Under normal circumstances, the higher an energy level is, the less it is populated by thermal energy. Under some circumstances (for example, the presence of an upper energy level that has a relatively long lifetime), a system can be constructed so that there are more atoms/molecules in an upper energy level than is allowed under conditions of normal thermodynamic equilibrium. Such an arrangement is called a population inversion.

When a population inversion exists, an upper-state system will eventually give off a photon of the proper wavelength and drop to the ground state. This photon, however, can stimulate the production of other photons of exactly the same wavelength because of stimulated emission of radiation. Thus, many photons of the same wavelength (and phase, and other similar characteristics) can be generated in a short time. This is light amplification by stimulated emission of radiation, or LASER—usually seen in lowercase as laser. Lasers typically have a very narrow wavelength range of emission.

Many types of energy levels—electronic, vibrational, bands in semiconductors—are used to make lasers. Many materials are active laser sources, including Cr^{3+} ions in ruby and alexandrite crystals, Ti^{3+} in sapphire, Nd^{3+} in garnet, and a variety of doped semiconductors. Gases or gas mixtures like He/Ne, Ar, Kr, CO_2, N_2, even Cu(g) can be made to lase. Certain organic dyes can also be made to lase; one advantage is that their laser action has a broader range of wavelengths (20-30 nm) and they can be tuned to a particular wavelength.