FOR IMMEDIATE RELEASE:
Wednesday, July 15, 2009

CONTACT:
Ashley Prime
aprime@qga.com
202/429-4002

Pat McMurray
pmcmurray@qga.com
202/429-6889

ON THE 40TH ANNIVERSARY OF THE FIRST MANNED MOON LANDING TODAY'S SCIENTISTS POINT TO NEW FRONTIERS

On the horizon are cures for diseases, "holistic reinvention" of vehicles, and an understanding of the human brain

Strong federal research funding will make these discoveries and others possible

Forty years ago, on July 20, 1969, the United States achieved an historic first when Apollo 11 Astronauts Neil Armstrong and Buzz Aldrin became the first humans to land on the moon. Armstrong's now famous words, "one small step for man, one giant leap for mankind," fulfilled the challenge set out nearly a decade earlier by President John F. Kennedy to land a man on the moon.

America's race to the moon also launched a generation of scientists. They were inspired by a sense of patriotism and the wonders of space and enabled by the country's newfound commitment to science following the Soviets' successful launch of the Sputnik satellite. The new R&D enterprise, built to support America's scientific ambitions and based largely on federally-funded research conducted at universities across the country, has had a remarkable effect on society and the economy. It has produced innovations in health, technology, energy, security, and defense. It has helped fuel the nation's economic growth. And, it has educated and trained new generations of scientists, engineers and doctors.

In anticipation of the anniversary of the first moon walk, The Science Coalition asked university researchers across the country to reflect on that event and share their thoughts about the next frontiers in science and what America must do to ensure that these scientific frontiers are reached. While each response is unique and reflective of the background of the respondent, together they make clear that there are many exciting new horizons in science. Research in such areas as energy and climate change, curing human disease, understanding the human genome, and answering questions about the Universe are, indeed, leading us to new frontiers.

The Science Coalition seeks to expand and strengthen the federal government's investment in university-based scientific, medical, engineering and agricultural research. Some highlights from the scientists' comments are below:

- "Perhaps more than anything, we need to address the scientific challenge of providing **more effective, efficient and diverse sources of energy** to drive the global economy, its citizens, and its infrastructure," said William McDonough, professor of geology at the University of Maryland.

- "Instead of looking for a single innovation to transform transportation, the next great challenge will be a **revolutionary and holistic reinvention of vehicles**. The next 'moon landing' will be a new science-driven way of approaching automobiles … that goes beyond slashing mpg or substituting gas with electricity," said Dennis Assanis, Director of the Michigan Memorial Phoenix Energy Institute and the W.E. Lay Automotive Laboratory at the University of Michigan.

- "The 21st Century equivalent to putting a man on the moon will be our **understanding of the human brain** – and in particular, **achieving the ability to stimulate the brain to repair itself**, including restoring old memories and learning new information after damage and disease. … That understanding will revolutionize the way we treat devastating neurological injuries and disease," said Elissa Newport, Chair of the Department of Brain and Cognitive Sciences at the University of Rochester. "We're almost there – if we merely stop cutting science funding, these discoveries are around the corner."

Most of the researchers have relied on federal grants throughout their careers to help support their work. And, like Dr. Newport, many spoke of the critical need for the U.S. to continue to invest in science and of what will be possible if there is strong and sustained funding for research.

- "We as a nation must realize that without a dedicated continuous support of scientific endeavors, our and our children's wellbeing cannot be sustained and improved. **America must preserve its leadership in creativity by increasing funding for research and, even more importantly, by educating its children**," said Alexander Rakhel, Distinguished Professor of Entomology, University of California Riverside, and Member of the National Academy of Sciences.

- "Like putting a man on the moon, answering these big questions would be a part of a journey to find our place in the Universe as well as preparing to extend our presence beyond earth. **Few investments would leave a greater legacy to future generations** or say more about our species," said Michael Turner, Professor of Astronomy & Astrophysics at the University of Chicago and former Chief Scientist at Argonne National Laboratory.

On the attached pages are the perspectives of 29 scientists from universities across the country, including the University of California (Berkeley, Riverside, Los Angeles, and Irvine), University of Chicago, Cornell University, Emory University, Johns Hopkins University, University of Maryland, University of Michigan, University of Rochester, Wayne State University, and West Virginia University. The full response and description of the research being conducted by each respondent is available on The Science Coalition website.

# # #

The Science Coalition is a non-profit, nonpartisan organization representing 45 of the nation's leading public and private research universities. It is dedicated to sustaining the federal government's investment in basic research as a means to stimulate the economy, drive innovation and secure America's global competitiveness. www.sciencecoalition.org

ON THE 40TH ANNIVERSARY OF THE FIRST MANNED MOON LANDING
TODAY'S SCIENTISTS POINT TO NEW FRONTIERS
FINDING CURES

Perspectives From	**University**
MEDICINE	
Peter Agre	Johns Hopkins Bloomberg School of Public Health
Anthony James	University of California, Irvine
Alexander S. Raikhel	University of California, Riverside
Elissa Newport	University of Rochester
Rafi Ahmed	Emory University
Akhilesh Pandey	The Johns Hopkins School of Medicine
Peter C. Searson	The Johns Hopkins University
Ling Qi	Cornell University
Michelle L. Cote	Wayne State University
Steven L. Salzberg	University of Maryland
Randy W. Schekman	University of California, Berkeley
Hans Keirstead	University of California, Irvine
Norman Cheng	Wayne State University
Michael Rose	University of California, Irvine
Victoria Meller	Wayne State University
David Reznick	University of California, Riverside
ENERGY/CLIMATE CHANGE	
Dennis Assanis	University of Michigan
Wayne Knox	University of Rochester
Earl Scime	West Virginia University
William F. McDonough	University of Maryland
Adam Riess	The Johns Hopkins University
Soroosh Sorooshian	University of California, Irvine
Omar Yaghi	University of California, Los Angeles
SPACE/UNIVERSE	
Michael Turner	University of Chicago
Lucy McFadden	University of Maryland
Charles Bennett	The Johns Hopkins University
Satya Atluri	University of California, Irvine
CHILD ABUSE/NEGLECT	
Douglas Barnett	Wayne State University
COMPLEX SYSTEMS	
William Sirignano	University of California, Irvine

MEDICINE

Curing the diseases that ravage the developing world:

"My personal dream is to unleash the finest minds in the world on the problems of the killer diseases of the developing world. These infectious diseases cause deaths of approximately 10 million small children each year worldwide. And these are diseases that we could and should conquer, including the big four: malaria, respiratory disease including tuberculosis, diarrheal disease, and HIV AIDS. Often children are infected by more than one at any time, and most also suffer concomitantly from malnutrition. While great efforts are being invested by aid agencies on behalf of each, the basic scientific understanding is still far from complete.

"We need bright young scientists to embrace this as their life's work. The conscience of our nation will be lifted mightily if we could end this dreaded scourge affecting the world's least fortunate."

Peter Agre, MD, Nobel Laureate
University Professor and Director
The Johns Hopkins Malaria Research Institute
The Johns Hopkins Bloomberg School of Public Health
In his **National Institutes of Health**-supported research at Johns Hopkins University, Dr. Peter Agre focuses on the biology of Malaria.

"While there may not be as many 'moving parts' as there were in the rockets, capsules and communication components that allowed us to go to the moon, the precise interplay and need for coordinated action of both the science and social aspects of disease control require a similar commitment of intellectual strength, emotional commitment, and resources. New ways of thinking, and in some cases, novel scientific and social methods will need to be discovered and developed to achieve disease eradication.

"America, more importantly, Americans, have accepted to some extent the challenge of disease eradication. We have had a 'war on cancer,' concerted efforts to stem the ravages of HIV, and a spectrum of other programs targeting specific diseases. A number of diagnoses that were once death sentences no longer pose the same threats. These changes were brought about by science, research and discovery, and it is reasonable to expect that similar efforts put to the major infectious diseases can have similar outcomes. In the case of mosquito-borne diseases, it is not too much to expect local elimination of some of these diseases, malaria and dengue fever in particular, in many parts of the world."

Dr. Anthony James
Distinguished Professor, Microbiology & Molecular Genetics
University of California Irvine School of Medicine
Distinguished Professor, Molecular Biology and Biochemistry, School of Biological Sciences
Dr. James' research program has been funded by a number of sources including the **National Institutes of Health.**

"Malaria, tuberculosis and AIDS are three major contributors of mortality and suffering in the developing world, particularly in sub-Saharan Africa. We must do more to overcome these and other devastating infectious diseases.

"Many devastating human diseases are transmitted by mosquitoes. Disease causing pathogens have successfully adapted to survive the immune defense of mosquito vectors. Hence, the understanding of the interactions between a pathogen and its vector host is essential for developing novel methods for disrupting disease spread. My laboratory aims to decipher mosquito immune responses during the invasion by pathogens. It is my hope that my work will contribute to the fight against malaria, Dengue fever and other diseases threatening humans.

"We as a society have greatly benefitted from advances in science and their application in our lives. However, we as a nation must realize that without a dedicated continuous support of scientific endeavors, our and our children's wellbeing cannot be sustained and improved. America must preserve its leadership in creativity by increasing funding for research and, even more importantly, by educating its children."

Alexander S. Raikhel
Distinguished Professor of Entomology
Member of the National Academy of Sciences
University of California Riverside

Dr. Raikhel's current work is in immune defense against pathogens causing malaria and Dengue fever and transmitted by mosquitoes. His work is supported by grants from the **National Institutes of Health.**

****

Helping the human brain repair itself:

"In my opinion, the 21st Century equivalent to putting a man on the moon will be our understanding of the human brain – and in particular, achieving the ability to stimulate the brain to repair itself, including restoring old memories and learning new information, after damage and disease. We're on the brink of understanding how to achieve this goal, and that understanding will revolutionize the way we treat devastating neurological injuries and disease, such as stroke and Alzheimer's, which are predicted to be the number one diseases of the next decades. To achieve this goal, America needs to continue its recent increase in funding for biomedical science. We're almost there – if we merely stop cutting science funding, these discoveries are around the corner."

Elissa Newport, Ph.D.
George Eastman Professor, Brain & Cognitive Sciences and Linguistics
Chair, Brain & Cognitive Sciences
University of Rochester

****

Controlling and preventing viral infections:

"Understanding the finer details of immunological memory at the cellular and molecular level has far-reaching consequences for confronting both emerging and re-emerging infections and for ultimately devising preventive strategies (vaccines and immuno-therapeutics) against some of the insidious pathogens (HIV/AIDS, Malaria and TB) that extract a heavy human toll around the globe."

A recent finding by Dr. Ahmed's group – that a therapeutic immunosuppressive drug, rapamycin, enhanced immunological memory – could potentially revolutionize and broaden treatment options in acute viral infections.

Dr. Rafi Ahmed, PhD
Director, Emory Vaccine Center
Professor & GRA Eminent Scholar
Dept of Microbiology & Immunology
Emory University

Supported by funding from the **National Institutes of Health**, Dr. Rafi Ahmed works in the area of "Immulogical memory" at Emory University.

****

Early diagnosis and cure of diseases:

"I think that the next big frontiers in science are to be able to diagnose diseases early and accurately and to be able to cure them. Apart from infectious diseases, we are still unable to 'cure' most diseases – the best we can do is to 'control' some of them. Also, for some diseases such as cancers, it might be possible to provide individualized therapy – the concept of 'personalized medicine' is still in its infancy and a lot more still needs to be done.

"A decade is not a long time, yet if the proper strategy is adopted, one can accelerate discoveries that impact medicine. If America took on the challenge, we could make significant progress."

Akhilesh Pandey, M.D., Ph.D.
Associate Professor at the Institute of Genetic Medicine and the Departments of Biological Chemistry, Oncology and Pathology
The Johns Hopkins School of Medicine

In his research, supported by the **National Institutes of Health** and the **National Heart, Lung and Blood Institute**, Dr. Akhilesh Pandey examines how cells "talk" to each other.

****

What lies at the intersection of nanoscience and medicine?

"The next great scientific frontier is at the interface between nanoscience and medicine. Over the next decade, research will likely contribute to significant breakthroughs in our understanding of cell biology and disease at the molecular level, providing a roadmap for new diagnostic and therapeutic strategies that could revolutionize healthcare and medicine. ...

"For example, collaborating with colleagues in medicine, we are developing semiconductor quantum dots for targeting and treating pancreatic cancer. Pancreatic

cancer is the fourth leading cause of cancer death in the U.S. and the survival rate amongst pancreatic cancer patients is extremely low, primarily due to the fact that a large fraction of tumors are metastatic at the time of diagnosis. Therefore, to improve survival of pancreatic cancer patients, there is an urgent need for detection at an early, and hence potentially curative, stage. Our approach is based on targeting molecular markers associated, and may lead to a new approach for early detection and identification of the stage of progression of pancreatic cancer."

Peter C. Searson, Ph.D.
Joseph R. and Lynn C. Reynold Professor of Materials Science and Engineering
The Whiting School of Engineering; Director of Johns Hopkins Institute for NanoBioTechnology
The Johns Hopkins University
Dr. Searson studies the applications of nanoscience to biology and medicine. His research is supported by the **National Science Foundation** and the **National Institutes of Health.**

****

Finding the causes of obesity and diabetes:

"My work is focused on identifying the cause or set of causes of obesity and diabetes. Delineating the characteristic nature and function of cells and genes involved in obesity and diabetes and other associated diseases such as cancer, may provide one or more candidate targets for drug intervention in conditions marked by chronic inflammation.

"The next great scientific frontier is finding cures for many human diseases. Our generation has witnessed a great many breakthroughs in science and medicine. Nonetheless, many human diseases – including cancer and neurodegeneration – remain incurable and lethal. Within the next decade, we will gain new insights into more diseases and thereby design more effective vaccines and drugs to prevent or treat them. This can only be accomplished through research and discovery, which in turn require increased focus on – and funding for – science and science education."

Ling Qi
Assistant Professor of Nutritional Sciences
Cornell University
Professor Ling Qi's work in metabolic regulation and diabetes is supported by the **National Institute of Diabetes and Digestive and Kidney Diseases.**

****

What if we could access our own genome sequence?

"The next decade will bring amazing strides in personalized medicine, including the ability for individuals to have access to their own genome sequence. Thus far, the sequencing of the human genome has brought with it as many questions as it has answers, but I believe we are poised to start benefiting widely from this prior work.

While all humans share over 99 percent of the same genetic code, the 1 percent of differences can be of great importance when determining what treatments we will respond best to and how susceptible we may be to certain conditions."

Michelle L. Cote, Ph.D.
Assistant Professor Department of Internal Medicine and Karmanos Cancer Institute, School of Medicine, **Wayne State University**
In her research, funded by the **National Institutes of Health** and the **National Cancer Institute**, Dr. Michele Cote is examining the parts of the genome associated with COPD and lung cancer. Her research could lead to better treatments and survival rates.

"The United States could map the genome of every man, woman, and child in the entire country. With the complete DNA sequences of every citizen in hand, we would have an unprecedented ability to study the entire range of human diseases, to determine how diet and lifestyle factors interact with our genes to affect our health, to understand precisely how genes influence our risk for cancer and infectious diseases, and a host of other questions related to human health. We could also start to deliver on the promise of 'personalized medicine,' in which treatments could be customized to each person's genome. And because the United States has long been a melting pot for different nationalities, the genetic variation we would uncover in the population would include a snapshot of the genes for the entire human race.

"The technology for creating this national genome map is already available. The latest DNA sequencers can sequence the entire genome of a human being in about a week, at a cost of only a few thousand dollars. By launching such an ambitious project, the U.S. would allow technology developers to reach economies of scale that might drive this cost down ten-fold or even 100-fold. New, very large data warehouses will be needed to store and search the data, but these too can be built by scaling up existing technology, with the expectation that costs will drop as the technology improves. The resulting database will be a resource for biomedical research that will dwarf anything in existence today, and that will provide an incredibly powerful tool for solving the major human health problems we face as a species."

Steven L. Salzberg, Ph.D.
Phillip H. and Catherine C. Horvitz Professor, Department of Computer Science
Director, Center for Bioinformatics and Computational Biology
University of Maryland, College Park
Dr. Salzberg's research focuses on the development of computational algorithms for analyzing DNA sequencing and is supported by grants from the **National Library of Medicine**, the **National Institute of General Medical Sciences**, the **National Institute of Allergy and Infectious Diseases**, the **U.S. Department of Agriculture**, the **National Science Foundation**, and the **Department of Homeland Security**.

****

The promise of stem cell research:

"The great breakthroughs will be in controlling cell fate during embryonic development. Learning how cells differentiate from a stem cell to a developed tissue will offer great insights and medical applications in tissue repair and replacement. In my lab we study how cells assemble themselves and how this process can be disrupted in diseases such as birth defects and Alzheimer's disease."

Randy W. Schekman, PhD.
Professor of Cell and Developmental Biology
Department of Molecular and Cell Biology, **University of California Berkeley**
Adjunct Professor, Biochemistry and Biophysics
Investigator, Howard Hughes Medical Institute
Editor-in-Chief, Proceedings of the National Academy of Sciences of the United States of America
Dr. Schekman's research receives support from the **National Institutes of Health**.

"If America decided to accept the challenge, the basic and clinical research communities could develop techniques to direct human stem cells to generate virtually unlimited amounts of every single human cell type. As one cell type provided the medical community with the opportunity to treat one human condition, unlimited quantities of every single human cell type would provide the medical community with the material to treat and study every human disease and injury. Such an accomplishment would spur untold biotechnological advances, the genesis of a new sector in the biotechnology industry, save the government untold billions of dollars annually, and alleviate immeasurable human suffering."

Dr. Hans Keirstead
Associate Professor, Anatomy & Neurobiology, School of Medicine
Associate Professor, Reeve-Irvine Research Center
Co-Director, Sue and Bill Gross Stem Cell Research Center
University of California Irvine
Dr. Keirstead's research focuses on stem cell-based approaches to treating spinal cord injury.

****

Predicting the progress of a disease:

"A new scientific frontier will be to facilitate predictive medicine through the improvement of clinical tools that can predict disease at an early stage. We wish to predict the progress of a disease, and to prevent the disease or control it at an early stage, and then to prescribe the treatment based on each individual's needs. MRI will play an important role. MRI is now reaching a maturity where it can contribute to fairly general routine examinations and early diagnosis. With fine image resolution, but without ionizing radiation, many quantitative methods in MRI have become feasible for the goal of predictive medicine. However, in order to advance techniques, more developments in MRI or imaging in general are still needed. The U.S. has the technology

to develop many new techniques in the next three to five years, or to let them evolve over the next decade. However, those developments will require more medical research and funding."

Norman Cheng, Ph.D.
Assistant Professor of Radiology, School of Medicine
Wayne State University
Dr. Cheng's current imaging research is supported by a grant from the **National Institutes of Health**.

Defeating aging:

"The slowing and eventual cessation of human aging would be a transformative event for humankind comparable to landing on the Moon. After the development of the Copernican model for the solar system, the idea of traveling to the Moon and back became a commonplace technological vision. Pieces were written about it in the 18th, 19th, and 20th Centuries, long before it was accomplished. Naturally, during most of this time-period many thought that travel to the Moon would never be achieved. Within biology and medicine, the idea of defeating human aging is even older. Some of the earliest recorded thoughts of both Western and Eastern civilizations concern means by which our aging could be slowed or arrested, and the topic has been discussed ever since."

In the 1970s, Dr. Rose deliberately produced animals with enhanced life spans that didn't involve mutilation or deprivation, the first time this had ever been done. Since then, chiefly at the University of California Irvine, Dr. Rose has been pursuing the idea of accomplishing the same goal for human subjects.

Dr. Michael Rose
Professor, Ecology and Evolutionary Biology, School of Biological Sciences
Director, Network for Experimental Research on Evolution, A University of California Multi-campus Research Program
University of California Irvine
Dr. Rose's research on aging has been supported by the **National Institute on Aging** and the **National Science Foundation.**

****

"The moon launch comparison is interesting because in my field, biological sciences, most research is conceived and carried out independently in small laboratories. An exception is the genome sequencing efforts of the last ten years. Genomes were sequenced by consortiums of labs, most guided by federal agencies and scientific societies. The push to get sequencing done, and the need to manage the massive amount of data produced, drove the development of technologies that changed the fundamental nature of experimentation. We can now ask questions about the regulation and evolution of genomes that would have been previously unthinkable.

"My research group uses information from the Drosophila (fruit fly) sequencing project to ask questions about how large groups of genes are coordinately regulated. This type

of research is crucial to understanding how genomes function normally – and how genome-wide misregulation leads to diseases like birth defects and cancer. Our studies rely on the tools and resources that flowed from the massive efforts of genome sequencing. This is similar to the power of the moon launch, which stimulated the development of technologies that changed research far beyond lunar exploration."

Victoria Meller
Associate Professor of Biological Sciences, College of Liberal Arts and Sciences
Wayne State University
Professor Meller's research in gene regulation has been funded by the **National Institutes of Health** and the **National Science Foundation.**

"Within a decade, we could map out the genetic changes that cause specific types of evolution to occur in a natural setting. There is a prevalent sense that there is a "gene for" specific traits, but in fact we know that this is not true. Individual genes can affect individual traits, but they can also affect many other traits, many other genes can affect a trait in question, and genes can interact with one another in unpredictable fashions. Thus, genes and their effects cannot be seen in isolation, but one always needs to consider their overall effects—a genetic change that might predispose us to a certain disease might at the same time protect us from other ailments. We also know that the static development of a trait can give us a distorted image for the role that individual parts of the genome play in defining a trait. Over the next decade, we could instead define the dynamical changes in the genome that are associated with the evolution of a trait and develop an enhanced concept for how the genome works and how it is modified to allow organisms to adjust to changes in their environment."

David Reznick
Professor of Biology
University Of California Riverside
Dr. Reznick's work has been continually supported by grants from the **National Science Foundation** since 1978.

ENERGY/CLIMATE CHANGE

Carbon-neutral transportation:

"Instead of looking for a single innovation to transform transportation, the next great challenge will be a revolutionary and holistic reinvention of vehicles. The next 'moon landing' will be a new science-driven way of approaching automobiles and other means of transportation that go beyond slashing MPG or substituting gas with electricity. The next great discovery will in fact be a series of tightly coordinated discoveries that will transform transportation systems toward sustainability.

"The future: Carbon Neutral Vehicles (CNV) – breaking down each element and function of the vehicle to find ways to eliminate greenhouse gases. This means from its fuels, to

how it runs, to how it interacts with other systems like the electrical grid, to the parts that make the vehicles, to the policies that guide the vehicles use – there is a revolution to find new ways to give that vehicle throughout its life cycle a tiny environmental footprint."

Dennis Assanis
Director, Michigan Memorial Phoenix Energy Institute
Director, W.E. Lay Automotive Laboratory
University of Michigan
His work is supported by the **Department of Defense** and **Department of Energy.**

****

Replacing fossil fuels:

"Certainly one of the greatest challenges we face today is to eliminate the large-scale use of fossil fuels through aggressive research into renewable energy sources that are safe, clean, and improve the environment, as a whole. Optical technologies such as improved solar energy collection and more efficient lighting and displays are just a few examples where we can see future advancements. In order to make these viable, the combined expertise of scientists and engineers from many diverse fields across the globe will be required."

Wayne Knox
Director, The Institute of Optics
University of Rochester

"The greatest scientific challenges facing our world involve the production and distribution of energy. … Nuclear fusion, having already demonstrated impressive progress over the past 50 years, is poised to make the next step toward energy production with the international ITER project – which will demonstrate controlled nuclear fusion. As a nation, we need to increase our involvement in ITER to the level of a major contributor and foster the innovation needed to design fusion systems that will be more economically viable and less complicated than ITER. It would take a 'moon race' or 'Manhattan' level project to move fusion energy from a scientific challenge to an implementation challenge. With vast supplies of fusion fuel, an energy based economy is feasible.

"I currently contribute to the development of fusion diagnostics and to the training of the next generation of plasma scientists."

Dr. Earl Scime
Robert C. Byrd Professor of Physics
Chair, Department of Physics, Eberly College of Arts and Sciences
West Virginia University

"Perhaps more than anything, we need to address the scientific challenge of providing more effective, efficient and diverse sources of energy to drive the global economy, its citizens and its infrastructure. We need to invest in understanding the interplay between climate change, water resources and the energy economy. We need to invest in all three areas of science and their associated areas of policy. Understanding the nature of water resource and its shifting distribution as a function of global climate change are likely to be a significant challenge to society in the future.

"I am developing methods for forensic identification of materials, environmental analysis and the analysis of materials that give us insights into how the Earth and inner planets were formed and operate. My research program spans the realms of practical science for society (environmental, national security and metrology) to fundamental scientific research that tells us about the Earth and the planets."

William F. McDonough
Professor, Department of Geology
University of Maryland
Professor McDonough's work has been funded by the **National Science Foundation** (earth and environmental sciences), **NASA** (meteoritics and planetary sciences), and the **Defense Intelligence Agency** (remote sensing).

****

Developing a "Plan B" for addressing climate change:

"The issue of global warming is a major concern whose understanding falls on the shoulders of science. Right now the focus is on Plan A; reducing our production of carbon dioxide, which is as it should be. However, the range of uncertainty in our models of the future atmosphere is large and the potential peril is great. I believe in the coming decade, we will learn a great deal about the quality of our understanding by comparing the current predictions to future data. In the face of such risk, I think it will be prudent for science to begin developing a "Plan B" for global warming. This could take the form of more aggressive interventions if the efforts to cut back on carbon output are not enough. For example, active blocking of sunlight above the atmosphere might be necessary. Achieving this would be an enormous scientific and engineering challenge but likely something America could achieve if necessary."

Adam Riess, Ph.D.
Professor, the Henry A. Rowland Department of Physics and Astronomy, Zanvyl Krieger School of Arts and Sciences, **The Johns Hopkins University**
Professor Riess' research focuses on deducing the nature of dark energy – one of the biggest mysteries in physics. His work is supported by **NASA** grants through the Hubble Space Telescope program.

****

Predicting floods and droughts:

"Since the Apollo days many advanced satellites have been launched to explore the outer space as well as the study of our own planet. … Through the observations made by numerous weather and environmental satellites, my team has been able to make significant progress in mapping global precipitation patterns with a resolution of a few kilometers in real time. The future looks even brighter as new generations of satellites are being developed and launched. Through an improved understanding of the earth's hydrologic cycle, predictions can be made for future extreme events such as floods and droughts. These predictions enable the development of policies that empower authorities to take action in adapting to and mitigating the impacts of climate change.

"As the United States is one of the major economic powers in the world, it has an obligation to take a leading role in addressing the climate change issue. In the next decade, new tools should be developed to better predict regional climate changes and provide policymakers with the data needed for better management."

Dr. Soroosh Sorooshian
Distinguished Professor Civil & Environmental Engineering, Henry Samueli School of Engineering
University of California Irvine
Distinguished Professor, Earth System Science, School of Physical Science UC Irvine
Dr. Sorooshian's research is currently supported by grants including those from NASA, the National Oceanic and Atmospheric Administration, and National Science Foundation.

Carbon dioxide capture:

"The pressing questions are those pertaining to energy. Specifically, clean energy. How do we clean the air we breathe from over 100 years of neglect and abuse? How do we create new concepts for harnessing energy from the sun and other renewable resources? Not surprisingly, the answer is in unlocking the power of molecules and large chemical structures where one potentially can create the very conditions under which it would be possible to use sunlight to convert carbon dioxide to clean fuels that recycle carbon. Ultimately, how do we produce hydrogen economically and store it safely for use with only water as a byproduct?

"My research is on capturing carbon dioxide before it reaches the atmosphere. My research group and I have invented one of the most extensive classes of materials named metal-organic frameworks (MOFs). They have wide uses in cleaning the air and environment. More significant is that MOFs are the products of minds that were originally directed to acquisition of basic knowledge through basic research."

Omar Yaghi
Professor, University of California Los Angeles Department of Chemistry & Biochemistry
Director, UCLA Center for Reticular Chemistry
Founder, UCLA Clean Energy Network
Professor Yaghi has received federal funding from the U.S. Department of Energy, U.S. Department of Defense, and the National Science Foundation.

SPACE/UNIVERSE

"We are poised to answer some of the most profound and most persistent questions that humankind has asked: How did the Universe begin? Are we alone? What is our cosmic destiny?

"We know that the Universe began from a big bang 13.7 billion years ago, but we don't know what triggered the big bang, or if there were other big bangs. We also know that most stars have planets, that there are 100 billion stars in our Milky Way galaxy and 100 billion galaxies in the observable Universe – a tremendous number of possibilities for life. However, we don't know how common earth-like planets are, how often they are the right distance from their star to support life, or how common life is (let alone intelligent life). Finally, we know that the Universe is expanding at an accelerating pace, caused by the action of a mysterious dark energy, but we don't know what that dark energy is, and until we do, we can only speculate about our cosmic destiny

"Together, powerful instruments that have been built and are being imagined and bold ideas have placed all of these questions within reach today. We have a theory for what triggered our big bang – a burst of acceleration know as cosmic inflation. The next step is to test the theory and discover its underlying details by making very precise measurements of the radiation left over from the big bang itself – the cosmic microwave background. Experiments to make these measurements both on the ground and in space have been designed, but await funding. Recently, NASA launched a space telescope called Kepler dedicated to searching for earth-like planets within our galaxy. Space telescopes capable of imaging planets discovered by Kepler and searching them for signs of life are in the process of being invented and likely could be built within 20 years.

"While there are no guarantees when working at the frontiers of knowledge, a sustained commitment over the next two decades and an investment in both people and equipment of $20 billion might well succeed in answering these big questions, or at the very least make dramatic progress. Like putting a man on the moon, answering these big questions would be part of a journey to find our place in the Universe as well as preparing to extend our presence beyond earth. Few investments would leave a greater legacy to future generations or say more about our species."

Michael Turner
Bruce & Dianna Rauner Distinguished Service Professor in Astronomy & Astrophysics
University of Chicago
Former Chief Scientist, Argonne National Laboratory

"Neil Armstrong and Buzz Aldrin's landing on the moon was a landmark day in human history and it ushered in a new age in the exploration of our solar system. As a rising high school senior on July 20, 1969 watching the men land on the moon was as awesome to me as it was to everyone else. Little did I know that I would be

participating in the space program three years later as an undergraduate researcher and eventually as a co-Investigator of robotic missions exploring asteroids and comets.

"Today, exploration of the solar system and the universe beyond has changed our view of ourselves, our home planet and the Universe beyond. We now know that the moon formed during a violent collision over 4 billion years ago that ejected a malleable chunk of Earth. That mass was captured into earth orbit and spun into the moon. Today we seek answers to questions of how life formed on Earth by exploring planets both near and far that contain water and organic material that are the seeds life on Earth, and we are characterizing planets around other stars. NASA currently has 65 active robotic spacecraft exploring both the solar system and beyond. Our colleagues around the world are doing the same with active spacecraft built by the EU, Japan, Russia and India.

"University researchers in partnership with aerospace companies and NASA initiate, design, and implement the great observatories and robotic space craft that have led the revolution in astronomy and astrophysics of the past five decades. Students working with us in our university research laboratories gain the ability to ask questions and design a plan of action to address them. In most cases we learn things that were totally unanticipated. And like the Apollo 11 landing on the moon, forty years ago, it changes the way we see ourselves, our community and our culture."

Lucy McFadden
Research Professor, Department of Astronomy
University of Maryland, College Park
Professor McFadden explores the physical properties of asteroids and comets in our solar system using robotic spacecraft. She was a co-investigator on NASA's historic NEAR and Deep Impact missions and is a co-investigator on the agency's current Dawn and EPOXI missions.

"The modern world has been defined by machines (robots) enhancing human capabilities. This will be the future of space flight as well. The astronaut-servicing of the Hubble Space Telescope is an excellent example. Now we should build on this hard-won knowledge and success. We should use our human presence in space not so much to 'go places', but to 'do things' and 'learn things.' How about building an enormous new telescope in space? Astronauts learned how to build an enormous structure in space when they built the Space Station. Let's use that knowledge to build a great new telescope – one too big to launch in one piece. Let's use it to answer fundamental questions, like whether or not we are alone in the universe, and to study how the universe began.

"If America decides to accept the challenge, we could answer these questions, and accomplish a range of other great research and discovery within the next decade, which in turn would spur innovation and create jobs here on Earth. We could do all this in partnership with other countries, not only to share the costs, but as a means of peaceful international cooperation."

Charles Bennett, Ph.D.

Professor, the Henry A. Rowland Department of Physics and Astronomy
Zanvyl Krieger School of Arts and Sciences
The Johns Hopkins University
Dr. Bennett's research into the nature of the dark energy that fills the universe, and exploring what happened at the beginning of the universe, has been supported by grants from **NASA**.

****

Developing "space age" materials:

"Knowledge of multi-functional and smart materials, nano-structured materials, and biomimetic materials will be important both for future space missions and for the future of earthbound infrastructure. Structural failure results in trillions of dollars of loss to the global economy each year.

"In order to reach our goals as a nation, I believe we need a National Department of Engineering, Science & Technology (DEST), parallel to the Departments of Commerce and Defense, with a prominent secretary, to integrate and coordinate research currently funded and supervised by various government agencies (including: NIH, DoD, FAA, NSF, NIST, DARPA). The secretary of DEST should be held accountable for developing and nurturing the human resources needed in science, engineering and technology in order to ensure the economic security of our country."

Dr. Satya Atluri
Samueli/Von Karman Professor of Aerospace Engineering, Mechanical & Aerospace Engineering
Henry Samueli School of Engineering, **University of California, Irvine**
Director, Center for Aerospace Research and Education
Dr. Atluri's work has been supported by grants from numerous agencies including: **National Science Foundation**, **Department of Defense** (DARPA), the **Office of Naval Research**, **Air Force Office of Scientific Research**, **Army** (Research Office, Research Labs), **NASA**, **Federal Aviation Administration**, **Department of Defense**, and **Department of Energy**.

ADDRESSING SOCIETY'S ILLS

Can science help us address child abuse and neglect?

"Nearly one million children each year in the U.S. are documented victims of severe forms of child abuse and neglect with the actual number likely in the 10s if not 100s of millions globally… . Despite the large scale nature of this problem, the scientific study of child abuse and neglect is less than 50 years old. Over the past four decades, preliminary progress has been made in our understanding of child abuse and neglect. We now have general consensus within the developed world on how to define and measure the wide range of forms in which child abuse and neglect occur. Several theories of the causes and consequences have been put forward and have received preliminary study. Animal models of child abuse and neglect also have been developed with primate species. Investigators have begun to develop an empirical science of

which treatments are effective at preventing child abuse and neglect as well as reducing some of the negative consequences associated with its aftermath.

"The biggest obstacle to research on child abuse and neglect is federal funding. Further, the science of understanding and responding to child abuse and neglect can be advanced greatly through the collaboration of disciplines including psychology, psychiatry, pediatrics, radiology, social work, law, public policy, criminal justice, primatology, and the social sciences."

Douglas Barnett, Ph.D.
Associate Professor of Psychology, College of Liberal Arts and Science
Wayne State University
Dr. Barnett is currently collaborating on a study funded by the **National Institutes of Health**.

MANAGING COMPLEX SYSTEMS

"The major challenges of the future are not focused on new technologies alone. Rather, we are challenged to manage technologies and people as part of a large system. Such large systems can be scientifically categorized as 'complex systems' because they have certain characteristics, including limited ability to manage from above because of a very large number of semi-autonomous decision makers and the ability to self-organize structures. So, these are more than just highly complicated systems such as an aircraft or a spacecraft. Examples of complex systems include a health-care system, an energy-supply-and-consumption system, a financial market, an air-traffic-control system, and a military force employed in a battle. The engineering/scientific challenges are to characterize these systems and to develop means to optimize their performances and/or the performance of certain elements/agents within the system."

William Sirignano
Professor, Electrical Engineering & Computer Science
The Henry Samueli School of Engineering, University of California Irvine
Dr. Sirignano's current research focuses on problems of fuel spray and droplet combustion; breakup of injected liquid streams; formation, injection, and burning of emulsified fuels; liquid-film combustors; turbine burners.
His research has been supported by the Army Research Office and the Air Force Office of Scientific Research.