

Applications of Light Technology Group Activity

Working in groups of 3-4, read the following article on electromagnetic waves. Afterwards, select one of the applications of electromagnetic waves provided, then research and write a one page report on your topic. Make sure to address all the questions provided below in your report. Then, present your findings to your class through a powerpoint presentation, poster or video.

Electromagnetic Waves

Electromagnetic waves provide a means of expanding human knowledge. The applications of our knowledge of light have benefits for society and the environment.

One example is the use of photo elasticity. Some materials, such as glass and Lucite, have an index of refraction that is different for different polarizations of light. When subjected to stress, such as bending, stretching, or compression, these photo elastic materials refract light in a particular way. When you place Lucite between polarizing and analyzing filters, the strain patterns (and thus the stresses) in the material become visible. Engineers often begin their design process by building Lucite models of their designs. This enables them to analyze the stresses in the models before completing the design of the actual structures. Under mechanical stress, these Lucite models reveal areas where stress accumulates. This allows engineers to make any necessary design changes before constructing a particular device.

Another innovative light technology is the remote-seeing application of light which uses electromagnetic radiation to examine the properties of objects or substances. The lidar user aims a laser beam at a remote object of interest and observes the resulting scattered light. The laser may be ultraviolet or near infrared. Scientists use lidar to examine rocks, rain, chemical compounds in the atmosphere, and clouds. Usually, the laser beam is pulsed so the timing between the pulse and detection of the scattered light can be measured. These measurements provide precise information about the distances between the laser and the object under observation. **Figure 1** shows a laser beam that measures air density, pressure, temperature, water vapour, and other constituents in the air such as oxygen, nitrogen, and carbon dioxide, providing scientists with information about the atmosphere at that location.



Figure 1 In this photo taken by Luc Girard, the University of Western Ontario's Purple Crow lidar sends laser light into the atmosphere. The laser light reflects off air molecules, revealing information about the atmosphere.

Allan Carswell, began studying laser research, while being a professor at York University in Toronto. Later, he led a team that developed the first CO₂ laser in Canada and the first Canadian commercial helium-neon laser. In 1974, Cardwell founded Optech, Inc. to develop practical applications of the lidar systems. Since then, Optech has become a world leader in developing lidar applications.

The Application

Lidar and photo elasticity tests are just two examples of the many applications of electromagnetic waves. Light technology is used in many diverse disciplines, including biology, chemistry, meteorology, medicine, engineering, and entertainment. Examples of applications of light technology are the study of human and animal vision, holography, laser eye surgery, mining, xenon lights, and stress analysis in materials. In this activity, you will choose one application of electromagnetic waves to investigate.

Your Goal

To learn about the benefits, costs, and risks of a technology that uses the wave nature of light.

Research

Select one of the applications of electromagnetic waves listed above. Research the technology to learn how it works, why it is beneficial, and how it impacts society and the environment.

Summarize

Use these questions to summarize your research:

- How is this technology useful? Give examples of its applications.
- How does the application use electromagnetic waves?
- What portion of the electromagnetic spectrum is used?
- Who benefits from this application?
- What are the costs, risk, or concerns surrounding the application?
- Can this phenomenon work if another type of electromagnetic wave is used? Explain why or why not.

Adapted from Nelson University Preparation - Physics 12.