Research in Basic Science Brings Innovations that Improve Our Lives.

In the 21st century, scientific discoveries affect how we live, how we work, how we communicate with the world around us. Yet scientists did not set out to develop many of these now vital technologies.

The history of science is rich in stories of how the study of very abstract concepts gave rise to unanticipated major technological advances.

In the 1600's, Isaac Newton questioned why objects move and the best way to describe their motion. He introduced a new and abstract concept called gravity and pondered how it could reach across space, even to the planets and stars. His questions became key to mechanical engineering, the use of satellite observatories, the understanding of the geology of our planet and to flight.

In the 1700's, electricity was a rare phenomenon — only exhibited in a few places like lightning. But this provoked the curiosity of scientists who gave us electric motors and generators. And in the 19th century James C. Maxwell connected magnetism and electricity with the vibrations of "electromagnetism," giving rise to the control of light, radio, radar and microwaves.

By the late 1800's, the behavior of substances heated so that they glowed from dull red to "white hot" caught the attention of physicists. Bohr, Planck, Einstein, Heisenberg and Schroedinger could not have predicted that their discoveries would result in transistors, televisions, computers, the Internet and cell phones.

The practical applications that emerged from scientific curiosity account for a large portion of the total Gross Domestic Product of all industrial nations and dominate not only our economy, but also our social behavior.

IN THE UPCOMING WEEKS WE WILL BE SHARING STORIES OF HOW OUR COUNTRY'S COMMITMENT TO FUNDING BASIC SCIENCE EXPLORATION HAS REVOLUTIONIZED OUR LIVES.

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 Lasers.

Some of the most powerful laser inventions of the 21st century allow for precision in areas like manufacturing, telecommunications and medicine. Yet scientists did not set out to develop these now vital technologies.

At the dawn of the 20th century, physicists Max Planck and a then unknown Albert Einstein developed a theory that explained light does not consist of continuous waves, or of small, hard particles. Instead, it exists as bundles of energy called photons, which possess the characteristics of both waves and particles. Each photon has an energy that corresponds to the frequency of the waves in the bundle.

In the 1950's, federal funding for research linked to Planck and Einstein's original work led to the development of the precursor to the laser. What began as a solely laboratory based phenomenon to help scientists study molecular structures is now used in a multitude of tools essential to our lives.

Modern telecommunications relies on photons, as tiny semiconductor lasers transmit light pulses carrying billions of bits of information per second over glass fibers. High power CO_2 lasers are used in manufacturing for drilling, cutting, welding, heat-treating and alloying. In medicine, lasers are used to correct vision, to diagnose and destroy cancers, to help heal wounds and to perform microsurgery. From the copy machines and laser printers in our offices, to the scan bar codes at the supermarket, the laser has fueled a flood of industrial activity.

And there is no ebbing of this trend in sight. Universities and national laboratories are exploring innovative techniques for using laser technology. New understanding of coherent ultra-short wavelengths may be the only practical way to manufacture nanotechnology structures the size of a grain of sand. And lasers may even offer the potential for unlimited energy – Inertial Confinement Fusion uses lasers to compress and heat hydrogen fuel to temperatures of 100 million degrees Celsius, and uses the inertia of the fuel to confine it long enough for fusion to occur.

Scientific innovation promises new opportunities for improving not only the lives of our families, but also society. Which, in the end, are the results we all want.

SCIENTISTS DID NOT SET OUT TO REVOLUTIONIZE OUR LIVES THROUGH LASER TECHNOLOGY – IT EMERGED BY APPLYING KNOWLEDGE LEARNED THROUGH OUR COMMITMENT TO FUND BASIC SCIENTIFIC EXPLORATION.

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

... like MRI.

The most powerful, yet non-invasive, diagnostic tools of the 21st century provide doctors immediate access to detailed images of their patients' bodies. Yet scientists did not set out to invent MRI.

Beginning in the 1930's, scientists in the United States began to understand the fundamental nature of particles, matter and energy, by using accelerators, or "atom smashers", to collide atomic particles at increasingly high energies. Meanwhile, condensed matter physicists began to illuminate the behavior of atomic particles in the presence of strong electromagnetic fields. Federal funding for research in nuclear, high energy, and condensed matter physics fueled research into the nature of these atomic particles and their interaction with matter, as well as the increasingly sophisticated and large magnets needed for the machines to accelerate atomic particles. What began as solely laboratory based phenomena evolved into the invention of new tools for the diagnosis and treatment of disease.

Today, magnetic resonance imaging (MRI) scans are able to look at the size and shape of organs and body structures, allowing doctors to identify strokes, soft tissue injuries and tumors quickly and prepare a medical response.

In short, MRI saves time, saves money, and most importantly, saves lives.

Today, universities and national laboratories are exploring new techniques for using this technology. Breast biopsies are now being guided in real-time by MRI – a new, important advance in diagnosing breast cancer.

Researchers are also developing methods to measure precisely and non-invasively patients' blood flow while they exercise. That information yields a better understanding of vascular disease and may ultimately lead to improved diagnosis and treatment. Which, in the end, are the results we all want.

SCIENTISTS DID NOT SET OUT TO INVENT MRI – IT EMERGED BY APPLYING KNOWLEDGE LEARNED THROUGH OUR COMMITMENT TO FUND BASIC SCIENTIFIC EXPLORATION.

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