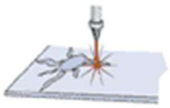
Laser

What is a laser?

Emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.

Many useful inventions use lasers. So do many inventions to entertain us.



- CD and DVD players use lasers.
- Bar code readers in stores use lasers.
- Doctors use lasers to do delicate surgery, such as eye surgery.
- Lasers carry TV and telephone signals over special cables.
- Metal workers use lasers to cut and weld metal into everything from street light poles to cars.
- Workers in clothing factories use lasers to cut through hundreds of layers of fabric at once.

Lasers are a special form of light. Laser light does not exist in nature.

Only human technology can create laser light.

So, what is "ordinary" or natural light?

Ordinary light, like sunlight, is made up of many different wavelengths, or colors, of light.

Please note that the wavelengths in these drawings are not to scale.

If you put all the different colors together, you get white light.

. . . and how is laser light different?

- First, the light from a laser contains exactly one color or wavelength rather than a lot of different wavelengths. Scientists say that laser light is "monochromatic," meaning of one color.

- Second, all the wavelengths are in phase. That is, they are all "waving" together, like a well-timed audience "wave" at a football game. All the wave crests (high points) and troughs (low points) are lined up. Scientists say the laser light is "coherent."

- And third, while light waves from ordinary sources (such as flashlights, lightbulbs, or the Sun) spread out in all directions . . .

. . . laser light waves all travel in the same direction, exactly parallel to one another. This means that laser light beams are very narrow and can be concentrated on one tiny spot. Scientists say the laser light is "**collimated**."

Because the laser light is monochromatic, coherent, and collimated, all of its energy is focused to produce a small point of intense power. This focused power makes laser light useful for cutting and welding. It also makes it possible to control laser light very precisely and make it do all kinds of useful things.

Space lasers!

Lasers are also finding many new uses in space missions. No, not in light sabers!

For one thing, lasers can be used in a device called a spectrometer.

A spectrometer uses light to identify the chemical composition of matter. For example, as light passes through a gas, the gas soaks up certain colors, or wavelengths, of light. Different gases absorb different wavelengths. So, the light that comes out the other side of a gas cloud will have a unique "fingerprint." A spectrometer can read that fingerprint and identify the gas.

For example, a spectrometer "looking at" sunlight that has passed through the air above a city can detect what gases the air contains, including all the pollution from cars and factories.
A new kind of laser spectrometer can go even farther and measure exactly how much of a gas is present. Want to look for signs of life on Mars? One way is to look for methane. Methane is a gas produced by living things, like bacteria. Even tiny amounts of methane on Mars could mean something is alive and well!

Let's say scientists send their special spectrometer to Mars as part of a lander or rover mission. The scientists know that methane—and only methane—absorbs a certain wavelength of light. So, like tuning in a radio station, they "tune" their laser spectrometer to that exact wavelength. The spectrometer's laser beam aims at a distant rock, zipping through the Martian air, bouncing off the rock, and shining back into the spectrometer's "eye." If the returning laser light is weaker, it can only mean that methane in the Martian air has absorbed some of the energy. And how much energy has been absorbed tells how much methane is present.