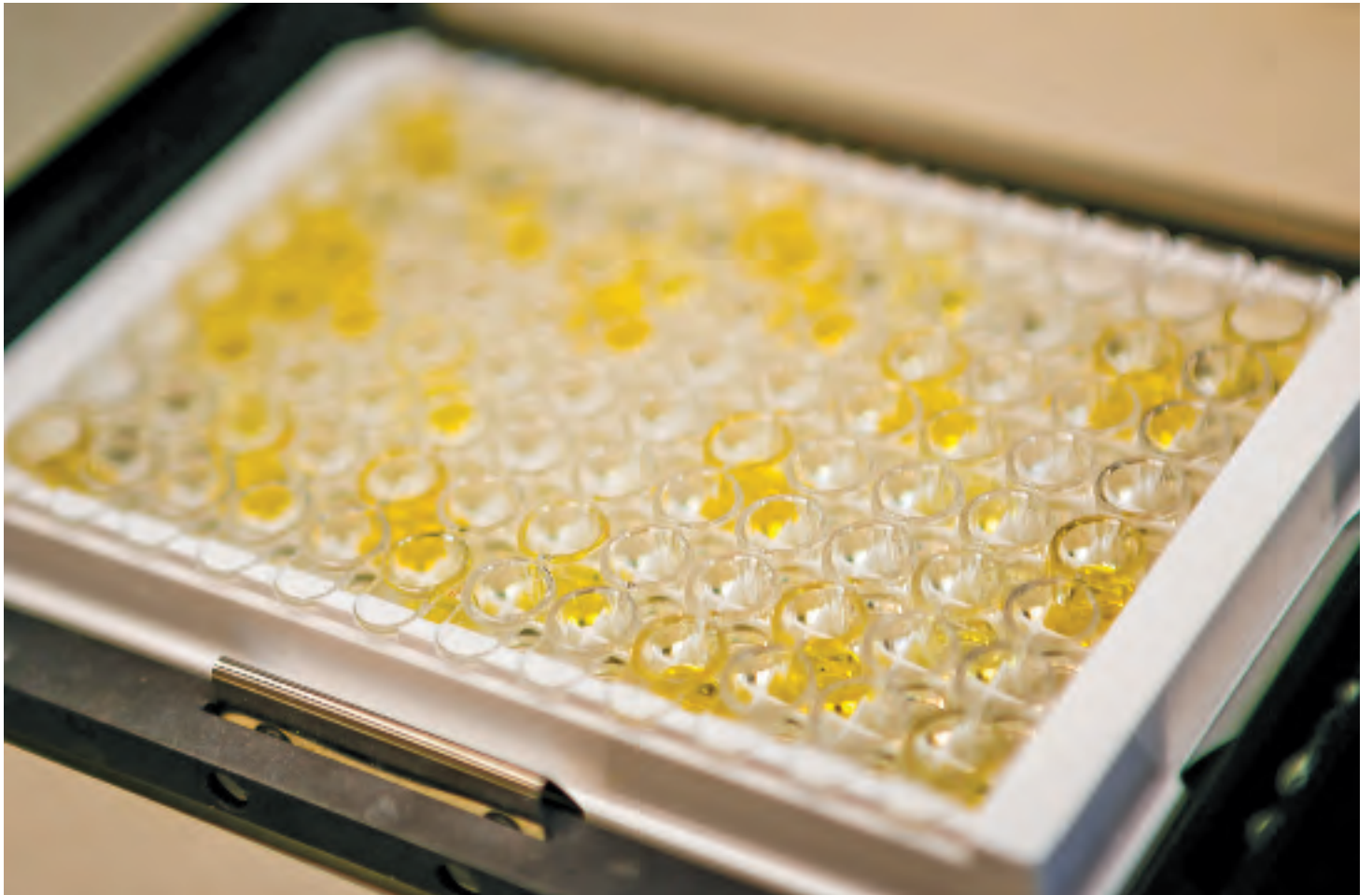
Pathogens of interest include Zika, West Nile, chikungunya, dengue, eastern equine encephalitis, rabies and Powassan viruses, as well as other zoonotic agents such as *Borrelia* (causing Lyme disease).

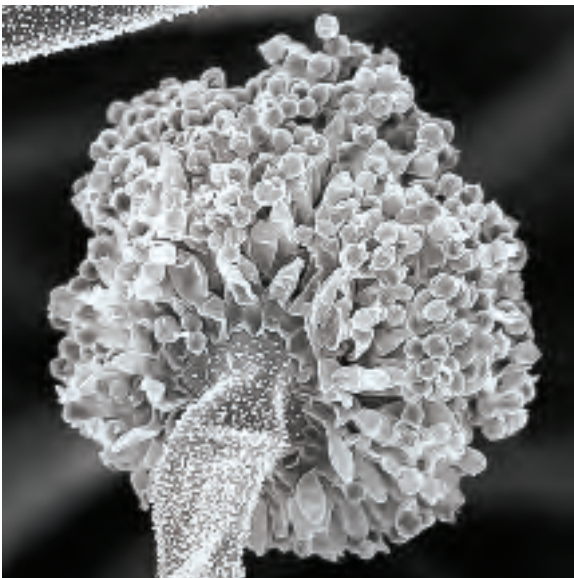
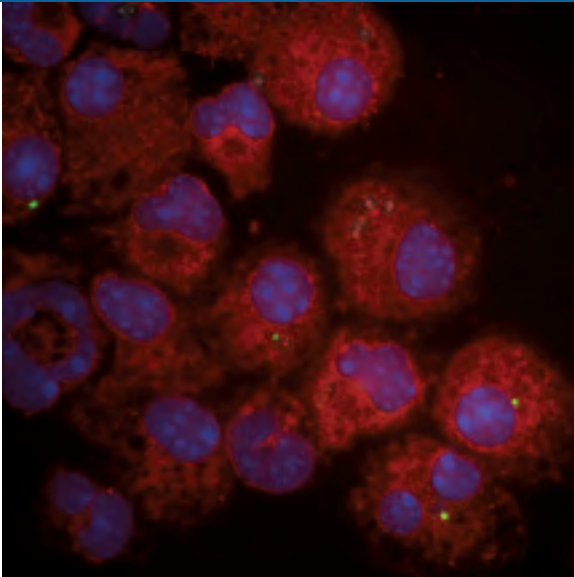
## ANTICIPATING THE NEXT EPIDEMIC

Wadsworth Center arbovirologists study the biological factors (the genetics of the vector, virulence of the pathogen, susceptibility of the host) in combination with the non-biological factors (temperature, precipitation, land development) that impact transmission intensity and perpetuation of pathogens.

Long before Zika was a household name, research at Wadsworth Center led to the expectation that Zika would become “the next epidemic.” As a result, tests with enhanced specificity were developed and this laboratory became one of the first laboratories besides CDC capable of rapidly responding to Zika outbreaks.

As clinical samples flooded the laboratory, one of Wadsworth Center’s immunologists identified an area for improvement in an existing Zika serology test and after intensive research and testing, was co-inventor of a new and highly specific test for Zika virus infection.





## IMMUNOLOGY

The immune system sometimes misses the mark, either failing to mount a response against foreign elements or mistakenly targeting host cells, leading to autoimmune diseases. Wadsworth Center investigators parse the immune system, studying its component cells and the mechanisms involved in host defense against bacterial and viral infections. Researchers consider factors that modulate immune response, including diet, environmental pollutants, aging, stress, hormones and genetic makeup. Avenues for novel therapeutics are assessed, such as the properties of mucosal antibodies that inhibit infection and the structure of immune molecules that mediate a protective response. Scientists develop tests to measure specific serum antibody levels for emerging and newly epidemic diseases, among them Powassan encephalitis, Lyme and Zika.

## PARASITOLOGY AND MYCOLOGY

Fungal and parasitic infections that debilitate the very young, the aged and immunocompromised patients, especially those with AIDS, highlight the need for more effective treatments.

Wadsworth Center researchers study yeasts, molds and other medically important fungi using recombinant DNA technology and animal models to understand how the pathogens cause disease. Their ultimate goal is to identify genes or proteins useful for diagnosis or development of novel drugs.

Similarly, scientists investigate parasites, with a particular focus on the causative agents of malaria, toxoplasmosis and cryptosporidiosis, the latter a potentially life-threatening gastrointestinal illness.

Traditional and molecular diagnoses of molds, yeasts and parasites from clinical specimens and the environment are performed, as well as more complex confirmatory testing.

## BACTERIOLOGY

The study of bacterial pathogens incorporates conventional and molecular diagnostics, surveillance, strain typing and research. Investigators focus on *Mycobacterium tuberculosis* to understand how the bacterium that causes tuberculosis lies dormant within the lungs, then overcomes the host's immune defenses to initiate disease.

Wadsworth Center scientists develop and validate molecular tools to detect and identify bacteria in complex clinical and environmental samples, methods that have helped address disease outbreaks caused by *E. coli* O157:H7 and *Legionella pneumophila*.

Naturally occurring outbreaks are tracked with DNA typing (bacterial fingerprinting) to confirm links between organisms causing human disease and their presence in implicated food or other products. This information is incorporated into a national database to proactively identify outbreaks that may affect neighboring states. This expertise also aids in the assessment of bioterror samples for infectious agents that may have been deliberately disseminated.

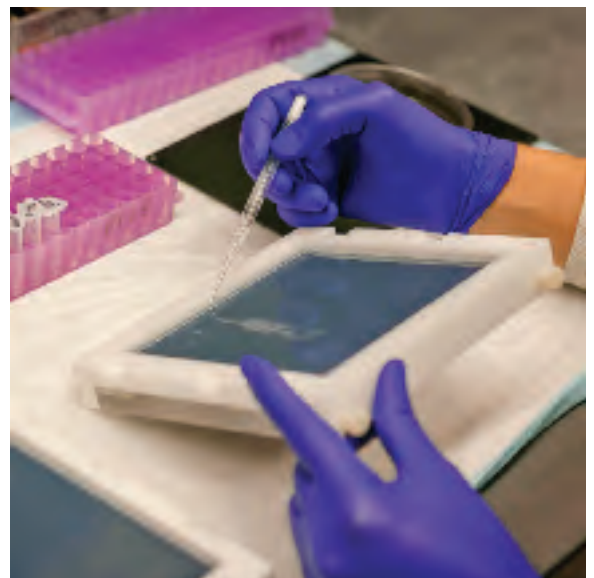
## PUTTING THE BRAKES ON OUTBREAKS

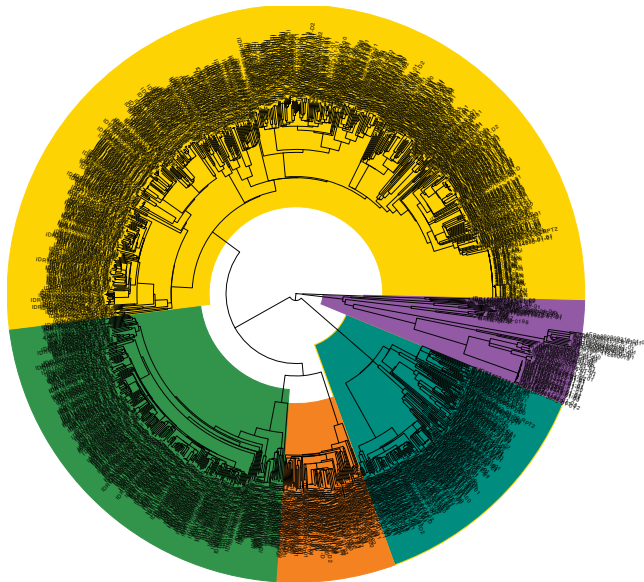
Culture (growth *in vitro*) is the classical approach to *Legionella* testing of environmental samples, but *Legionella* bacteria are slow-growing and the submitted samples are usually heavily contaminated with other bacteria. Obtaining results by culture can take a long time, delaying the required public health response.

Instead, the Bacteriology Laboratory first screens water samples using a rapid, in-house developed, multiplex real-time PCR assay. Positive samples are then cultured, and isolates are genotyped by pulsed-field gel electrophoresis (PFGE).

For outbreak analysis, the Applied Genomic Technologies Core performs whole genome sequencing of human and water isolates and the Bioinformatics Core performs sequence analysis of the data, which confirms and enhances the PFGE results.

This work contributed to the identification of a contaminated cooling tower in NYC responsible for significant morbidity and mortality during one *Legionella* outbreak.





**A *Mycobacterium tuberculosis* phylogenetic tree of strains isolated from new TB patients in New York informs epidemiological investigations and provides insight into drug resistance.**

## ANTIMICROBIAL RESISTANCE

With the introduction of antibiotics approximately 70 years ago, minor wounds and illnesses ceased to be life-threatening. In the intervening years, with the widespread use of these medications, many organisms have become resistant. In 2016 in the United States alone, over two million people became ill and over 23,000 died because of antibiotic resistant organisms. For some organisms, even antibiotics normally reserved as the last line of defense no longer work, and no effective antibiotics exist to treat the patient.

In 2016, Wadsworth Center became one of only seven laboratories in the United States designated by CDC as an Antibiotic Resistance Regional Laboratory, testing specimens from an eight-state region for seven threats deemed as urgent or serious in the CDC Antibiotic Resistance threat report. In addition, the Mycology Laboratory is designated as one of only four in the country to test certain fungal pathogens for antifungal resistance.

In close collaboration with the CDC, Wadsworth Center scientists work on special projects designed to address specific antimicrobial resistance threats, using both gold standard and cutting-edge technologies to provide for faster outbreak detection and response, better tracking of antimicrobial resistance, and provision of real-time actionable data to prevent and combat future threats in the Northeast.

## COMBATING TUBERCULOSIS

Wadsworth Center is the first state public health laboratory in the nation to perform whole-genome sequencing as a clinical diagnostic test for tuberculosis (TB) and to use the results to predict the best treatment for the patient.

This one test can replace nearly a dozen tests, reducing turnaround time for diagnosis and susceptibility testing for first- and second-line treatments from 41 to 11 days, for example. Even greater decreases in turnaround time are anticipated with further improvements in technology.

Since TB infection can continue to be spread for up to two to three weeks after initiation of medication, quickly determining and prescribing the correct treatment greatly reduces the risk for disease transmission and spread throughout the community.

## Reference, Readiness and Response

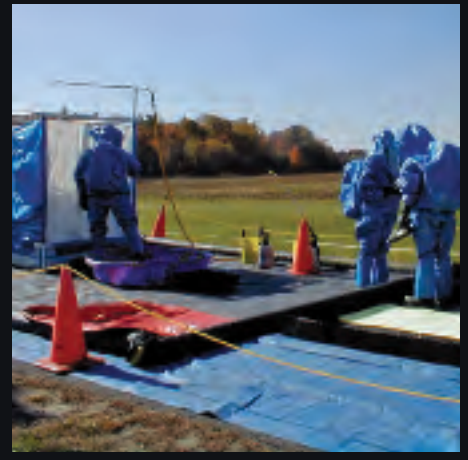
Rapid identification of biological and environmental threats is an everyday event at New York State's public health reference laboratory.

### BIOLOGICAL

- Staff have identified more than 30 emerging and re-emerging disease-causing organisms in recent years, including West Nile virus, Hantavirus, Zika, Powassan virus, *Legionella*, *Listeria* and *Cryptosporidium*.
- In a single year, bacteriologists implemented almost two dozen new molecular-based methods and tested more than 10,000 specimens using such tests, in some cases linking New York State patients with nationwide foodborne disease outbreaks.
- Virologists developed a molecular test to simultaneously detect 11 respiratory viruses in a single reaction, and used archived influenza specimens to demonstrate the evolution of the influenza virus over a single flu season.
- Rabies specialists developed and licensed a novel approach to producing a biological reagent used by all public health laboratories as part of the gold-standard rabies diagnostic test.
- The Biodefense Laboratory analyzed more than 1,000 suspicious materials and clinical specimens for the presence of *Bacillus anthracis* following the anthrax attacks in the fall of 2001, and continues to assess potential biothreats to this day.

### CHEMICAL AND RADIOLOGICAL

- The federal government designated Wadsworth Center as one of only two sites to evaluate prototype mobile units for screening environmental samples to rule out potential hazards, such as nerve agents, explosives or radiation, prior to biological testing.
- As a Level 1 Laboratory in the Laboratory Response Network for Chemical Threats, staff provides surge-capacity testing to the CDC, detecting many toxic chemicals including mustard gas and nerve agents.
- As a member laboratory of the Food Emergency Response Network, Wadsworth Center's Environmental Health Program ensures the safety of the nation's food supply by testing for the presence of radiation.
- The Nuclear Chemistry Laboratory partners with the Bureau of Environmental Radiation Protection to provide analytical support during radiological events through measurements of milk, soil, air and vegetation samples collected by trained DOH staff.



Training for preparedness takes place in the field and at the laboratory bench with first responders and other critical partners.



Determining PFOA levels in serum

# Environmental Health Science



Scientific and technological advances of the last years allowed for the detection of more and more minute quantities of contaminants in complex environmental samples. Complementing that capacity today is the emerging ability to directly measure environmental chemicals or their byproducts in clinical specimens, called biomonitoring. At Wadsworth Center, scientists employ these and other approaches to monitor the environment for public health threats, assess individual exposures, and investigate the relationships between environmental, occupational, and dietary exposures and health effects. Their studies also examine the underlying interactions of environmental toxicants with immune, endocrine, neurologic and genetic systems.

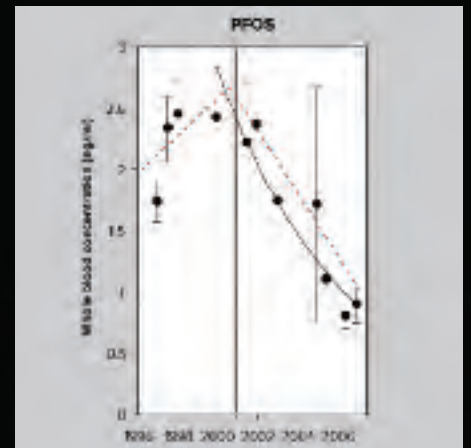


## Biomonitoring

Biomonitoring measures personal environmental exposures, rather than inferring exposure from chemical concentrations in air, water or soil. This approach directly quantifies the suspect chemical, its metabolites or reaction products in human specimens. Wadsworth Center scientists are developing methods to measure biomarkers of exposure in serum and urine in order to identify individuals at risk. Biomonitoring can help determine the relationship between exposure and disease, and target prevention and remediation efforts more appropriately. For example, an objective measure of exposure to emissions from the World Trade Center disaster in state employees and National Guardsmen will support investigations of future health effects.

### BIOMONITORING IN ACTION

- Measurement of nicotine metabolites to determine the effect of smoking law changes on exposure of bar and restaurant workers to secondhand smoke.
- Assessment of fish-borne exposure to bioaccumulative flame retardant chemicals in anglers.
- Evaluation of mercury exposure in New York City adults to identify at-risk populations and identify sources of exposure.
- Response to accidental or deliberate release of toxic chemicals to identify agents, determine exposure and assess re-occupancy.
- Collaboration with the local community to identify exposure to enriched and depleted uranium in former factory workers and local residents.
- Assessment of perfluorochemical exposures among populations affected by drinking water contamination.
- Evaluation of early life exposure to perfluorinated compounds (PFCs) via analysis of newborn screening bloodspots.



Use of bloodspots in detecting declining levels of perfluorooctane sulfonate (PFOS) in New York State infants from 1997 to 2007. Production of these PFCs was phased out from 2000 to 2002.





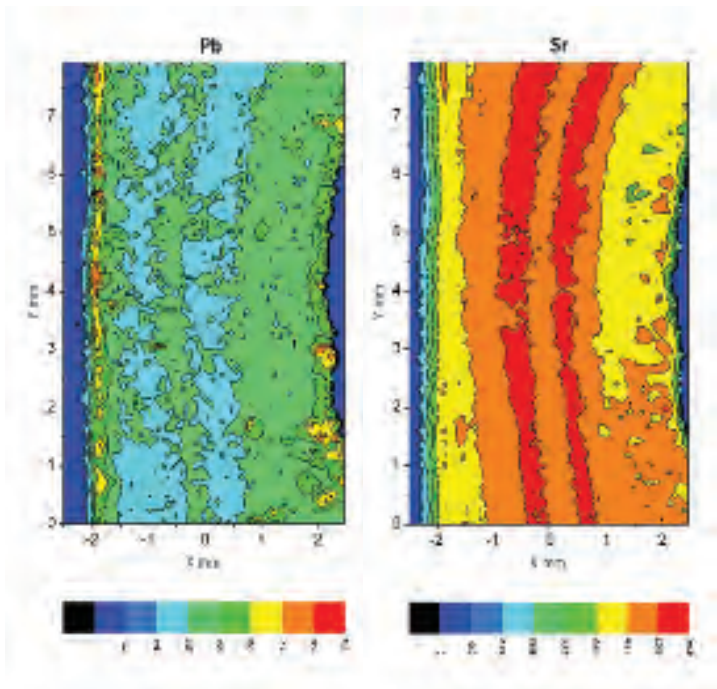
## ENVIRONMENTAL EXPOSURES AND CHILDREN

Wadsworth Center works with the National Institutes of Health and five other centers to test children's blood and urine for the presence of organic chemical contaminants, such as flame retardants, insecticides, and toxic heavy metals, including lead, cadmium, mercury and arsenic. Results provide accurate measurements that support research studies of the impact of environmental exposures on children's health. Wadsworth Center plays a key role in overseeing the quality of measurements for toxic metals in blood and urine.

## BISPHENOL A EXPOSURE

Wadsworth Center conducts pioneering human biomonitoring studies on the occurrence of bisphenol A (BPA) in currency notes, paper receipts, paper products and clothing, and the exposure of New Yorkers to this compound. BPA, produced in quantities of over eight billion pounds each year worldwide, is used in the production of polycarbonate plastics, and in the resin lining of food and beverage cans. BPA is now being found in foodstuffs and house dust, as well as in human urine and breast milk. BPA is an endocrine-disrupting chemical. Human exposures to BPA have been associated with a wide array of adverse health outcomes, including obesity and diabetes. As concern grows regarding the toxic effects of BPA, it is gradually being replaced in many consumer products with compounds such as bisphenol S. Changes in regulations for the use of bisphenols in some countries have changed the patterns of bisphenols found in urine. The method developed in the laboratory is being applied to a large-scale study of the exposure of newborn babies in upstate New York to BPA for examining the association of exposure to health outcomes.





**A novel X-ray fluorescence instrument detects lead (Pb) and strontium (Sr) concentrations in goat shin bone, while other trace metal analyses take place in a clean-room environment.**

## TOXICOLOGY

Differences in how chemicals are metabolized can be explained, in part, by an organism's own genetic make-up. Variant forms of enzymes that bioactivate foreign compounds, whether therapeutic drugs or environmental pollutants, can predispose individuals to toxic or beneficial effects.

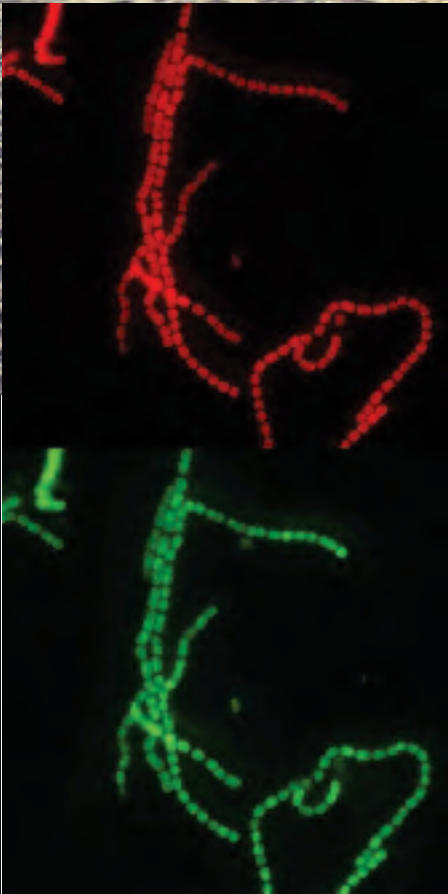
Wadsworth Center scientists study variants of a complex metabolizing system known as cytochrome P450. They investigate the influence of metals, fluoride, nanoparticles and other foreign substances on P450 function, and study the enzymes' differential expression in multiple tissues.

Other efforts to identify environmental triggers of disease examine alterations in nervous system function produced by exposure to contaminants such as PCBs, pesticides, methylmercury and engine exhaust fumes.

The Trace Elements Laboratory conducts biomonitoring research for lead, arsenic and mercury, and performs analyses in support of public health lead poisoning programs.







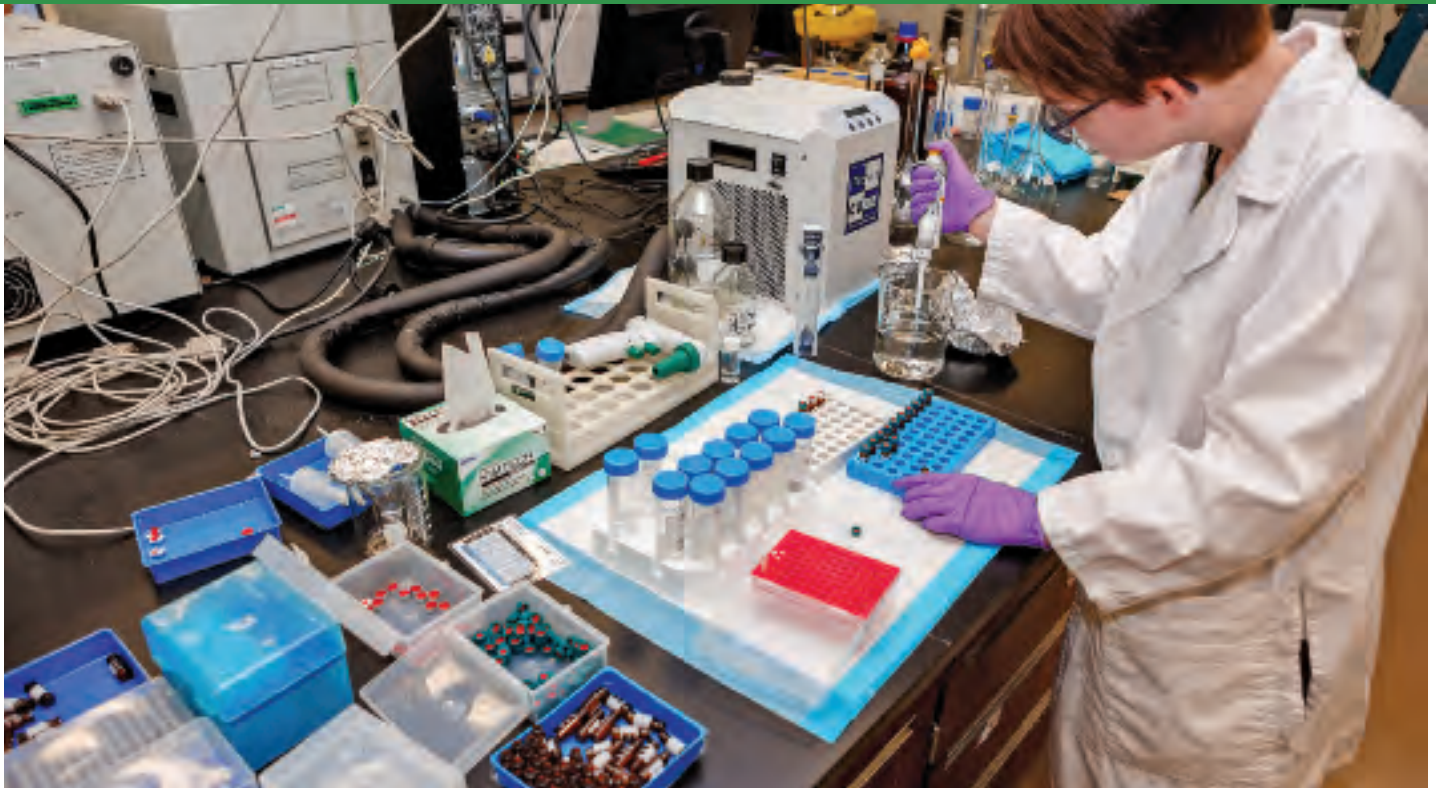
## Do (or Don't) Jump in the Water

Micron-sized organisms whose presence in recreational waters indicates bacterial contamination take time to identify. The lag between sample collection and reporting means that day-old data, at best, inform decisions on beach closings. Wadsworth Center has addressed this vital issue by developing a molecular-based assay that is hours faster than culture, the gold standard. This Environmental Protection Agency-based test amplifies a segment of an *Enterococcus* gene, giving rapid and accurate results.

*Enterococcus* isn't the only thing living in recreational waters. As part of public health responses, Wadsworth Center tests for *Giardia*, *Cryptosporidium* and other waterborne pathogens. Molecular methods are also used to discriminate human, agricultural and avian sources of fecal pollution impacting beaches and to rapidly differentiate toxin-producing species of blue green algae from their non-toxic counterparts, delivering the news bathers need to hear faster.

### DRINKING WATER QUALITY

Wadsworth Center scientists develop state-of-the-art methods to quantify the sources, distribution, fate and transport of waterborne toxicants, including persistent organic pollutants (e.g., PCBs and dioxins), perfluorinated compounds and heavy metals. These rapid and accurate analytical tools aid routine monitoring of water resources and improve response to public health emergencies.



### **MEDICAL MARIJUANA AND CANNABINOID TESTING**

Enhancing the safety of Medical Marijuana in New York, Wadsworth Center scientists perform over 12,000 tests per year for contaminants such as pathogenic microorganisms, heavy metals, mycotoxins and pesticides. Equally as important, they confirm the cannabinoid potency of each product type.

Testing of illicit synthetic cannabinoids for law enforcement agencies is literally a moving target comprised of a large, ever-growing, and continually evolving family of potent chemicals. Because no laboratory knows prior to testing exactly what chemical they are looking for, specialized extraction, separation, and analysis, called untargeted analysis, must be performed.



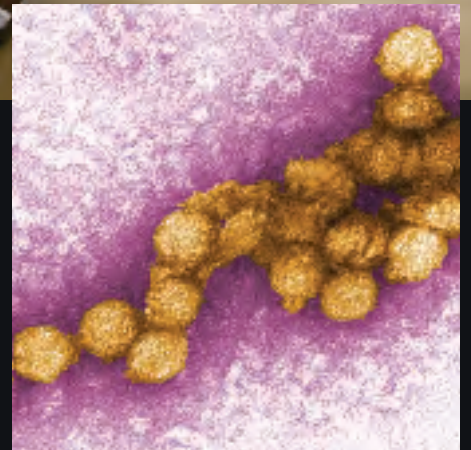
## Crossing Corridors, Crossing Disciplines

Scientists at Wadsworth Center don't work in isolation. They confer and collaborate, whether their laboratories are separated by hallways or miles. Extensive core facilities facilitate these cross-disciplinary collaborations, providing investigators and their collaborators of all disciplines with expertise and access to specialized equipment and services.

Working together, they bridge scientific divides, drawing upon their disparate expertise to wrestle with a particular challenge. For example, multiple lines of work focus on arthropod-borne agents such as West Nile virus (WNV) and Zika:

- Clinical laboratory groups test for these viruses in patients to aid decisions on treatment.
- Other groups concentrate on testing for these viruses in mosquitoes to study the transmission and pathogenesis, as well as the ecology and evolution of the virus and its insect hosts.
- And molecular biological research is geared toward understanding the machinery that replicates the viral RNA genome, with the goal of identifying molecular targets for antiviral therapy and screening prospective drugs.

It is this synergy of clinical science combined with basic and applied research that uniquely describes New York's public health laboratory.



West Nile virus



Saliva collection from West Nile-infected mosquito

CDC Public Health Image Library

## Public Health Science from A to Z

**A** Anthrax  
Antibiotic resistance  
Asbestos  
Autism  
Autoimmune disorders

**B** Bacterial infections  
Birth defects  
Bloodborne viruses  
Biomonitoring  
Borrelia

**C** Chikungunya  
Chemical pollutants  
Cystic fibrosis  
Clostridium

**D** Dengue virus  
Developmental disorders  
Drug toxicity

**E** *E. coli* O157:H7  
Enterococcus  
Epilepsy

**F** Flavivirus  
Francisella

**G** Giardiasis

**H** Hepatitis  
Hereditary disease  
HIV  
Histoplasma

**I** Influenza

**J** Japanese Encephalitis virus  
Jamestown Canyon virus  
Junin virus

**K** Kawasaki virus  
Klebsiella

**L** Lead poisoning  
Listeriosis  
Lyme disease

**M** Malaria  
Medical marijuana  
Meningococcal disease  
Microcystin  
Microbiome

**N** Neural plasticity  
Newborn screening  
Norovirus

**O** Olfaction  
Opioids  
Organic solvents  
Outbreaks  
Outdoor air  
Ozone

**P** Parasites  
Phthalates  
PFOA

**Q** Q fever

**R** Rabies  
Radon

**S** SARS  
Sarin  
Spinal cord injury  
Syphilis

**T** Tickborne disease  
Trichinosis  
Tuberculosis  
Taenia (tapeworm)

**U** Uranium, enriched and depleted  
Urine

**V** Vaccine development  
Viral infections

**W** West Nile virus  
Whooping cough  
WTC

**X** X-ray crystallography  
XDR

**Y** Yellow fever  
Yersinia pestis

**Z** Zika  
Zoonotic diseases

# Ensuring Quality of Laboratory Services

The analysis of human clinical specimens or samples collected from the environment provides information that is essential to health assessment and disease or exposure prevention. The quality assurance and regulatory oversight programs of New York State that reside in Wadsworth Center ensure that hospital-based and commercial testing laboratories provide accurate, reliable and reproducible test results.







### CLINICAL LABORATORIES AND BLOOD BANKS

Wadsworth Center's Clinical Laboratory Reference System oversees the permitting of laboratories testing human specimens collected in New York. The reference system accredits clinical diagnostic laboratories, validates and approves laboratory methods and materials, provides consultation and reference testing, conducts cooperative research relevant to methods and materials, inspects laboratories, and regularly ensures compliance with proficiency testing regulations.

Increasingly, clinical laboratories are developing in-house diagnostics, known as laboratory-developed tests (LDTs), which are not subject to approval by the Food and Drug Administration. Wadsworth Center's reference system requires that their performance claims be documented before the new tests may be used. The reference system is a multifaceted program that is integrated throughout Wadsworth Center, as well as with other New York State Department of Health entities and governmental agencies.

### ENVIRONMENTAL LABORATORIES

Any environmental laboratory testing samples collected in New York must be certified by Wadsworth Center's Environmental Laboratory Approval Program (ELAP). Laboratories are certified for testing chemical and bacteriological pollutants in a range of sample types, including drinking water, natural waters, waste effluents, soils, sediments, chemical waste and air. Certification is based on successful participation in proficiency testing, on-site inspection of facilities and appropriate staffing. Perhaps unique among state accreditation programs is ELAP certification for detecting Biological Critical Agents in environmental samples, such as the causative agents of anthrax, botulism and plague.

**Summa® canisters collect ambient air and the samples are analyzed for the presence of volatile organic compounds.**



## TISSUE BANKS

Developing and enforcing standards of practice for tissue banks and transplantation facilities, the Tissue Resources Program ensures the safe and ethical solicitation, collection, processing, distribution, and use of human tissue in New York State. Banks that recover, process, store and/or distribute nontransplant bodies and/or anatomic parts for medical research and/or health professional education must also be licensed and meet requirements for record keeping and tracking.

## PHYSICIAN OFFICE LABORATORIES

In New York State, laboratory testing performed in a physician's office for that clinician's own patients is exempt from state clinical laboratory permit requirements. However, the federal Clinical Laboratory Improvement Amendments of 1988 require that all entities performing laboratory procedures register with the federal Centers for Medicare and Medicaid Services (CMS) and adhere to quality control and assurance, testing personnel, record keeping and other technical requirements.

Wadsworth Center provides certification of these facilities through the Physician Office Laboratory Evaluation Program, under contract to the CMS.

## BREATH AND BLOOD ALCOHOL TESTING

This program permits individuals to perform blood and breath alcohol analysis, ensures training agencies fulfill the necessary requirements and approves breath alcohol instruments and ignition interlock devices.

## REGULATED MEDICAL WASTE

The Regulated Medical Waste Program ensures the proper handling, storage and treatment of regulated medical waste in hospitals and clinical laboratories. The program also reviews and approves manufacturers' applications for the use of new alternative regulated waste treatment systems.

## LABORATORY INVESTIGATIONS

This unit handles and investigates complaints issued against regulated parties, works closely with the regulatory programs to perform on-site investigations and prepares referrals for administrative actions to the Health Department's Division of Legal Affairs.



## CORE FACILITIES

Core facilities provide scientific staff with access to shared instrumentation, services and expertise that would normally be beyond the fiscal means of an individual investigator or program. Thus, core facilities eliminate needless duplication of high-end analytical equipment and specialized personnel services. Wadsworth Center's cores are grouped into three general themes:

### **IMAGING**

Advanced Light Microscopy and Electron Microscopy, including various modes of image analysis

### **BIOCHEMISTRY, IMMUNOLOGY AND HISTOPATHOLOGY**

Biochemistry Instrumentation, Flow Cytometry and Nuclear Magnetic Resonance Spectroscopy, and Histopathology

### **GENOMICS AND BIOINFORMATICS**

DNA Sequencing, including Next-Generation Sequencing, Genotyping and Bioinformatics

## EDUCATIONAL PROGRAMS

Wadsworth Center houses the University at Albany, School of Public Health's Departments of Biomedical Sciences and Environmental Health Sciences. Master's and doctoral degree students prepare for teaching, research and technical careers in academia, government and industry. In addition, Wadsworth Center offers its own Master of Science Degree in Laboratory Sciences, and hosts a summer program for undergraduate students.

## EXTRAMURAL FUNDING

Wadsworth Center administers legislatively authorized extramural funding programs that support New York State investigators studying specific topics, including:

### **BREAST CANCER**

The Health Research Science Board supports breast cancer research and education.

### **MULTIPLE SCLEROSIS**

The New York State Multiple Sclerosis Research Fund supports scientific research into the causes and/or treatment of multiple sclerosis.

### **SPINAL CORD INJURIES**

The Spinal Cord Injury Research Board distributes research awards to find a cure for spinal cord injuries.

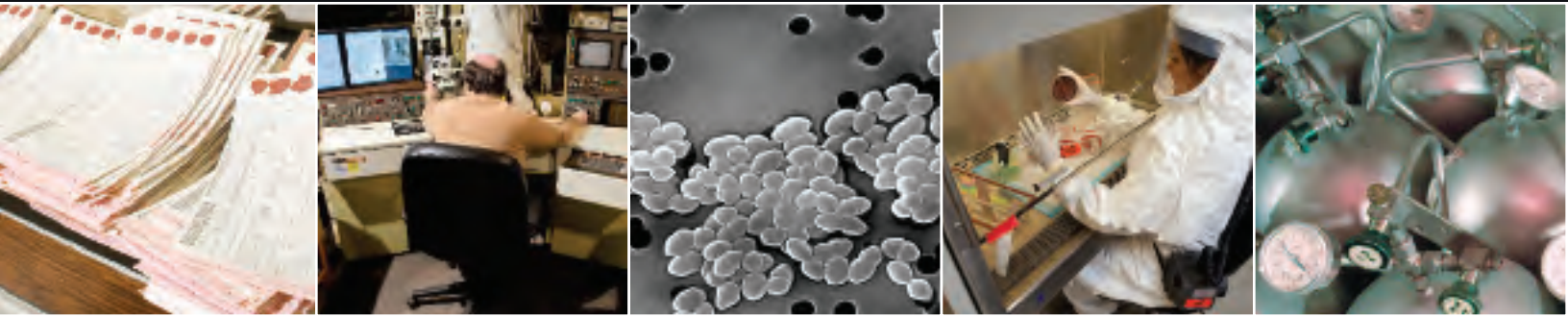
### **STEM CELLS**

The Empire State Stem Cell Board makes awards in fields related to stem cell biology.

## HEALTH RESEARCH, INC.

Health Research, Inc. (HRI), a 501(c)(3) not-for-profit corporation affiliated with the Department of Health, administers external grant support received by Wadsworth Center investigators and disseminates the benefits of the laboratory's expertise through programs such as technology transfer.

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**Department  
of Health**

Wadsworth  
Center