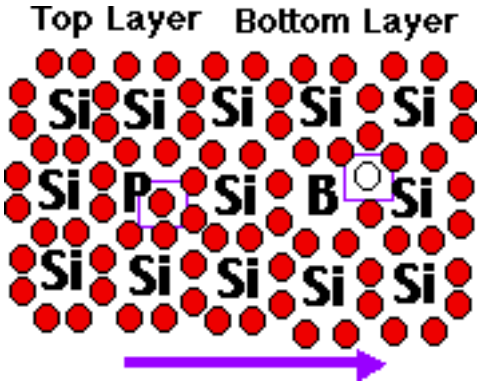
Solar Electric Physics

The energy that comes from the sun comes through the sun's rays. These rays include photons. Photons are small particles that are actually just excited electrons. Using the following diagram, that shows the three layers of a solar cell in Lewis structures. If you are unfamilar with Lewis structures, consult the definition page for it.

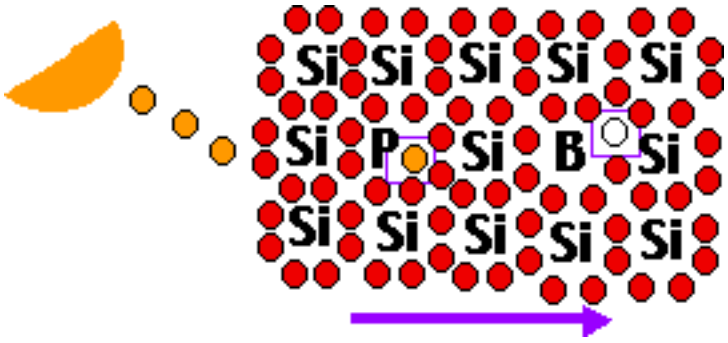
A solar cell consists of three layers. The following picture of a lewis structure is like a two dimensional representation of layers. The leftmost Lewis structure is like the top most layer.



The leftmost Lewis structure and top layer is called N-Type Silicon because it has an extra electron. The phosphorus (P) atom has an extra electron, and in the Lewis structure has another circle filled although it has eight electrons connected to it. Remember, Phosphorus has an electron configuration of $[Ne]3s^2p^3$. This extra electron will become more important later. The middle layer is pure silicon, and has not net charge. Silicon's electron configuration is $[Ne]3s^2p^2$. A pure silicon layer will not have either an extra electron, or an extra hole where an electron is needed. For this reason, it is not designated as N-type or P-type. The rightmost Lewis structure and lowest layer is called P-Type Silicon because it has a deficiency of one electron. Because Boron's electron configuration is $[He]2s^2p^1$, it has an extra hole where an electron is needed.

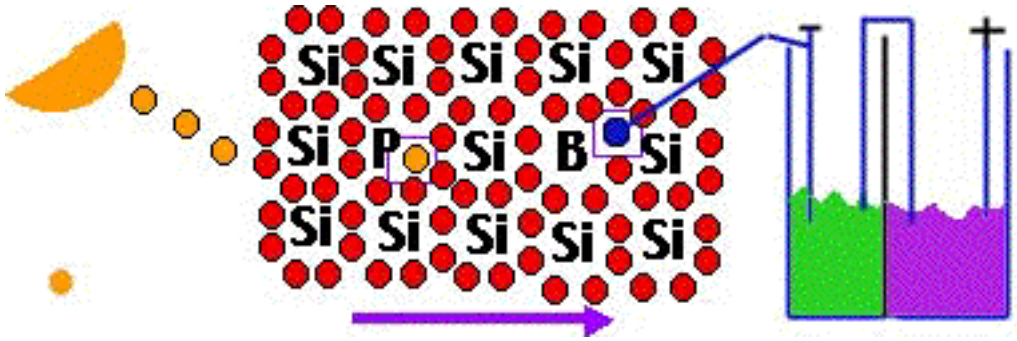
These three layers together form the solar cell. A solar cell is the combination of two blocks, one of P-type and the other of N-type Silicon. This combination is called a PN Junction. The reason that solar cells were discovered around the time that transistors were is because a solar cell is just a special kind of a transistor. Both are PN Junctions. The paths of electrons from phosphorus to silicon to boron is called an electron sea.

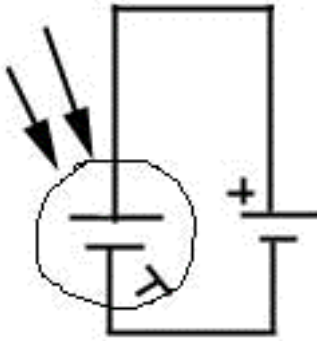
The actual action that occurs within the solar cell is very simple once Lewis structures are understood. The extra electron of the phosphorus atom will leave the phosphorus and pass over to the boron atom to fill its hole. The path of the extra electron from phosphorus to the boron is the way that the sun's photon rays are converted to electrical energy. The photon comes from the sun and falls into the hole left by the phosphorus atom's escaped electron. The following diagram demonstrates the solarelectric effect.



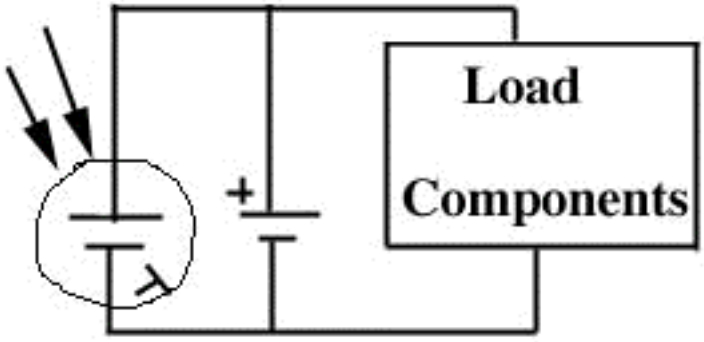
The following discussion relates the solarelectric effect and energy collection from the process of the solar cell. If you are not familar with the use of drawings to represent electronic components, called Schematics, refer to the page describing it.

A simple circuit that uses the energy harvested by a solar cell involves a way to store the energy taken from the sun. Large batteries are usually used to hold this energy for a solar electric house. A less larger circuit that involves a small solar cell will have a correspondingly smaller battery. The following two illustrations show a solar cell in operation and converting the sun's rays to electrical energy, first with the solarelectric effect, then with the schematic drawing.





In a small circuit, the energy made by the solar cell can be used to power another component, like a light bulb or a light-emitting diode (LED). The other components that a solar cell, or any other power source supplys energy to, are called the load. The following diagram express the meaning of load first with a box for load with schematic components.

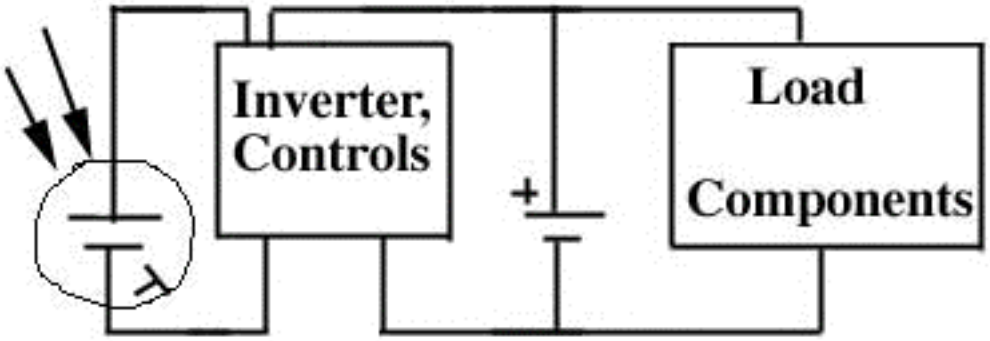


In these circuits, as in all other circuits, the components are rated for the amount of current, or voltage that they can

withstand. The rays that come from the sun have a specifc voltage, that pressures the photon to pass from the N-type silicon over to the P-type silicon. If the voltage is not high enough, then the photons will not pass from the N-type silicon to the P-type silicon. When the voltage is high enough, the photons pass through the electron sea and cause an electronic current.

At night while the battery holds energy converted by the solar cell, and this energy will leak if not held in place. One way to keep the energy inside the battery is to place a diode (a junction of P-Type Silicon and N- Type Silicon) in between the solar cell and the battery that it supplies energy to.

In a solar house the load is the appliances, tools, and electric things that people use. A circuit that might be used that used the electricity of a solar house is illustrated below.



To learn the basic calculations of electricity, go to the help page for Electricity. To see how much you remember from reading this page, take a quiz over this material.