In [physics](http://en.wikipedia.org/wiki/Physics), **energy** ([Ancient Greek](http://en.wikipedia.org/wiki/Ancient_Greek): ἐνέργεια [*energeia*](http://en.wikipedia.org/wiki/Energeia) "activity, operation"[[1]](http://en.wikipedia.org/wiki/Energy#cite_note-0)) is an indirectly observed quantity that is often understood as the ability of a [physical system](http://en.wikipedia.org/wiki/Physical_system) to do [work](http://en.wikipedia.org/wiki/Work_(physics)) on other physical systems.[[2]](http://en.wikipedia.org/wiki/Energy#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Energy#cite_note-2) Since work is defined as a [force](http://en.wikipedia.org/wiki/Force) acting through a distance (a length of space), energy is always equivalent to the ability to exert pulls or pushes against the basic forces of nature, along a path of a certain length.

The total energy contained in an object is identified with its [mass](http://en.wikipedia.org/wiki/Mass), and energy cannot be created or destroyed. When [matter](http://en.wikipedia.org/wiki/Matter) (ordinary material particles) is changed into energy (such as energy of motion, or into radiation), the **mass** of the system does not change through the transformation process. However, there may be mechanistic limits as to how much of the matter in an object may be changed into other types of energy and thus into [work](http://en.wikipedia.org/wiki/Work_(thermodynamics)), on other systems. Energy, like mass, is a [scalar](http://en.wikipedia.org/wiki/Scalar_(physics)) physical quantity. In the [International System of Units](http://en.wikipedia.org/wiki/International_System_of_Units) (SI), energy is measured in [joules](http://en.wikipedia.org/wiki/Joule), but in many fields other units, such as [kilowatt-hours](http://en.wikipedia.org/wiki/Kilowatt-hour) and [kilocalories](http://en.wikipedia.org/wiki/Kilocalorie), are customary. All of these units translate to units of work, which is always defined in terms of forces and the distances that the forces act through.

A system can transfer energy to another system by simply transferring matter to it (since matter is equivalent to energy, in accordance with its mass). However, when energy is transferred by means other than matter-transfer, the transfer produces changes in the second system, as a result of work done on it. This work manifests itself as the effect of force(s) applied through distances within the target system. For example, a system can emit energy to another by transferring (radiating) [electromagnetic energy](http://en.wikipedia.org/wiki/Electromagnetic_energy), but this creates forces upon the particles that absorb the radiation. Similarly, a system may transfer energy to another by physically impacting it, but in that case the energy of motion in an object, called [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy), results in forces acting over distances (new energy) to appear in another object that is struck. Transfer of [thermal energy](http://en.wikipedia.org/wiki/Thermal_energy) by [heat](http://en.wikipedia.org/wiki/Heat) occurs by both of these mechanisms: heat can be transferred by electromagnetic radiation, or by physical contact in which direct particle-particle impacts transfer kinetic energy.

Energy may be stored in systems without being present as matter, or as kinetic or electromagnetic energy. Stored energy is created whenever a particle has been moved through a field it interacts with (requiring a force to do so), but the energy to accomplish this is stored as a new position of the particles in the field—a configuration that must be "held" or fixed by a different type of force (otherwise, the new configuration would resolve itself by the field pushing or pulling the particle back toward its previous position). This type of energy "stored" by force-fields and particles that have been forced into a new physical configuration in the field by doing work on them by another system, is referred to as [potential energy](http://en.wikipedia.org/wiki/Potential_energy). A simple example of potential energy is the work needed to lift an object in a gravity field, up to a support. Each of the basic forces of nature is associated with a different type of potential energy, and all types of potential energy (like all other types of energy) appears as system [mass](http://en.wikipedia.org/wiki/Mass), whenever present. For example, a compressed spring will be slightly more massive than before it was compressed. Likewise, whenever energy is transferred between systems by any mechanism, an associated mass is transferred with it.

