DEPARTMENT OF HEALTH AND HUMAN SERVICES

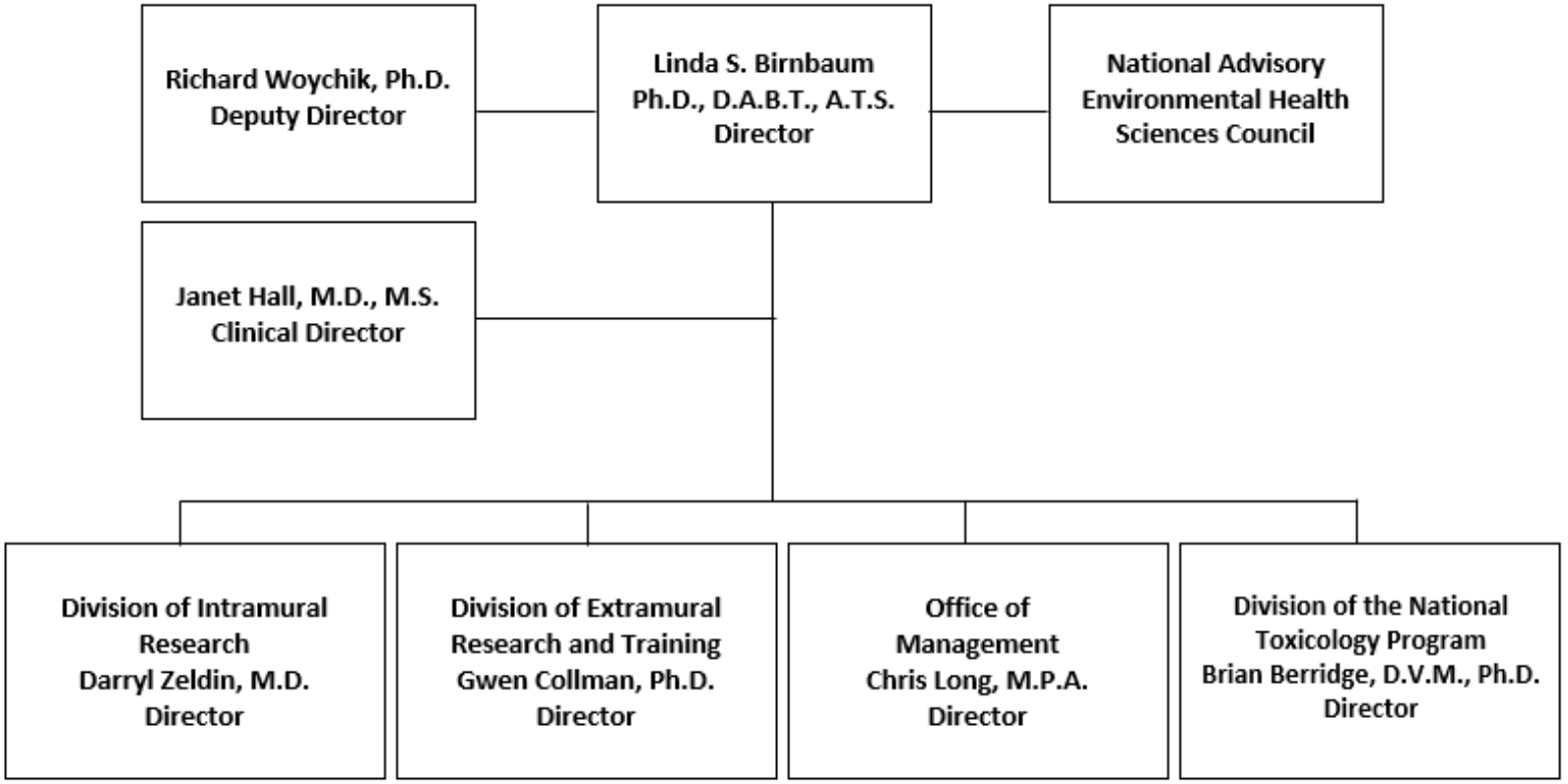
NATIONAL INSTITUTES OF HEALTH

National Institute of Environmental Health Sciences (NIEHS)

NATIONAL INSTITUTES OF HEALTH

National Institute of Environmental Health Sciences

Organization Structure



NATIONAL INSTITUTES OF HEALTH

National Institute of Environmental Health Sciences

For carrying out section 301 and title IV of the PHS Act with respect to environmental health sciences, [$774,707,000]*$666,854,000*.

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Amounts Available for Obligation[1]
(Dollars in Thousands)

Source of Funding	FY 2018 Final	FY 2019 Enacted	FY 2020 President's Budget
Appropriation	$751,143	$774,707	$666,854
Mandatory Appropriation: (non-add)			
Type 1 Diabetes	*(0)*	*(0)*	*(0)*
Other Mandatory financing	*(0)*	*(0)*	*(0)*
Rescission	0	0	0
Sequestration	0	0	0
Secretary's Transfer	-1,765	0	0
Subtotal, adjusted appropriation	$749,378	$774,707	$666,854
OAR HIV/AIDS Transfers	0	0	0
Subtotal, adjusted budget authority	$749,378	$774,707	$666,854
Unobligated balance, start of year	0	0	0
Unobligated balance, end of year	0	0	0
Subtotal, adjusted budget authority	$749,378	$774,707	$666,854
Unobligated balance lapsing	-74	0	0
Total obligations	$749,304	$774,707	$666,854

[1] Excludes the following amounts (in thousand) for reimbursable activities carried out by this account:
FY 2018 - $6,177 FY 2019 - $6,215 FY 2020 - $6,215

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Budget Mechanism - Total[1]

(Dollars in Thousands)

MECHANISM	FY 2018 Final		FY 2019 Enacted		FY 2020 President's Budget		FY 2020 +/- FY 2019 Enacted	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Research Projects:								
Noncompeting	421	$181,900	475	$204,145	453	$176,980	-22	-$27,165
Administrative Supplements	*(54)*	6,961	*(26)*	3,000	*(9)*	1,000	*(-17)*	-2,000
Competing:								
Renewal	16	6,438	12	5,567	9	3,701	-3	-1,866
New	173	64,068	136	49,463	135	42,705	-1	-6,757
Supplements	2	767	0	0	0	0	0	0
Subtotal, Competing	191	$71,273	148	$55,030	144	$46,406	-4	-$8,624
Subtotal, RPGs	612	$260,135	623	$262,174	597	$224,386	-26	-$37,789
SBIR/STTR	42	18,672	45	20,123	41	18,232	-4	-1,891
Research Project Grants	654	$278,807	668	$282,297	638	$242,617	-30	-$39,680
Research Centers:								
Specialized/Comprehensive	29	$38,890	27	$36,713	23	$31,537	-4	-$5,177
Clinical Research	0	0	0	0	0	0	0	0
Biotechnology	0	0	0	0	0	0	0	0
Comparative Medicine	0	0	0	0	0	0	0	0
Research Centers in Minority Institutions	0	0	0	0	0	0	0	0
Research Centers	29	$38,890	27	$36,713	23	$31,537	-4	-$5,177
Other Research:								
Research Careers	47	$6,369	47	$6,403	40	$5,500	-7	-$903
Cancer Education	0	0	0	0	0	0	0	0
Cooperative Clinical Research	0	0	0	0	0	0	0	0
Biomedical Research Support	0	0	0	0	0	0	0	0
Minority Biomedical Research Support	0	199	0	198	0	170	0	-28
Other	47	9,881	60	22,536	52	19,358	-8	-3,178
Other Research	94	$16,450	107	$29,136	92	$25,028	-15	-$4,108
Total Research Grants	777	$334,147	802	$348,147	753	$299,182	-49	-$48,965
Ruth L Kirchstein Training Awards:	FTTPs		FTTPs		FTTPs		FTTPs	
Individual Awards	47	$2,011	54	$2,429	46	$2,087	-8	-$343
Institutional Awards	369	17,918	371	15,500	319	13,314	-52	-2,185
Total Research Training	416	$19,929	425	$17,929	365	$15,401	-60	-$2,528
Research & Develop. Contracts	125	$153,713	127	$158,876	109	$136,454	-18	-$22,422
(SBIR/STTR) (non-add)	*(0)*	*(0)*	*(0)*	*(190)*	*(0)*	*(164)*	*(0)*	*(0)*
Intramural Research	499	213,187	527	220,393	527	189,393	0	-31,000
Res. Management & Support	131	28,402	135	29,362	135	26,424	0	-2,938
Res. Management & Support (SBIR Admin) (non-add)	*(0)*	*(0)*	*(0)*	*(154)*	*(0)*	*(139)*	*(0)*	*(0)*
Total, NIEHS	630	$749,378	662	$774,707	662	$666,854	0	-$107,853

[1] All items in italics and brackets are non-add entries.

Major Changes in the Fiscal Year 2020 President's Budget Request

Major changes by budget mechanism and/or budget activity detail are briefly described below. The FY 2020 President's Budget for NIEHS is $666.9 million, which is $107.9 million below the FY 2019 enacted level.

Research Project Grants (RPGs) (-$39.7 million; total $242.6 million):
NIEHS plans to support a total of 638 RPG awards in FY 2020. Noncompeting RPGs will decrease by 22 awards and $27.2 million from the FY 2019 Enacted level. Competing RPGs will decrease by four awards and $8.6 million. NIEHS will continue to support new investigators in FY 2020.

Funding reductions have been distributed across all budget activities.

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Summary of Changes

(Dollars in Thousands)

FY 2019 Enacted	$774,707
FY 2020 President's Budget	$666,854
Net change	-$107,853

CHANGES	FY 2020 President's Budget FTEs	FY 2020 President's Budget Budget Authority	Change from FY 2019 Enacted FTEs	Change from FY 2019 Enacted Budget Authority
A. Built-in:				
1. Intramural Research:				
a. Annualization of January 2019 pay increase & benefits		$85,350		$361
b. January FY 2020 pay increase & benefits		85,350		1,084
c. Paid days adjustment		85,350		6
d. Differences attributable to change in FTE		85,350		0
e. Payment for centrally furnished services		26,147		-202
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		77,897		-32,249
Subtotal				-$31,000
2. Research Management and Support:				
a. Annualization of January 2019 pay increase & benefits		$16,958		$273
b. January FY 2020 pay increase & benefits		16,958		818
c. Paid days adjustment		16,958		4
d. Differences attributable to change in FTE		16,958		0
e. Payment for centrally furnished services		2,874		-319
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		6,592		-3,713
Subtotal				-$2,938
Subtotal, Built-in				-$33,938

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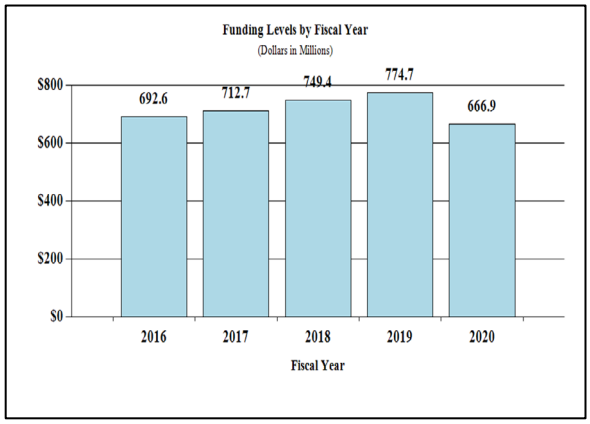
Summary of Changes - Continued

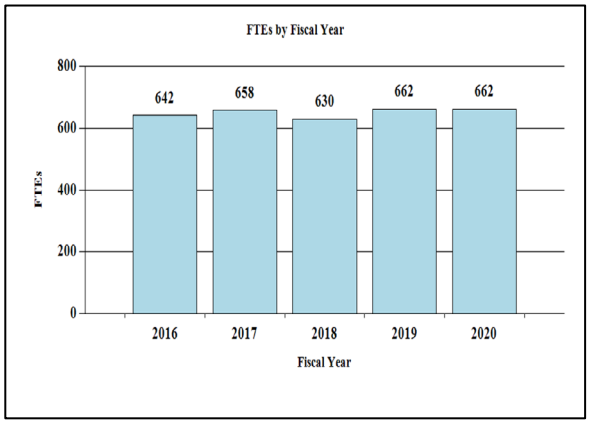
(Dollars in Thousands)

CHANGES	FY 2020 President's Budget		Change from FY 2019 Enacted	
	No.	Amount	No.	Amount
B. Program:				
1. Research Project Grants:				
a. Noncompeting	453	$177,980	-22	-$29,165
b. Competing	144	46,406	-4	-8,624
c. SBIR/STTR	41	18,232	-4	-1,891
Subtotal, RPGs	638	$242,617	-30	-$39,680
2. Research Centers	23	$31,537	-4	-$5,177
3. Other Research	92	25,028	-15	-4,108
4. Research Training	365	15,401	-60	-2,528
5. Research and development contracts	109	136,454	-18	-22,422
Subtotal, Extramural		$451,037		-$73,915
	FTEs		FTEs	
6. Intramural Research	527	$189,393	0	$0
7. Research Management and Support	135	26,424	0	0
8. Construction		0		0
9. Buildings and Facilities		0		0
Subtotal, Program	662	$666,854	0	-$73,915
Total changes				-$107,853

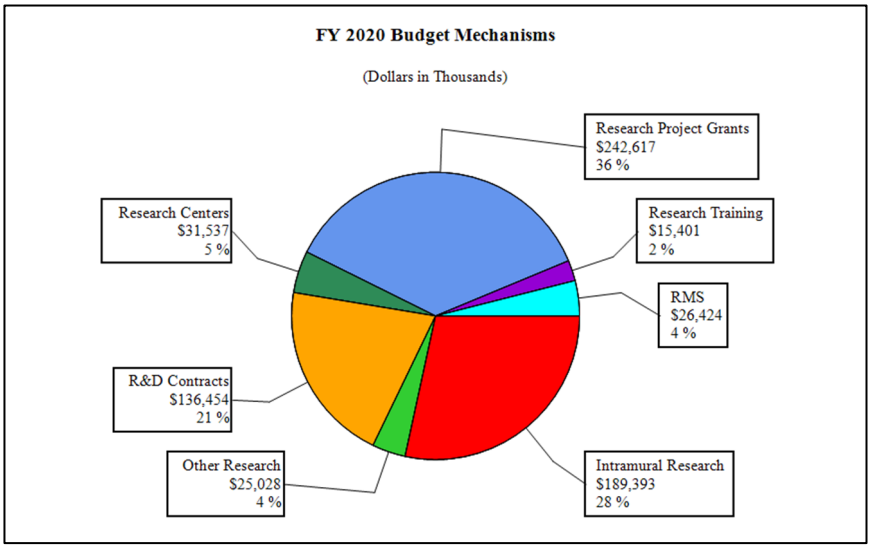
Fiscal Year 2020 Budget Graphs

History of Budget Authority and FTEs:

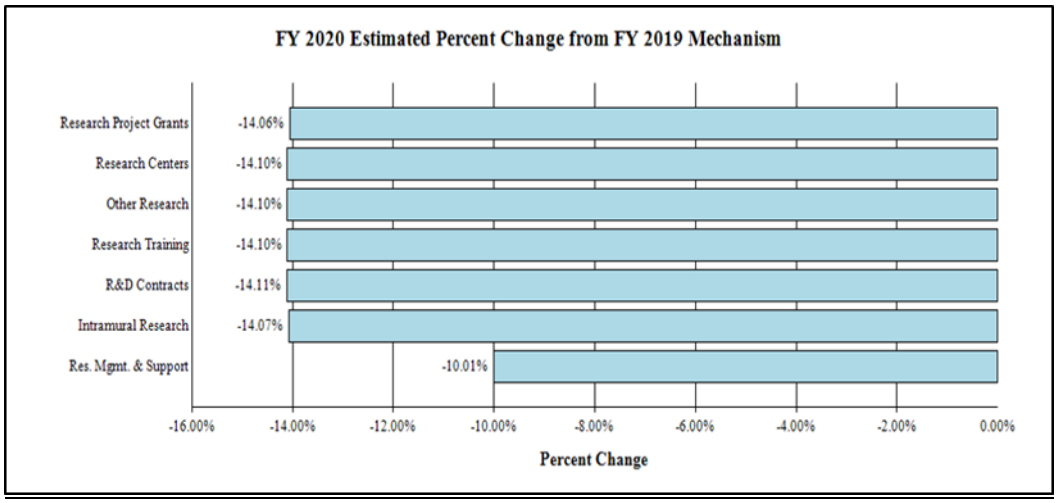




Distribution by Mechanism (dollars in thousands):



Change by Selected Mechanism:



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Budget Authority by Activity[1]
(Dollars in Thousands)

	FY 2018 Final		FY 2019 Enacted		FY 2020 President's Budget		FY 2020 +/- FY2019 CR	
Extramural Research	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
Detail								
Fundamental Research		$197,674		$201,827		$173,410		-$28,417
Exposure Research		89,770		97,055		83,389		-13,666
Translational Research and Special Populations		106,188		111,367		95,686		-15,681
Predictive Toxicology		90,881		92,129		79,157		-12,972
Training and Education		23,276		22,573		19,395		-3,178
Subtotal, Extramural		**$507,789**		**$524,952**		**$451,037**		**-$73,915**
Intramural Research	**499**	**$213,187**	**527**	**$220,393**	**527**	**$189,393**	**0**	**-$31,000**
Research Management & Support	**131**	**$28,402**	**135**	**$29,362**	**135**	**$26,424**	**0**	**-$2,938**
TOTAL	**630**	**$749,378**	**662**	**$774,707**	**662**	**$666,854**	**0**	**-$107,853**

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

NATIONAL INSTITUTES OF HEALTH
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Authorizing Legislation

	PHS Act/ Other Citation	U.S. Code Citation	2019 Amount Authorized	FY 2019 Enacted	2020 Amount Authorized	FY 2020 President's Budget
Research and Investigation	Section 301	42§241	Indefinite	$774,707,000	Indefinite	$666,854,000
National Institute of Environmental Health Sciences	Section 401(a)	42§281	Indefinite		Indefinite	
Total, Budget Authority				$774,707,000		$666,854,000

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Appropriations History

Fiscal Year	Budget Estimate to Congress	House Allowance	Senate Allowance	Appropriation
2011	$707,339,000		$706,227,000	$689,781,000
Rescission				$6,057,112
2012	$700,537,000	$700,537,000	$676,033,000	$686,869,000
Rescission				$1,298,182
2013	$684,030,000		$686,103,000	$685,570,818
Rescission				$1,371,142
Sequestration				($34,410,941)
2014	$691,348,000		$686,753,000	$665,439,000
Rescission				$0
2015	$665,080,000			$667,502,000
Rescission				$0
2016	$681,782,000	$675,783,000	$695,900,000	$693,702,000
Rescission				$0
2017[1]	$693,533,000	$710,387,000	$722,301,000	$714,261,000
Rescission				$0
2018	$533,537,000	$725,387,000	$737,727,000	$751,143,000
Rescission				$0
2019	$693,199,000	$760,113,000	$775,115,000	$774,707,000
Rescission				$0
2020	$666,854,000			

[1] Budget Estimate to Congress includes mandatory financing.

Justification of Budget Request

National Institute of Environmental Health Sciences

Authorizing Legislation: Section 301 and title IV of the Public Health Service Act, as amended.
Budget Authority (BA):

	FY 2018 Actual	FY 2019 Enacted	FY 2020 President's Budget	FY 2020 +/- FY 2019
BA	$749,378,000	$774,707,000	$666,854,000	-$107,853,000
FTE	630	662	662	0

Program funds are allocated as follows: Competitive Grants/Cooperative Agreements; Contracts; Direct Federal/Intramural and Other.

Director's Overview

Over more than five decades, the National Institute of Environmental Health Sciences (NIEHS) has built a solid scientific foundation of knowledge in environmental health sciences that provides our Nation and the world with the strongest available basis for decisions that can protect and promote human health. But as our increasingly complex and connected world shows us, new knowledge inevitably gives rise to new questions. NIEHS is taking a multi-pronged approach—adopting the most promising new technologies to build on our existing knowledge base and using it as a springboard to launch us toward answers to these new questions—to inform decisions and improve the health and lives of all people.

Transformational Tools and Technologies: NIEHS research creates and deploys new technologies to advance environmental health sciences. A new NIEHS-developed tool, known as spectrally resolved fiber photometry, uses color indicators to simultaneously measure the activity of multiple sets of neurons in the brains of freely moving mice. The technique, which for the first time allows scientists to determine how two distinct neural pathways work together to control movement, will be used to figure out what goes wrong in human brain disorders such as Parkinson's disease, Alzheimer's disease, stroke, multiple sclerosis, and addiction.

NIEHS partners with the National Center for Advancing Translational Sciences (NCATS) on the "Tissue Chip for Drug Screening" initiative to develop bioengineered devices capable of predicting whether drugs or chemicals will be safe or toxic in humans. Three recent NIEHS awards are advancing this technology by creating a "lung chip" model of human influenza infection; a multi-organ microfluidics system designed to enable the study of drug delivery for polycystic ovary syndrome in a robotics laboratory; and a functional network of heart, liver, skin, bone, and vasculature tissues to investigate systemic diseases and improve drug delivery.

NIEHS is partnering with the National Cancer Institute (NCI) to support studies to improve existing assay approaches for population studies and create new tools to detect DNA damage

caused by environmental exposures such as chemicals, radiation, and diet. Researchers in this new consortium, working in areas such as lung and breast cancer, will further precision medicine by sharing best practices and cross-testing new biomarkers in human samples and populations to improve ways to predict which people will be more susceptible to environmental insults.

Immediately following Hurricane Harvey, NIEHS funded several projects to follow up on environmental and public health issues arising from this severe event. One key question is, what chemicals were people exposed to from floodwaters following Hurricane Harvey? To answer this question, researchers distributed 400 wristband sensors to community members in Texas that will measure their exposure to flood-borne chemicals over time. The study will generate 1.2 million chemical data points that can be used to assess hurricane exposures, as well as the influence of cleanup measures on them, to inform response to future disasters.

Along with developing new tools and technologies for research, NIEHS is using innovative approaches to develop our most important resource: scientists. Recognizing the fast pace of data science and the need for researchers trained in using new tools for data integration and visualization, geospatial mapping systems, artificial intelligence and machine learning, and research vocabularies, NIEHS held a Data Science Workforce meeting in April 2018 to explore what skills are needed and how best to ensure their availability in environmental health sciences.

A new career outcome taxonomy and visualization method informs the field by enabling detailed analysis of the sectors, types, and specifics of jobs postdocs obtain following training. The tool, developed by the NIEHS Office of Fellows Career Development, creates a win-win situation by enabling institutions to more systematically track the professional landings of their trainees, and providing fellows with meaningful data about potential career options.

Fundamental to all NIEHS's efforts in scientific computing, data science, data integration, and analytics is state of the art data infrastructure. In FY 2020, NIEHS will be embarking on a critical effort to upgrade data and communications infrastructure in its main facility. The goal is a facility that meets industry and NIH standards to support current and future NIEHS science and technology demands.

Building on Basic Science: Basic research on the effects of environment on biological systems and processes is central to environmental health sciences. The knowledge generated by environmental health sciences provides a critical component of our understanding of human health and disease. For example, an international team led by NIEHS scientists has discovered how two proteins work together to repair genetic damage in cells called DNA protein crosslinks (DPCs). Analogous to "tangles" of DNA, DPCs are often formed by exposure to chemotherapeutic drugs or environmental exposures to chemicals, tobacco smoke, or ultraviolet light. Understanding how these proteins, named ZATT and TDP2, untangle and repair DNA could improve health outcomes for cancer patients.

Another recent NIEHS-funded study is focused on understanding the association between exposure to uranium, arsenic, and other metals and high prevalence of hypertension among members of the Navajo Nation. The investigator's model, which combined data analysis of serum circulating inflammatory potential (a measure of metal exposure) with geospatial mapping

of abandoned uranium mines, showed greater inflammatory potential with proximity to the mines, suggesting exposure as a contributor to cardiovascular disease. In a separate study that used a geospatial approach in tandem with epidemiology, researchers mapped seasonal cyanobacterial harmful algal blooms across northern New England and fit them to population rates of amyotrophic lateral sclerosis (ALS) in the same region. The results generated the first regionally comprehensive map of water concentrations of phycocyanin (PC), a toxicant, for thousands of lakes and revealed a 48 percent increased risk of ALS when average PC exposures were 100 micrograms/liter, suggesting that cyanotoxin exposure may increase the risk of ALS.

Understanding the role of environmental exposures in Parkinson's disease (PD) is the focus of two related scoping reviews by the National Toxicology Program Division's Office of Health Assessment and Translation. The first will use a systematic review approach to map the evidence of associations between chemical exposures and PD. A second, more detailed scoping review will examine the large body of evidence linking exposure to the herbicide paraquat to the development of PD. These reviews build on a significant body of evidence assembled through investments in basic environmental health science.

Exploring the Next Frontier: Exploring the effects of environmental changes on the developing microbiome and links to increased risk of disease later in life is the focus of a significant and ambitious new NIEHS research investment under the paradigm of Developmental Origins of Health and Disease (DOHaD). Studies will include investigations of impacts on the microbiome from exposure to a wide range of agents such as phthalates, perfluorooctanoic acid (PFOA), particulate matter, silver nanoparticles, cadmium, and other chemicals, and will explore their connection to various diseases and health conditions including diabetes, autism spectrum disorder, obesity, breast cancer, Alzheimer's disease, reproductive effects, and atherosclerosis, among others. Another project, the Baby Connectome—part of the NIH Human Connectome Project—is using structural and functional MRI data combined with behavior assessments to map the neural pathways of infants and young children and produce a detailed picture of early brain development. This information will provide an important baseline for understanding how environmental exposures disrupt such development. To determine how the environment affects the body at an even more granular level, that of cellular regulation, NIEHS is launching funding announcements to support research in epitranscriptomics. These projects will examine how environmental exposures perturb RNA modification to discover new markers and mechanisms of disease that may point the way to prevention or treatment.

The themes of the NIEHS 2018–2023 Strategic Plan[1] will guide the Institute's priorities over the next five years. Theme 1: Advancing Environmental Health Sciences, will be supplemented by the 2018 strategic plan, "Toxicology in the 21st Century (Tox21)," which will expand federal efforts to improve *in vitro* high-throughput testing approaches. Another major effort, the Human Health Exposure Analysis Resource (HHEAR), will extend the ability of NIH-funded researchers to add or expand research on environmental health exposures in their existing projects through access to specialized laboratory and statistical analyses. As part of Theme 2: Promoting Translation—Data to Knowledge to Action, NIEHS is co-sponsoring a major new initiative of

[1] NIEHS 20182023 Strategic Plan: Advancing Environmental Health Sciences, Improving Health.

the National Academies of Sciences, Engineering, and Medicine. The Environmental Health Matters Initiative is designed to harness the knowledge of experts across the purview of all three academies, as well as a diverse range of scientific disciplines and societal sectors, to work collectively to explore complex challenges and formulate innovative opportunities to respond. Under Theme 3: Enhancing EHS Through Stewardship and Support, NIEHS will continue to build the next generation of leaders through programs such as the Outstanding New Environmental Scientist awards, and to maximize their potential for discovery through efforts such as maintaining existing environmental epidemiology cohorts and enriching infrastructure investments. Armed with a newly updated Strategic Plan, NIEHS is poised to launch the field of environmental health sciences to ever greater discoveries that will empower new abilities to identify risks, prevent exposures, and treat diseases, and ensure that all Americans can lead healthier, more productive lives.

Overall Budget Policy:
The FY 2020 President's Budget request is $666.9 million, a decrease of $107.9 million or 13.9 percent compared with the FY 2019 Enacted level. Reductions are distributed across all programmatic areas and basic, epidemiology, or clinical research.

Program Descriptions

Fundamental Research: NIEHS's program in Fundamental Research investigates the basic biological processes of how our bodies function, and of the pathways and systems that are susceptible to the effects of environmental stressors. This research addresses all levels of biological organization–molecular, biochemical pathway, cellular, tissue, organ, model organism, human, and population–and builds on the knowledge from new tools and techniques that allow us to ask more in-depth questions about the effects of our environment on biological systems.

Estimates suggest 25 percent of people across the world have non-alcoholic fatty liver disease (NAFLD), and it is one of the most common liver diseases in the United States. NAFLD results in excess fat in the liver. Obesity and metabolic disease are known risk factors for developing NAFLD. Studies have shown endocrine disrupting chemicals (EDCs), which are metabolic disrupting chemicals, may contribute to obesity and metabolic disease by disrupting normal hormone signaling events. All Americans are exposed to EDCs due to the widespread presence of these chemicals and their tendency to persist in the environment. Data suggest exposures to these chemicals also play a role in development of toxicant-associated fatty liver disease (TAFLD), a disease distinct from NAFLD. Scientists suspect EDC exposures, combined with other risk factors for liver disease such as poor diet, serve as the tipping point toward liver disease. To understand how EDCs contribute to TAFLD, NIEHS-funded scientists tested the effects of EDCs on a signaling pathway known to be affected by chemical exposure. High-throughput methods uncovered a new mechanism of action for structurally diverse EDCs, whereby chemicals inhibit multiple activation steps at the signaling receptor and block signal transduction preventing normal physiological signaling from occurring. After comparing EDC exposure levels in a large human population study with the levels of chemical resulting in signaling pathway perturbation seen in these studies, the authors suggest this new mechanism of action is relevant to human exposures and may contribute to the rise in liver disease.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $173.4 million, a decrease of $28.4 million or 14.1 percent compared with the FY 2019 Enacted level.

Program Portrait: Environmental Risks for Psychiatric Disorders

FY2019 Level: $4.5 million
FY2020 Level: $5.0 million
Change: +$0.5 million

One in five adults in the United States, nearly 45 million people, suffer with mental illnesses, including conditions such as schizophrenia, major depression, and bipolar disorder. The public health burden is immense, accounting for over $300 billion in disability-associated costs per year, as well as societal costs from the loss of work productivity, divorce, suicide, accidents, accidental drug overdoses, and other related outcomes. Emerging evidence over the past decade links exposure to toxic chemicals with central nervous system and behavior changes like those seen in psychiatric disorders, providing strong impetus to understand how environmental exposures may affect a person's underlying biological and genetic susceptibility, and thus their risk of developing such disorders.

NIEHS has a decades-long history of supporting projects focused on determining how environmental exposures impact the brain and behavioral endpoints, particularly during developmental windows. Recent investments have targeted research toward environmental contributors to risk and expression of autism spectrum disorders and attention-deficit/hyperactivity disorder (ADHD). However, a paucity of research has examined associations between environmental exposures and psychiatric disorders with clinical symptoms that emerge in later adolescence or early adulthood. This gap is particularly compelling when considering that nearly half of all U.S. adolescents (ages 13–18) experience a mental disorder.

NIEHS has begun to expand its efforts to identify common pathways and mechanisms implicated in psychiatric disorders that are potential targets of environmental exposures. A 2017 workshop brought together experts in psychiatry, fundamental neuroscience, human genetics, immunology, and environmental health sciences. Key data gaps that emerged from this workshop include: limited awareness and application in environmental health sciences of Research Domain Criteria, a National Institute of Mental Health (NIMH) framework for new approaches to investigating mental disorders; lack of human studies with exposure and clinical measures of sufficient statistical power to assess exposure-condition associations or uncover gene-environment interactions; incomplete understanding of inflammatory responses to environmental exposures, such as diet, infectious agents, and chemicals, and their potential role in the development of psychiatric conditions; and uncertainties around epigenetics as a potential mediator or biomarker of exposure-psychiatric disease associations.

Based on the opportunities and challenges identified in this workshop, NIEHS is developing a Program Announcement (PAR) with special review to stimulate investigations of this understudied area of environmental health sciences.

Exposure Research: This program is focused on the study of environmental exposures, not only chemical environmental pollutants, but also exposures arising from other sources such as pharmaceuticals or diet. The program goals are to develop improved methods to detect and measure environmental exposures in humans, including biological markers, sensor and detector tools, remote exposure detection, better analytical methods, and informatics technologies.

Over the past 50 years, the United States has experienced a substantial rise in chemical production. This leads to questions about the presence of chemical products and contaminants throughout the environment, from the food we eat to the water we drink and the air we breathe.

At the same time, incidence rates of some adverse health outcomes such as childhood cancer or obesity have increased. Less than one percent of the estimated 82,000 chemicals currently registered for use in the United States are measured in human biomonitoring studies. The need for new methods to provide rapid screening to enhance biomonitoring is immense. Traditional methods are targeted toward known chemicals, yet questions remain about the extent to which the American public is exposed to unknown chemicals. NIEHS-funded scientists have harnessed state of the art, high-resolution mass spectrometry technology to screen human serum samples for unknown environmental chemicals and have validated this approach as a feasible and novel biomonitoring screen.[2] This technology works by physically separating the components in serum samples and then analyzing the mass of individual components, which allows for specific chemical detection. This powerful approach requires a minimal sample size while maximizing the identification of potential chemical exposures, allowing a more comprehensive analysis of exposure. Exposure research funded by NIEHS continues to push the envelope of discovery with better analytical methods aimed at protecting U.S. citizens from suffering environmentally-linked diseases.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $83.4 million, a decrease of $13.7 million or 14.1 percent compared with the FY 2019 Enacted level.

Translational Research and Special Populations: This program includes a wide set of research activities encouraging integration of clinical, population, and community-based research to translate findings into improved public health practice and disease prevention. These activities include research investments targeted toward understanding environmental risks to special populations (elderly people, children, and underserved populations) with an eye to developing interventions and solutions to real-world problems.

Global estimates state that more than 800,000 deaths each year are linked to particulate matter (PM) exposure. PM can be a mixture of dust, soot, smoke, combustion products, and/or chemicals in the air. Exposure to PM has varied effects in people, with some individuals being highly susceptible to air pollution and others more tolerant of exposures. PM has been shown to contribute to both cardiovascular morbidity and mortality and is accepted as a factor contributing to adverse cardiovascular events. People with cardiovascular disease are more susceptible to air pollution than those without heart disease. While PM has been linked to a measure of heart function known as QT prolongation, nothing is known about the genetic susceptibility to PM-associated QT prolongation. NIEHS-funded scientists examined the DNA of 22,158 men and women in a racially and ethnically diverse study cohort in a genome-wide association study of gene-environment interactions.[3] Using PM air pollution exposures below current Environmental Protection Agency (EPA) guidelines, scientists found genetic variation may modify susceptibility to PM-associated QT prolongation. This work suggests genetic variation

[2] Gerona R, Schwartz J, Pan J, Friesen M, Lin T, and Woodruff T. Suspect screening of maternal serum to identify new environmental chemical biomonitoring targets using liquid chromatography-quadrupole time-of-flight mass spectrometry. Journal of Exposure Science and Environmental Epidemiology (2018) 28, 101-108.

[3] Gondalia R, et al., Whitsel EA. Genome-wide Association Study of Susceptibility to Particulate Matter-Associated QT Prolongation. Environ Health Perspect. 2017 Jun 8;125(6):067002. doi: 10.1289/EHP347.

contributes to PM-associated QT prolongation, and future studies are needed to determine whether this special population is adequately protected by current air pollution guidelines.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $95.7 million, a decrease of $15.7 million or 14.1 percent compared with the FY 2019 Enacted level.

Program Portrait: Chronic Kidney Disease of Unknown Origin (CKDu)

FY2019 Level: $1.7 million
FY2020 Level: $3.5 million
Change: +$1.8 million

Thirty million U.S. adults suffer from chronic kidney disease (CKD), a condition which prevents the kidneys from removing excess fluid and waste from the body and can lead to additional health problems. Chronic kidney disease of unknown origin (CKDu) is a form of early onset CKD that is not identified in the context of traditional risk factors for CKD, such as diabetes, heart disease, high blood pressure, and specific infections. Symptoms do not arise until kidney damage is irreversible, leading to devastating health outcomes. The global prevalence of CKDu appears to be increasing over the past two decades, particularly in tropical agricultural workers, yet the causes are unknown, and diagnosis is confounded by a lack of universal criteria for this disease. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) and NIEHS hosted a workshop on CKD in Agricultural Communities in June 2018 that brought together clinicians, basic scientists, epidemiologists, and public health officials to discuss current gaps in CKDu knowledge.[4] Participants discussed potential causes, research barriers, and opportunities, including potential collaborations. While little is known about the cause of CKDu, participants agreed it is likely multifactorial with environmental exposures playing a key role. Genetic susceptibility may also be involved. Both NIDDK and NIEHS are funding research into the role of environmental exposures, especially agricultural exposures coinciding with work conditions, in CKDu risk. An international workshop is planned for March 20-22, 2019, in partnership across the NIH and with international health organizations.

Predictive Toxicology: The mission of the research investment in the National Toxicology Program (NTP) is to evaluate environmental agents of public health concern and generate information to be used by health regulatory agencies to make informed decisions affecting public health. NTP also works to develop new and improved test methods, including alternatives to animal testing and high-throughput methods to test substances faster, in order to disseminate useful public health information more rapidly. NTP research also helps to develop new and improved models of toxicity that can help to predict cancer and other adverse health outcomes that may result from fetal or early life exposures.

Allergic contact dermatitis (ACD) may develop in workers and consumers exposed to skin-sensitizing chemicals and products, and accounts for the most significant source of workplace illness. Regulatory agencies require the testing of chemicals and products to determine their potential to cause ACD, and widely used test methods for this purpose use guinea pigs or mice. The NTP Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM) is tasked with evaluating alternatives to animal use for chemical safety testing. NICEATM also supports the Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM), a committee representing 16 federal regulatory and research agencies that generate or use toxicity testing data. Recently, the ICCVAM Skin Sensitization

[4] www.niddk.nih.gov/news/meetings-workshops/2018/chronic-kidney-diseases-in-agricultural-communities-2018

Workgroup developed an approach that uses non-animal and computational inputs to predict human skin sensitization hazard from chemicals with more accurate predictions than animal tests. In April 2018, EPA released a draft Science Policy to accept results obtained using these approaches in lieu of animal test data, becoming the first agency in the world to do so. NICEATM conducted all computational analysis and model evaluation/optimization in support of this project.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $79.2 million, a decrease of $13.0 million or 14.1 percent compared with the FY 2019 Enacted level.

Program Portrait: National Toxicology Program Responsive Evaluation and Assessment of Chemical Toxicity (REACT)-PFAS

FY 2019 Level: $2.0 million
FY 2020 Level: $2.0 million
Change: $0.0 million

Per and Polyfluorinated Alkyl Substances (PFAS) are industrial chemicals used for a variety of products including non-stick cookware, stain resistant fabrics, food packaging, and firefighting foams. Public health concerns regarding PFAS pollution are increasing. Due to their toxicity, persistence, and bioaccumulation, PFOA and perfluorooctane sulfonate (PFOS) have been replaced by other PFAS. It is estimated that there are hundreds of PFAS released into the environment as either primary products, impurities, or breakdown products. Little is known about the toxicity of these various forms of PFAS. Because of the large number of new PFAS chemicals entering the environment, EPA, Department of Defense, National Center for Environmental Health/Agency for Toxic Substances Disease Registry, and other federal agency partners have expressed interest in an expanded evaluation of PFAS compounds including mixtures and novel firefighting foams.

To contribute to these interests, NTP has developed the Responsive Evaluation and Assessment of Chemical Toxicity (REACT) Program. This is an expedited approach to identifying potential public health hazards of environmental agents of concern. The approach leverages the full spectrum of NTP capabilities including *in vitro*, *in silico*, *in vivo*, and literature-based assessments with an emphasis on assessments of fundamental bioactivity, mode of action, and relevance to exposed individuals. REACT-PFAS is considering PFAS chemicals as a class of agents and is a collaborative program with EPA's National Center for Computational Toxicology. Initial testing has focused on a set of approximately 100 PFAS. The program applies existing knowledge of similar chemicals to direct more hypothesis-driven assessments of specific chemicals using a portfolio of complex *in vitro* assays and *in vivo* studies. Any putative hazards identified will be contextualized with *in silico* modeling to predict likely human exposures of concern. When integrated with research from partner agencies, the REACT-PFAS program will inform evidence-based risk assessments by regulators and policy makers.

Training and Education: This program's goal is to attract the brightest students and scientists into the environmental health sciences field to ensure a cadre of professionals to conduct the interdisciplinary research necessary to solve critical environmental health problems. The program includes efforts at the high school and undergraduate levels (opportunities for laboratory-based training), the graduate level (institutional training grants and individual fellowships), and the faculty level (grants for young investigators).

The Undergraduate Research Education Program (UP) to Enhance Diversity in the Environmental Health Sciences (R25 award mechanism) is an NIEHS funding program that aims to support research educational activities that enhance the diversity of the biomedical,

behavioral, and clinical research workforce in the environmental health sciences.[5] It is designed to increase the pool of scientists from underrepresented backgrounds engaged in NIH-funded environmental health science research. The goal of one R25 UP program is to recruit and train 40 undergraduate students from underrepresented backgrounds over the next five years. Participants in this program are engaged in hands-on research in environmental health sciences and coursework that explores real-world environmental exposures while reviewing key concepts in environmental health sciences. For example, trainees traveled to the Navajo Nation in northern Arizona to work with mentors to collect environmental samples and discuss environmental health issues with Navajo Nation community members and policy makers. The Navajo Nation has faced environmental contamination from the Gold King Mine spill, which occurred upstream of Tribal lands. Together with their mentors, trainees published an article detailing their work with the Navajo Nation.[6] A second course discussed environmental health science in the context of the Flint, Michigan, lead water crisis and included a field trip to a home undergoing environmental assessment for sources of lead exposure. Trainees leveraged this experience to develop a radio spot to educate the public on lead abatement. The R25 UP-funded program is just one example of engaging underrepresented students in state of the art environmental health research with students reporting that participation in the program has been transformative in their education.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $19.4 million, a decrease of $3.2 million or 14.1 percent compared with the FY 2019 Enacted level.

Intramural Research: NIEHS intramural programs focus on high-caliber, high risk-high reward science with potential for high-impact breakthroughs. Studies are often conducted over long periods of time to provide continued depth to a body of knowledge and account for the latency of many environmentally-mediated diseases. NIEHS intramural programs comprise unique components, such as the National Toxicology Program Division and the NIEHS Clinical Research Unit, which creates opportunities for clinicians and basic scientists to collaborate on disease studies. Other intramural research areas include epidemiological studies of environmentally-associated diseases (the Sister Study of breast cancer) and exposures (the 2010 Deepwater Horizon Oil Spill), as well as studies to inform intervention and prevention strategies that can reduce the health effects of exposures to hazards in our environment.

More young adults are diagnosed with and dying from colorectal cancer than ever before.[7] While obesity is known to be a risk factor for developing colorectal cancer, little is known about the molecular events that contribute to this devastating disease. NIEHS intramural scientists investigated molecular signatures in a diet-induced mouse model of obesity and reported epigenetic changes in the lining of the colon that appear to be involved in the link between

[5] www.grants.nih.gov/grants/guide/rfa-files/RFA-ES-14-004.html
[6] www.truthout.org/articles/water-is-our-life-how-a-mining-disaster-affected-the-navajo-nation/
[7] Siegel RL, Fedewa SA, Anderson WF, Miller KD, Ma J, Rosenberg PS, Jemal A. Colorectal Cancer Incidence Patterns in the United States, 1974-2013. *J Natl Cancer Inst*. 2017 Aug 1;109(8).

obesity and colorectal cancer in mice.[8] Importantly, they found that the changes were reversed after long-term weight loss, but not after short-term weight loss. The researchers also found that obesity-related changes in fatty acid metabolism were different in younger mice compared with older mice. This groundbreaking work suggests that one path toward prevention of colorectal cancer may be sustained weight loss.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $189.4 million, a decrease of $31.0 million or 14.1 percent compared with the FY 2019 Enacted level.

Research Management and Support (RMS): The RMS program provides administrative, budgetary, logistical, and scientific support in the review, award, and monitoring of research grants and training awards. NIEHS oversaw approximately 864 off-site research grants and centers in FY 2018. Other RMS functions include on-site strategic planning, coordination, and evaluation of NIEHS programs; administration and facilities maintenance; regulatory compliance; ethics training and compliance; and liaison with other Federal agencies, Congress, stakeholders, and the public.

The NIEHS 2018-2023 Strategic Plan: *Advancing Environmental Health Sciences, Improving Health*, provides an updated roadmap for the Institute's research priorities. It continues to move NIEHS in the direction of cutting-edge, innovative environmental health sciences, while maintaining continuity of key existing research and translational priorities. The new NIEHS strategic plan is consistent with the overall NIH strategic plan.

Budget Policy:
The FY 2020 President's Budget estimate for this program is $26.4 million, a decrease of $2.9 million or 10.0 percent compared with the FY 2019 Enacted level.

[8] Li R, Grimm SA, Mav D, Gu H, Djukovic D, Shah R, Merrick BA, Raftery D, Wade PA. 2018. Transcriptome and DNA methylation analysis in a mouse model of diet-induced obesity predicts increased risk of colorectal cancer. Cell Rep 22(3):624–637.

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Budget Authority by Object Class[1]

(Dollars in Thousands)

	FY 2019 Enacted	FY 2020 President's Budget	FY 2020 +/- FY 2019
Total compensable workyears:			
Full-time equivalent	662	662	0
Full-time equivalent of overtime and holiday hours	1	1	0
Average ES salary	$180	$180	$0
Average GM/GS grade	12.0	12.0	0.0
Average GM/GS salary	$100	$100	$0
Average salary, grade established by act of July 1, 1944 (42 U.S.C. 207)	$117	$121	$3
Average salary of ungraded positions	$154	$154	$0

	OBJECT CLASSES	FY 2019 Enacted	FY 2020 President's Budget	FY 2020 +/- FY 2019
	Personnel Compensation			
11.1	Full-Time Permanent	43,983	44,150	167
11.3	Other Than Full-Time Permanent	22,637	22,723	86
11.5	Other Personnel Compensation	1,454	1,459	6
11.7	Military Personnel	799	843	44
11.8	Special Personnel Services Payments	8,620	8,653	33
11.9	**Subtotal Personnel Compensation**	**$77,493**	**$77,828**	**$336**
12.1	Civilian Personnel Benefits	23,366	24,105	739
12.2	Military Personnel Benefits	354	374	20
13.0	Benefits to Former Personnel	0	0	0
	Subtotal Pay Costs	**$101,213**	**$102,308**	**$1,095**
21.0	Travel & Transportation of Persons	2,102	1,821	-281
22.0	Transportation of Things	457	393	-64
23.1	Rental Payments to GSA	2	1	0
23.2	Rental Payments to Others	39	35	-4
23.3	Communications, Utilities & Misc. Charges	1,523	1,304	-219
24.0	Printing & Reproduction	1	1	0
25.1	Consulting Services	174	156	-19
25.2	Other Services	38,207	19,138	-19,068
25.3	Purchase of goods and services from government accounts	108,921	101,386	-7,534
25.4	Operation & Maintenance of Facilities	11,991	9,991	-2,000
25.5	R&D Contracts	114,618	97,605	-17,013
25.6	Medical Care	484	416	-68
25.7	Operation & Maintenance of Equipment	6,494	5,586	-908
25.8	Subsistence & Support of Persons	27	23	-4
25.0	**Subtotal Other Contractual Services**	**$280,915**	**$234,301**	**-$46,614**
26.0	Supplies & Materials	14,070	9,193	-4,877
31.0	Equipment	11,535	7,483	-4,052
32.0	Land and Structures	0	0	0
33.0	Investments & Loans	0	0	0
41.0	Grants, Subsidies & Contributions	362,848	310,012	-52,836
42.0	Insurance Claims & Indemnities	0	0	0
43.0	Interest & Dividends	3	3	0
44.0	Refunds	0	0	0
	Subtotal Non-Pay Costs	**$673,494**	**$564,546**	**-$108,948**
	Total Budget Authority by Object Class	**$774,707**	**$666,854**	**-$107,853**

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Salaries and Expenses
(Dollars in Thousands)

OBJECT CLASSES	FY 2019 Enacted	FY 2020 President's Budget	FY 2020 +/- FY 2019
Personnel Compensation			
Full-Time Permanent (11.1)	$43,983	$44,150	$167
Other Than Full-Time Permanent (11.3)	22,637	22,723	86
Other Personnel Compensation (11.5)	1,454	1,459	6
Military Personnel (11.7)	799	843	44
Special Personnel Services Payments (11.8)	8,620	8,653	33
Subtotal Personnel Compensation (11.9)	**$77,493**	**$77,828**	**$336**
Civilian Personnel Benefits (12.1)	$23,366	$24,105	$739
Military Personnel Benefits (12.2)	354	374	20
Benefits to Former Personnel (13.0)	0	0	0
Subtotal Pay Costs	**$101,213**	**$102,308**	**$1,095**
Travel & Transportation of Persons (21.0)	$2,102	$1,821	-$281
Transportation of Things (22.0)	457	393	-64
Rental Payments to Others (23.2)	39	35	-4
Communications, Utilities & Misc. Charges (23.3)	1,523	1,304	-219
Printing & Reproduction (24.0)	1	1	0
Other Contractual Services:			
Consultant Services (25.1)	174	156	-19
Other Services (25.2)	38,207	19,138	-19,068
Purchases from government accounts (25.3)	75,722	69,953	-5,769
Operation & Maintenance of Facilities (25.4)	11,991	9,991	-2,000
Operation & Maintenance of Equipment (25.7)	6,494	5,586	-908
Subsistence & Support of Persons (25.8)	27	23	-4
Subtotal Other Contractual Services	**$132,615**	**$104,848**	**-$27,768**
Supplies & Materials (26.0)	$14,070	$9,193	-$4,877
Subtotal Non-Pay Costs	**$150,807**	**$117,594**	**-$33,213**
Total Administrative Costs	**$252,020**	**$219,902**	**-$32,118**

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Detail of Full-Time Equivalent Employment (FTE)

OFFICE/DIVISION	FY 2018 Final			FY 2019 Enacted			FY 2020 President's Budget		
	Civilian	Military	Total	Civilian	Military	Total	Civilian	Military	Total
Division of Extramural Research									
Direct:	71	-	71	77	-	77	77	-	77
Reimbursable:	2	-	2	2	-	2	2	-	2
Total:	73	-	73	79	-	79	79	-	79
Division of Intramural Research									
Direct:	310	1	311	322	1	323	322	1	323
Reimbursable:	2	-	2	2	-	2	2	-	2
Total:	312	1	313	324	1	325	324	1	325
Division of National Toxicology Program									
Direct:	103	1	104	111	1	112	111	1	112
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	103	1	104	111	1	112	111	1	112
Office of Management									
Direct:	89	2	91	75	2	77	75	2	77
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	89	2	91	75	2	77	75	2	77
Office of the Director									
Direct:	47	2	49	67	2	69	67	2	69
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	47	2	49	67	2	69	67	2	69
Total	624	6	630	656	6	662	656	6	662
Includes FTEs whose payroll obligations are supported by the NIH Common Fund.									
FTEs supported by funds from Cooperative Research and Development Agreements.	0	0	0	0	0	0	0	0	0

FISCAL YEAR	Average GS Grade
2016	11.8
2017	11.9
2018	12.0
2019	12.0
2020	12.0

NATIONAL INSTITUTES OF HEALTH
National Institute of Environmental Health Sciences

Detail of Positions[1]

GRADE	FY 2018 Final	FY 2019 Enacted	FY 2020 President's Budget
Total, ES Positions	1	1	1
Total, ES Salary	180,440	180,440	180,440
GM/GS-15	34	34	34
GM/GS-14	60	61	61
GM/GS-13	115	118	118
GS-12	110	115	115
GS-11	81	83	83
GS-10	1	1	1
GS-9	36	44	44
GS-8	13	14	14
GS-7	19	21	21
GS-6	1	1	1
GS-5	0	0	0
GS-4	1	1	1
GS-3	0	0	0
GS-2	0	0	0
GS-1	0	0	0
Subtotal	471	493	493
Grades established by Act of July 1, 1944 (42 U.S.C. 207)	0	0	0
Assistant Surgeon General	0	0	0
Director Grade	3	3	3
Senior Grade	3	3	3
Full Grade	0	0	0
Senior Assistant Grade	0	0	0
Assistant Grade	0	0	0
Subtotal	6	6	6
Ungraded	171	180	180
Total permanent positions	474	498	498
Total positions, end of year	649	680	680
Total full-time equivalent (FTE) employment, end of year	630	662	662
Average ES salary	180,440	180,440	180,440
Average GM/GS grade	12.0	12.0	12.0
Average GM/GS salary	96,240	99,935	99,935

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.