The Laws of Thermodynamics

Chapter 4 explains thermodynamics quite well, but I'd like to add a note about the Laws of Thermodynamics.

Physicists like to express them in a semi-joking manner as follows:

1. **You can't win -** Energy is only converted between different forms, it cannot be created. (We have no idea how it appeared in the first place.)
2. **You can't even break even -** When energy is converted, the useful work obtainable is always less than the energy put in. The disorder of an isolated system always increases. There are no perpetual-motion machines.

0 or 3. **You must play the game -** The disorder of the universe is always increasing and you are part of it.

The 2nd law can be stated many different ways. My freshman chemistry teacher passed out a sheet with about 20 different ways to express that law.

Maybe when we understand more about black holes or quantum mechanics, we may learn of a way around these laws.

The fundamental laws of particle interactions seem to allow all processes to reverse, but the probability of a disorganized system composed of a huge number of randomly-moving particles adopting an organized configuration is negligibly small. There are just too many possible disorganized configurations. Mixing two colors of paint is easy, separating them again is exceedingly difficult.