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Enabled by light

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From the moment the sun comes up in the morning to the second the moon and stars appear in the night sky, human beings see everything around them because of light, says Anthony Johnson, director of the Center for Advanced Studies in Photonics Research at the University of Maryland in Baltimore County.

In fact, every time someone listens to a CD, watches a DVD, buys something at the grocery store or makes a phone call, light is most likely enabling the activity.

"We use it all the time, and we don't even think about it," says Mr. Johnson. "If we are going to make scientific advances, we have to understand light. ... It would benefit the nation and the world."

In everyday activities, the importance of light often is overlooked. Not only does much of daily living depend upon its illumination, qualities associated with it also may hold the answers to many of society's current problems.

Since Mr. Johnson, who has a doctorate in physics, believes that future discoveries and inventions depend upon a better knowledge of light, he is the principal investigator for a new program called "Hands-On Optics: Making an Impact With Light," which will bring science education to tens of thousands of underserved children nationwide. Development of the pilot program began in October, and the full project will expand to the nation in 2006.

In September, the Optical Society of America in Northwest; the International Society for Optical Engineering in Bellingham, Wash.; Mathematics, Engineering, Science Achievement in Oakland, Calif.; and the National Optical Astronomy Observatory in Tucson, Ariz.; were awarded a \$1.7 million grant from the National Science Foundation in Arlington to implement the project, which will target middle school students.

It will focus on connecting optics industry volunteers with science classrooms. Volunteers will give presentations, including optics-related activities, after school, during weekends and at summer camps. Sample experiments will include building a kaleidoscope, constructing a pinhole camera and creating holograms. The program will be aimed at young girls and minority groups, who typically are underrepresented in the science and technology work force.

Interest in light at a young age surely will help build the ranks of upcoming optical experts, says Elizabeth Rogan, executive director of the Optical Society of America. She is hoping these individuals, who will need a strong background in math and physics, will use their knowledge to work on projects such as the early detection of cancer cells.

In the future, she imagines optics will be used to improve many fields, from medicine to military and defense to transportation. For instance, through optical technology, she suggests that drivers will be informed of the most expeditious routes on the highway, reducing traffic congestion. Further, she anticipates that optics will be involved in technological advances to help the elderly who are losing their vision.

Currently, optics also are used in other areas such as face and eye recognition technology and procedures such as laser eye surgery. Optical technology also aided in accurately

measuring the distance between the Earth and the moon.

"Physicists have decided that optics will be the answer in the future," Miss Rogan says. "It's an enabling technology that is behind many of the things that work so simply, but they are really not that simple."

Light Force Therapy, a photo-stimulation treatment that was approved in October 2000 by the Food and Drug Administration, helps ease the pain associated with a number of conditions, including arthritis; tendinitis; fibromyalgia; muscle and joint pain; and muscle spasm, stiffness and soreness.

Originally used to cure "incurable" horses, the process uses light-emitting diodes to produce beams of light at specific wavelengths and frequencies, which help to relieve acute or chronic pain associated with disease or injury, says Kim Peterson, founder and president of Light Force Therapy in Elizabeth, Colo.

She says light is able to speed up certain cellular metabolic processes that increase oxygen and blood flow, stimulate nerve function, decrease inflammation, increase mobility and facilitate pain reduction and muscle relaxation.

"When people have chronic pain, their bodies don't accept anti-inflammatory drugs for a long period of time," she says. "The drugs tend to lose their effectiveness. People are looking for things that offer credible alternatives to taking a lot of pills."

Not only is the use of light healing the sick, it also is providing protection for the nation, says Thomas Giallorenzi, division director at the Naval Research Lab in Southwest. For instance, military aircraft use digital cameras in reconnaissance and surveillance missions to obtain the most accurate images possible. The cameras of the military use about 90 million pixels, while the average commercial digital camera uses about 4 million pixels. When struck by light, each pixel creates a tiny electric charge, which enables the picture to be read digitally.

The U.S. Navy also is using fiber optics to fabricate acoustic sensors to detect submarines. Fiber optics uses the transmission of light to send signals. The acoustic signal is impressed upon the light, which is transmitted down the fiber.

Tests are being done at White Sands Missile Test Range in White Sands, N.M., for new technology that would enable commercial and military airplanes to carry a laser that would "confuse" missiles launched from the ground or approaching enemy aircraft. Ideally, the laser would make the missiles fly off in another direction. Right now, however, there is no way to tell where the missiles would land.

Researchers continue to study light, says Mr. Giallorenzi, who holds a doctorate in applied physics. Among various projects, they are hoping to learn more about how it reacts with different materials and how it can be converted into electrical signals.

"The average person takes most of the activities associated with light for granted," he says. "They are so commonplace, but when you look at your TV, it's an optical display system. Just about anything you do involves light."