A Century in Focus
Light plays a vital role in our daily lives and is an imperative cross-discipline of science in the 21st century. It has revolutionized medicine, bolstered critical security and defense systems and opened up international communication via the Internet – linking cultural, economic and political aspects of the global society. For centuries, light has transcended all boundaries, including geography, gender, age, culture and race. Today, optics and photonics are used to enhance quality of life around the world, enabling a $78 trillion world economy.

The Science of Light
From fiber optics and telecommunications to medical imaging and cancer research, optics and photonics are advancing today’s critical technologies. Based on the science of light, optics and photonics are specialized fields of physics and engineering. These technologies are prevalent in almost every aspect of day-to-day life. From your computer screen to your cell phone and car headlights, optics and photonics are critical technologies that will continue to grow and enhance people’s lives.

Health and Medicine
Optics and photonics are critical to our healthcare experience, driving medical instrument innovation, early detection and diagnosis and fostering less invasive and more effective treatments. Optics and photonics are utilized in numerous medical devices that help to save lives. Imaging equipment used for CAT, MRI and PET scans, as well as mammography, aid in the diagnosis of disease. Laser and optical techniques enable fundamentals ranging from research and technology development, to biomedical studies, to clinical applications. Applications include: microscopy and optical coherence topography, molecular probes and nanobio-optics, optical biosensors, optical trapping and manipulation in molecular and cellular biology and therapeutic laser applications.

Defense and Homeland Security
Photonic integration enables increased performance, manufacturability, stability and cost savings throughout the defense and security infrastructure, including communications, intelligence, navigation, electronic warfare and sensing systems. Optics and photonics are essential to areas such as night vision technology, laser rangefinders, invisible security systems, detecting and combating biological terrorism and computer security, to name a few.

Communications and Entertainment
Fiber optics connects the world through high-speed communications. In fact, the Internet was developed by optics researchers. Today’s optics research is bringing higher-speed communications to our homes via fiber technology – enabling advanced data transmissions, like video streaming and other applications. As broadband Internet continues to spread and become a necessary quality-of-life service, the optical infrastructure needed to power the Internet will continue to create unique opportunities for capital investment worldwide.
Photonics technologies have a major impact on the world economy with a current global market of €300 billion and projected market value of more than €600 billion in 2020.¹

While less than 2 percent of the U.S. public companies are engaged in photonics, these companies contribute 10 percent of public company annual revenues and 6 percent of public company employment.²

Western Union sent the first electronically-transmitted photograph in 1921.³

The word “photronics” appeared around 1960, when the laser was invented by Theodore Maiman.⁴

In 1948, the Hale Telescope, named after OSA member George Ellery Hale, sees first light.⁵

The latest transatlantic fiber-optic cable can transmit a hundred hours of digital video or 30 million phone calls across the Atlantic.⁶

In 1947, Edwin Land at an OSA meeting in New York City demonstrated the first instant camera and film system. He was later named an Honorary Member of The Optical Society.⁷

We have optical fibers to thank for providing us the ability to use social media, texting, video-conferencing and many other forms of modern communication – the Internet would not be possible without optics.⁸

As part of the space race, optical scientists and engineers developed instruments and materials that steered the spacecraft, mapped the moon and brought back some of the 20th century’s most iconic images.⁹

Nearly 50 years ago, optical equipment and technology were critical components of the U.S. Apollo program, which culminated in the first steps by humans on the moon.¹⁰

Although Albert Einstein is most known for his theories of relativity, he won the Nobel Prize his theoretical contributions on the photoelectric effect, which is the observation that many metals emit electrons when light shines upon them.¹¹

² http://www.geglobalresearch.com/blog/the-importance-of-photonics-technology
³ http://www.osa.org/en-us/history/exhibits/optics_photonics_timeline/
⁵ http://www.astro.caltech.edu/palomar/about/history.html
⁶ http://science.nationalgeographic.com/science/space/universe/future-is-calling/
⁷ https://www.osapublishing.org/view_article.cfm?gotourl=https%3A%2F%2Fwww%2Eosapublishing%2Eorg%2FDirectPDFAccess%2FC9968287-9FE3-E325-E8304EA6E9DC3F67_52950%2Fiosa-56-3-273%2Fpdf%3Fda%3D1%26id%3D52950%26seq%3D0%26mobile%3Dno&org
⁹ https://www.osapublishing.org/opn/abstract.cfm?uri=opn-26-6-40
¹⁰ https://www.osapublishing.org/opn/abstract.cfm?uri=opn-26-6-40
¹¹ http://www.optics4kids.org/home/content/celebs/optics-icons/
Issac Newton made many contributions to the field of optics, mechanics, astronomy, and mathematics. His well-known optics contributions include the discovery that white light is made up of many colors, the reflecting telescope, among others.\textsuperscript{12}

Ninety-nine percent of international data is transmitted by wires at the bottom of the ocean called submarine communications cables, which use fiber optic technology. In total, they are hundreds of thousands of miles long and can be as deep as Everest is tall.\textsuperscript{13}

Optical light has a frequency more than a million times larger than that received by a radio.\textsuperscript{14}

In 2013, Internet traffic was five gigabytes per capita. This number is expected to reach 14 gigabytes per capita by 2018,\textsuperscript{15} thanks to the field of optics.

Scientists are experimenting whether it’s possible to create a network of photonic neurons to perform brain functions – like pattern recognition—but significantly faster.\textsuperscript{16}

\textsuperscript{12} http://www.optics4kids.org/home/content/celebs/optics-icons/
\textsuperscript{13} http://mentalfloss.com/article/60150/10-facts-about-internets-undersea-cables
\textsuperscript{14} http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=135842
\textsuperscript{15} http://mentalfloss.com/article/60150/10-facts-about-internets-undersea-cables
\textsuperscript{16} http://phys.org/news/2015-08-wild-world-optics-photonics.html
Light is energy, otherwise known as electromagnetic radiation (EM). Light visible to the human eye illuminates colors. Other forms of EM radiation are not visible to the eye, such as: radio waves, microwaves, X-rays, etc. Light can be blocked, reflected or bent, and light is produced, controlled and detected by lenses or other products.

Optics is the study of visible, ultraviolet and infrared light. Optics is a branch of physics involving the behavior and properties of light, including light’s interaction with matter and the instruments that use or detect it.

Photonics relates to the emission and transmission of light. Photonics is the study of light, including generation, detection and manipulation through emission, transmission, modulation, signal processing, switching, amplification and detection/sensing. The term photonics developed as an outgrowth of the first practical semiconductor light emitters invented in the early 1960s and optical fibers developed in the 1970s.

Lenses can bend light in order to form or scatter images. Convex lenses focus light waves into an image, while concave lenses spread out light waves. Lenses can magnify images, whether through simple reading glasses or interstellar microscopes.

Lasers are special sources of light of only one pure color, or wavelength. Regular light from the sun or a light bulb contains all of the colors of a rainbow, but such light can be split into its individual colors by passing through a prism. Light from a laser cannot be broken into other colors. Lasers can focus across long distances, generate energy to cut through materials (from human skin to thick metal) and carry information for communication and other purposes.