Research in Basic Science Brings Innovations That Improve Our Lives...

... like Satellites.

The most powerful communication tools of the 21st century provide us with the split-second ability to send sounds, pictures and numerical data. Yet scientists did not set out to invent satellite technology.

In 1907, a young student named Robert Goddard attracted unwanted attention in a cloud of smoke from a powder-fueled rocket fired in the basement of a campus physics building. To their credit, instead of expelling young Goddard, school officials took an immediate interest in his work. After two decades of research, Goddard launched his first liquid fuel rocket in 1926.

Then, in the 1950's, the world was changed forever by the launch of the Russian satellite Sputnik. Sputnik captured the world's attention and the United States responded with dedicated federal funding for new research in basic science. The innovations that grew out of this support include microwave and optical technology, detection and digital processing of signals, precision timing and global positioning systems. What began as solely laboratory-based phenomena evolved into the invention of new communications tools.

Today, satellite communications allow news organizations to provide worldwide live, on-the-spot broadcasting, cell phone networks to keep businesses and families in touch, financial access to ATM machines and the simple pleasure of satellite TV and radio.

In short, satellites save time and money. Most importantly, they keep us in touch with the people who matter most to us.

Today, universities and national laboratories are exploring more advanced technologies that make use of navigation software and Global Positioning System (GPS) receivers. Further miniaturization of satellite systems using nanotechnology and microelectronics research may make even smaller satellites possible, saving resources and reducing space flight payload sizes. And these technologies hold the possibility of allowing for more cost effective and reliable communication. Which, in the end, are the results we all want.

SCIENTISTS DID NOT SET OUT TO INVENT THE TECHNOLOGY BEHIND SATELLITE COMMUNICATIONS — IT EMERGED BY APPLYING KNOWLEDGE LEARNED THROUGH OUR COMMITMENT TO FUND BASIC SCIENTIFIC EXPLORATION.

Science is an important investment for America, even when government resources are scarce.

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Research in Basic Science Brings Innovations That Improve Our Lives...

... like Solar Energy.

Using technology to harness the sun's energy now complements the sun's primary role in sustaining life on the planet. Yet scientists did not set out to invent solar energy technology.

In 1839, a 19-year-old physicist, Edmund Becquerel, first observed what is called the photovoltaic effect - the generation of electric current using a light sensitive device. Sixty years later, at the dawn of the 20th century, physicists Max Planck and an unknown Albert Einstein suggested that light consists of bundles of energy, which came to be called photons, and provided key scientific underpinnings for the later realization of solar energy technology.

In 1954, Becquerel's century-old discovery, illuminated by the work of many others, resulted in the introduction of the first solar photovoltaic device to produce a useful amount of electricity. And by 1958, solar cells were being used in small-scale scientific applications and for the space program. Industry developments and federal funding of research in the 1970's made remote applications of the technology possible. What began as a laboratory curiosity is now providing solar energy to power devices essential to our lives.

Today, photovoltaic solar cells convert sunlight into electricity. The simplest cells power watches and calculators, while more complex systems can light houses and provide power to large scale electric grids. In short, solar energy can save money and is conserving our valuable non-renewable resources.

The new millennium has seen universities and national laboratories exploring even more research and production advances. Next-generation photovoltaic materials currently under development may bring dramatic decreases in price as well as greater availability. And smaller systems that produce hydrogen fuel by using electricity could help to bring about the transition to a hydrogen-based economy.

Work on photovoltaic solar cells may bring a future of cleaner, cheaper forms of energy. Which, in the end, is the result we all want.

SCIENTISTS DID NOT SET OUT TO INVENT THE ABILITY TO HARNESS SOLAR ENERGY — IT EMERGED BY APPLYING KNOWLEDGE LEARNED THROUGH OUR COMMITMENT TO FUND BASIC SCIENTIFIC EXPLORATION.

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Where will Cosmic Rays Take Us?

A mystery of our universe that has scientists probing the frontiers of knowledge involves the study of highly energetic particles that bombard the earth from all directions of space – cosmic rays.

In 1912, Austrian scientist Victor Hess piloted a balloon to a then daunting altitude of 17,500 feet. He found that radiation at high altitudes is more intense than it is on the ground, and concluded that this "cosmic" radiation must come from outer space.

Then in 1938, French physicist Pierre Auger discovered that cosmic rays collide with molecules high in the earth's atmosphere to create a veritable shower of invisible particles that rain down on the earth's surface.

But even today, nobody knows how the most powerful of these cosmic rays are made, or where they come from. Some produce huge particle showers over an area as large as a city, and have an energy 10 million times greater than we can make with any particle accelerator here on earth. Scientists believe that they must come from somewhere far outside our solar system, or even from outside our galaxy.

With the help of federal research funding, physicists from the United States and around the world have recently come together to construct the world's largest cosmic ray observatory on the Argentine high plain near the Andes. When complete, it will have 1600 detectors spaced across an area the size of the state of Rhode Island. Each detector is self-powered with a small solar energy panel. When a particle shower strikes a group of detectors, they transmit their data to a central computer using ordinary cell phone technology. And satellite-based Global Positioning System (GPS) devices tell scientists exactly when each event occurs.

The Pierre Auger Cosmic Ray Observatory will reveal clues about the engine that powers our universe's cosmic ray accelerator.

WHEN WE PROBE THE MYSTERIES OF OUR UNIVERSE, THERE'S NO TELLING WHERE THE DISCOVERIES MIGHT LEAD US, OR HOW THEY MIGHT REVOLUTIONIZE OUR LIVES – THE ONLY WAY WE'LL FIND OUT IS BY FUNDING BASIC SCIENTIFIC EXPLORATION.

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