Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force											Date: March 2019	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	320.961	383.322	356.107	0.000	356.107	363.097	370.504	384.410	391.617	Continuing	Continuing
613001: *Physics and Electronics*	-	94.693	113.504	105.346	0.000	105.346	107.406	109.604	113.708	115.841	Continuing	Continuing
613002: *Aerospace, Chemical and Material Sciences*	-	100.173	118.763	109.915	0.000	109.915	112.073	114.356	118.653	120.876	Continuing	Continuing
613003: *Mathematics, Information and Life Sciences*	-	95.920	114.438	105.513	0.000	105.513	107.590	109.780	113.901	116.036	Continuing	Continuing
613004: *Education and Outreach*	-	30.175	36.617	35.333	0.000	35.333	36.028	36.764	38.148	38.864	Continuing	Continuing

A. Mission Description and Budget Item Justification

Defense Research Sciences consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory (AFRL). This program supports fundamental broad-based scientific and engineering research in areas critical to Air Force weapon, sensor, and support systems. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601F, and 0602298F.

As directed in the FY 2018 NDAA, Sec 825, amendment to PL 114-92 FY 2016 NDAA, Sec 828 Penalty for Cost Overruns, the FY 2018 Air Force penalty total is $14.373M. The calculated percentage reduction to each research, development, test and evaluation and procurement account will be allocated proportionally from all programs, projects, or activities under such account.

This program is in Budget Activity 1, Basic Research because this budget activity includes scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: March 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	342.919	348.322	354.360	0.000	354.360
Current President's Budget	320.961	383.322	356.107	0.000	356.107
Total Adjustments	-21.958	35.000	1.747	0.000	1.747
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	35.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.014	0.000			
• SBIR/STTR Transfer	-8.786	0.000			
• Other Adjustments	-13.158	0.000	1.747	0.000	1.747

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 613001: *Physics and Electronics*		
Congressional Add: *Program Increase - Basic Research*	0.000	11.000
Congressional Add Subtotals for Project: 613001	0.000	11.000
Project: 613002: *Aerospace, Chemical and Material Sciences*		
Congressional Add: *Program Increase - Basic Research*	0.000	11.000
Congressional Add Subtotals for Project: 613002	0.000	11.000
Project: 613003: *Mathematics, Information and Life Sciences*		
Congressional Add: *Program Increase - Basic Research*	0.000	11.000
Congressional Add Subtotals for Project: 613003	0.000	11.000
Project: 613004: *Education and Outreach*		
Congressional Add: *Program Increase - Basic Research*	0.000	2.000
Congressional Add Subtotals for Project: 613004	0.000	2.000
Congressional Add Totals for all Projects	0.000	35.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: March 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*

Change Summary Explanation

Decrease in FY 2018 in Other Adjustments is due to realignment of funds to PE 0602212F to support Research and Development Projects, 10 U.S.C. Section 2358.

Increase in FY 2020 due to civilian pay inflation adjustment.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: March 2019
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613001 / *Physics and Electronics*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
613001: *Physics and Electronics*	-	94.693	113.504	105.346	0.000	105.346	107.406	109.604	113.708	115.841	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Physics and Electronics Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major areas being investigated in this project are complex electronics and fundamental quantum processes; plasma physics and high energy density non-equilibrium processes; and lasers and optics, electromagnetics, communication, and signal processing. While the following specific sub-areas are the focus of the project, there is interest in exploring novel ideas that may bridge these major efforts as well as those in the other projects within this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Complex Electronics and Fundamental Quantum Processes	38.328	41.489	42.639
Description: Scientific focus areas are atomic and molecular physics, photonics, quantum electronic solids, gigahertz-terahertz electronics and material, semiconductor and electromagnetic materials, and optoelectronics. ***FY 2019 Plans:*** Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, memristive systems, new classes of hightemperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules. ***FY 2020 Plans:*** Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, metamaterials, cathodes, dielectric and magnetic materials, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photonic systems, quantum dots and defects in solids, and ultracold atoms and molecules. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $1.150 million. Funding increased due to added emphasis in complex electronics and fundamental quantum processes.			
Title: Plasma Physics and High Energy Density Non-Equilibrium Processes	19.742	21.371	21.964
Description: Scientific focus areas are plasma, electro-energetic physics and space sciences. ***FY 2019 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Continue to explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2020 Plans:*** Continue to explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.593 million. Justification for the increase is described in the plans above.			
Title: Lasers and Optics, Electromagnetics, Communication and Signal Processing ***Description:*** Scientific focus areas are physical mathematics and applied analysis, novel computational methods, electromagnetics and wave propagation in complex media, ultra-fast dynamics, for revolutionary approaches to remote sensing and imaging physics, and surveillance and navigation. ***FY 2019 Plans:*** Continue to explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Continue to investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2020 Plans:*** Continue to explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Continue to investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $1.099 million. Funding increased due to added emphasis in lasers and optics, electromagnetics, communication and signal processing	36.623	39.644	40.743
Accomplishments/Planned Programs Subtotals	94.693	102.504	105.346

	FY 2018	FY 2019
Congressional Add: Program Increase - Basic Research	0.000	11.000

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

	FY 2018	FY 2019
FY 2018 Accomplishments: N/A ***FY 2019 Plans:*** Conduct Congressionally directed effort.		
Congressional Adds Subtotals	0.000	11.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: March 2019
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613002 / *Aerospace, Chemical and Material Sciences*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
613002: *Aerospace, Chemical and Material Sciences*	-	100.173	118.763	109.915	0.000	109.915	112.073	114.356	118.653	120.876	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Aerospace, Chemical, and Materials Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Air Force. Research stresses high-risk, far-term, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Research topics include: aero-structure interactions and control; energy, power, and propulsion; complex materials and structures; and cross-disciplinary research reflecting the highly integrated nature of future weapon systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Aero Structure Interactions and Control	29.527	31.763	32.397
Description: Scientific focus areas are high temperature aerospace materials, non-equilibrium aerothermodynamics and chemistry, unsteady, compressible flow turbulence, multiscale fluid-material interactions, and flow control. ***FY 2019 Plans:*** Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance structures, and thermodynamics. ***FY 2020 Plans:*** Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance structures, and thermodynamics. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.634 million. Justification for the increase is described in the plans above.			
Title: Energy, Power, and Propulsion	31.855	34.269	34.953
Description: Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, space power and propulsion, and combustion and diagnostics.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
FY 2019 Plans: Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, and structures. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. This includes developing novel energetic materials as well as understanding and optimizing combustion processes. ***FY 2020 Plans:*** Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hydrodynamics, structural dynamics, and multi-fidelity simulations. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. This includes developing novel energetic materials as well as understanding optimizing and controlling combustion processes. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.684 million. Justification for the increase is described in the plans above.			
Title: Complex Materials and Structures ***Description:*** Scientific focus areas are design, manufacturing, and dynamics and control of multifunctional materials and microsystems, multi-scale mechanics, diagnostics and prognosis, and physico-chemistry of novel organic materials. ***FY 2019 Plans:*** Continue to investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, that may be able to change functionality or performance characteristics to enhance the mission versatility of future air and space systems, with a key goal of increasing functionality while decreasing weight and volume. Explore materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the mesoscale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2020 Plans:*** Continue to investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, that can adapt to environmental constraints or mission requirements. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the mesoscale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility. ***FY 2019 to FY 2020 Increase/Decrease Statement:***	38.791	41.731	42.565

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
FY 2020 increased compared to FY 2019 by $0.834 million. Justification for the increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	100.173	107.763	109.915

	FY 2018	FY 2019
Congressional Add: Program Increase - Basic Research	0.000	11.000
FY 2018 Accomplishments: N/A		
FY 2019 Plans: Conduct Congressionally directed effort.		
Congressional Adds Subtotals	0.000	11.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: March 2019
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613003 / *Mathematics, Information and Life Sciences*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
613003: *Mathematics, Information and Life Sciences*	-	95.920	114.438	105.513	0.000	105.513	107.590	109.780	113.901	116.036	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Mathematics, Information Sciences, and Life Sciences seeks to expand fundamental knowledge and enable revolutionary advances and supporting technologies critical to the future of the Air Force. Major areas being investigated in this project are data fusion, machine learning and artificial intelligence, information and complex networks, cyber-security, autonomous decision making, dynamical systems, optimization and control, and natural materials and systems. While the following are specific sub-areas within this project, there is a continuing interest to explore novel ideas to bridge disciplines within this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Information and Complex Networks	24.452	26.369	26.898
Description: Scientific focus areas are information operations and security, data and information fusion, advanced computing, artificial intelligence and complex networks. ***FY 2019 Plans:*** Continue to design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems. This includes traditional aspects of information assurance, software engineering, and reliable systems, but the emphasis is on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Sub-areas include system and network performance prediction, design and analysis, and modeling of human-machine systems. ***FY 2020 Plans:*** Continue to design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems, including hardware and software interactions. This includes traditional aspects of information assurance, but with an emphasis on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Analyze, optimize and design multi-scale networks with resilient features against noise and corruption from difficult environments and adversarial operations, using rigorous mathematical models of information exchange, physical operations, and human-machine interactions. Develop new computing approaches and algorithms for network-of-network information processing at the speed of warfare. Develop new mathematical approaches for predictive, multi-scale and multi-physics simulations of Air Force systems and systems-of-systems in realistic environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.529 million. Justification for the increase is described in the plans above.			
Title: Decision Making	19.070	20.565	20.978

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: Scientific focus areas are mathematical modeling of cognition and decision making, development and testing of advanced representations and processes for higher-level artificial intelligence, trust between humans and autonomous agents, mixed human-machine decision making, and computational social science for asymmetric threat detection and predictive large-scale influence. ***FY 2019 Plans:*** Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. This includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision making. ***FY 2020 Plans:*** Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision-making to achieve accurate real-time integration of human expertise and knowledge into a machine-based battlespace network. Develop new mathematical models for information capture; object, scene and relation identification; and multi-level reasoning and meta-learning. Advance the critical knowledge base in modeling of individual and group cognitive processing and decision making, and construct advanced methodologies for predictive, verifiable simulations of large-scale socio-cultural and human-machine hybrid networks. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.413 million. Justification for the increase is described in the plans above.			
Title: Dynamical Systems, Optimization, and Control	25.206	27.180	27.725
Description: Scientific focus areas are computer models of dynamical data and communication networks, data-fusion, dynamics and control theory for multi-scale and complex networks, and mathematics of distributed optimization in uncertain, variable, continuous and discrete networked systems. Includes the development of advanced computing architectures for solving optimization and data-fusion problems in real time and by embedded processors in autonomous or semi-autonomous platforms. ***FY 2019 Plans:*** Continue to develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. This includes developing novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2020 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Continue to develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Develop novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.545 million. Justification for the increase is described in the plans above.			
Title: Natural Materials and Systems ***Description:*** Scientific focus areas are natural materials and nature inspired systems, human performance and biosystems, cognitive neuroscience and biophysics. ***FY 2019 Plans:*** Continue to investigate multi-disciplinary approaches for studying the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production. ***FY 2020 Plans:*** Continue to investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems are built, assembled and organized, and functioning to accomplish their objectives. Develop fundamental understanding of bio-chemical mechanisms and control procedures for the production and manufacture of natural materials, and develop reverse-engineering approaches to optimize the bio-chemical functionality. Develop approaches to adapt, blend and mimic existing natural sensory systems and neural systems of varying complexity, to add existing capabilities to these organisms and design in-silico replicas with similar or advanced capabilities. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.588 million. Justification for the increase is described in the plans above.	27.192	29.324	29.912
Accomplishments/Planned Programs Subtotals	95.920	103.438	105.513

	FY 2018	FY 2019
Congressional Add: Program Increase - Basic Research	0.000	11.000
FY 2018 Accomplishments: N/A ***FY 2019 Plans:*** Conduct Congressionally directed effort.		
Congressional Adds Subtotals	0.000	11.000

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: March 2019
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613004 / *Education and Outreach*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
613004: *Education and Outreach*	-	30.175	36.617	35.333	0.000	35.333	36.028	36.764	38.148	38.864	Continuing	Continuing

A. Mission Description and Budget Item Justification

The major efforts in the Science and Technology (S&T) Education and Outreach Project are to facilitate interactions between the international and domestic research communities and Air Force researchers, and to support and develop scientists and engineers with an awareness of Air Force basic research priorities. These professional interactions and collaborations benefit the Air Force by increasing awareness of Air Force basic research priorities in the research community as a whole, and attracting talented scientists and engineers to address Air Force needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This project also seeks to enhance interactions with Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Outreach to International S&T Community ***Description:*** Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate. ***FY 2019 Plans:*** Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations. ***FY 2020 Plans:*** Continue to leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.252 million. Justification for the increase is described in the plans above.	10.625	12.189	12.441
Title: Outreach to U.S. S&T Workforce ***Description:*** Strengthen science, mathematics, and engineering research and infrastructure in the U.S., thereby strengthening current and future Air Force S&T capabilities.	19.550	22.428	22.892

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: March 2019
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613004 / *Education and Outreach*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
FY 2019 Plans: Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new investigators to participate in critical Air Force research. Support science, mathematics, and engineering research, and educational outreach programs including Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions. ***FY 2020 Plans:*** Continue identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research. Support science, mathematics, and engineering research including Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions. Support science activities that encourage elementary/middle/ high school youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering (STEM) fields. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increased compared to FY 2019 by $0.464 million. Justification for the increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	30.175	34.617	35.333

	FY 2018	FY 2019
Congressional Add: Program Increase - Basic Research	0.000	2.000
FY 2018 Accomplishments: N/A		
FY 2019 Plans: Conduct Congressionally directed effort.		
Congressional Adds Subtotals	0.000	2.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.