adafruit learning system

Collin's Lab: Solar

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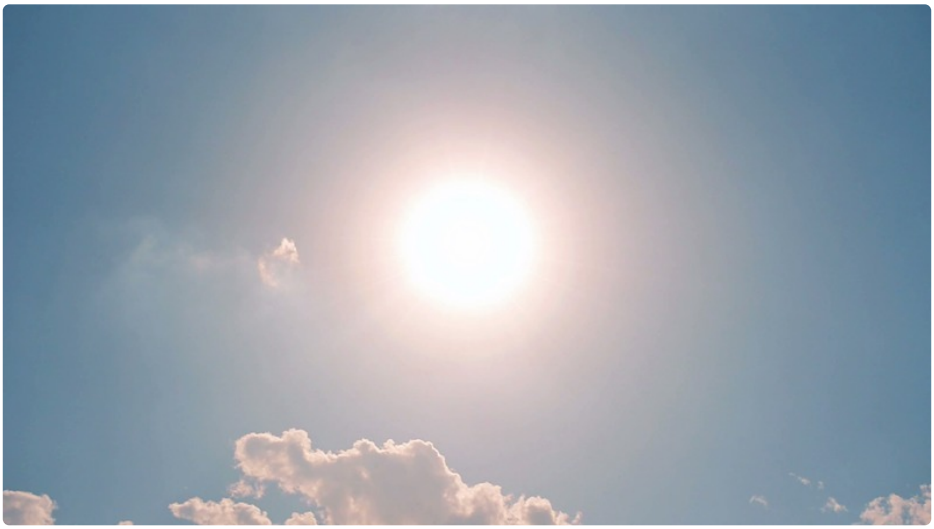
Video

Harness the power of the sun for - whatever! Solar technology may be commonplace, but converting light into electricity is still an amazing bit of magic. Join Collin as he explores what makes solar tick and it how it relates to other common components.

Transcript

Right now - energy radiating from the sun is making me sweat. Fortunately solar power technology allows me to also use the sun's energy to cool off a bit.

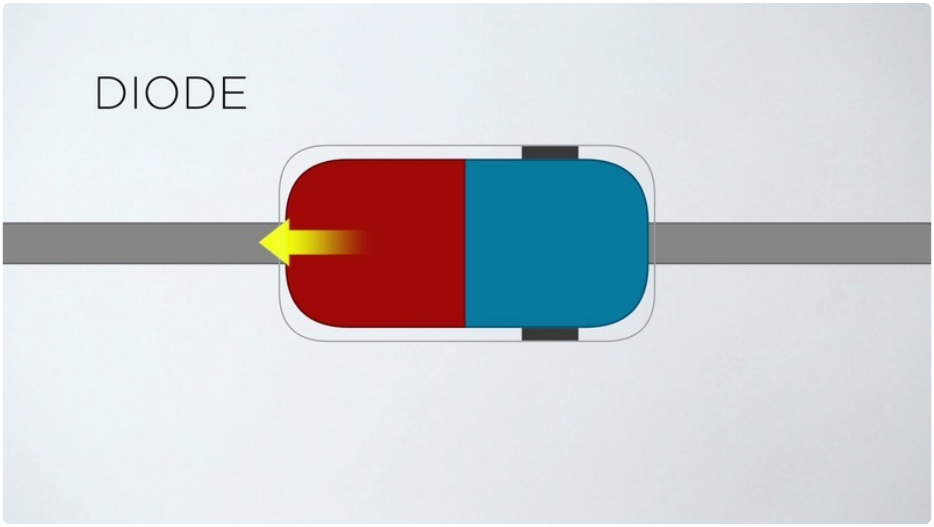
Your move, sun ...



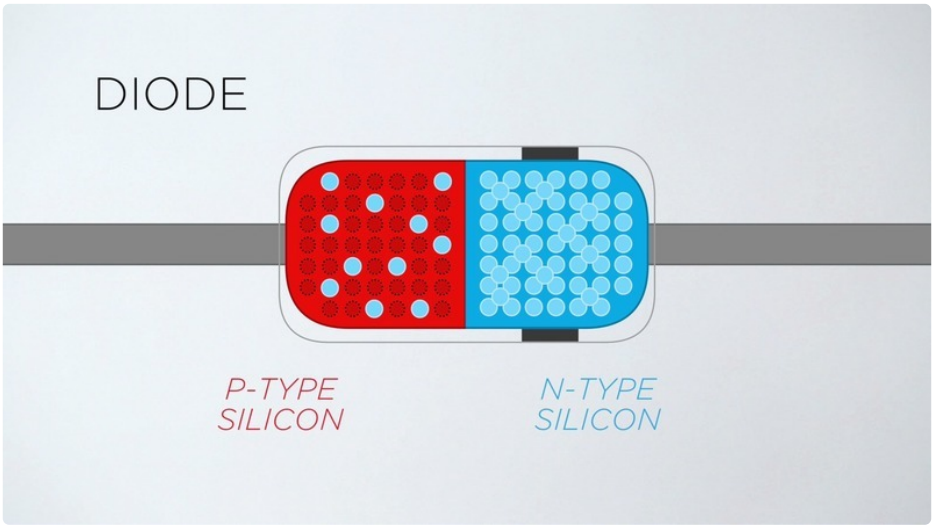
Right - anyway!

Solar panels were first used to power satellites back in the 1950s, but since then they've become much more efficient & widely used.

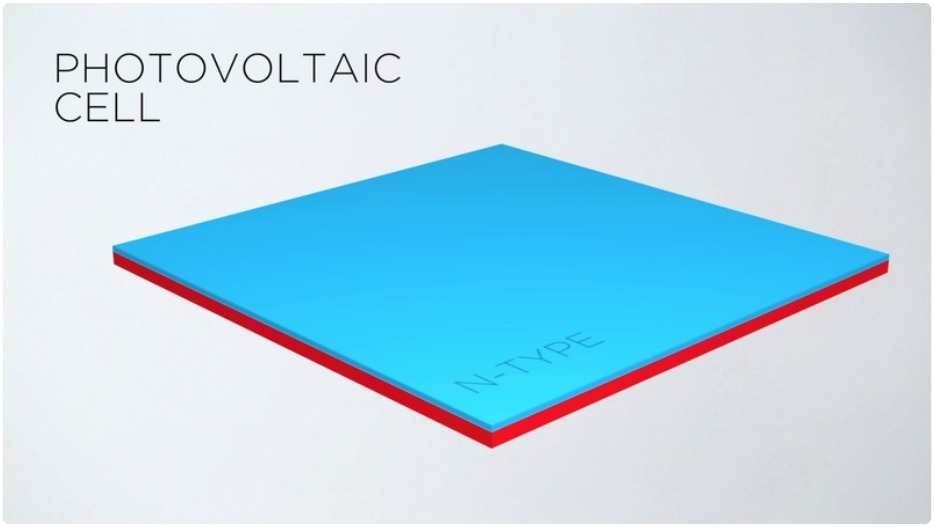
A panel like this one converts light into electricity using an array of solar or "photovoltaic" cells. These cells are surprisingly simple devices - quite similar to diodes ...



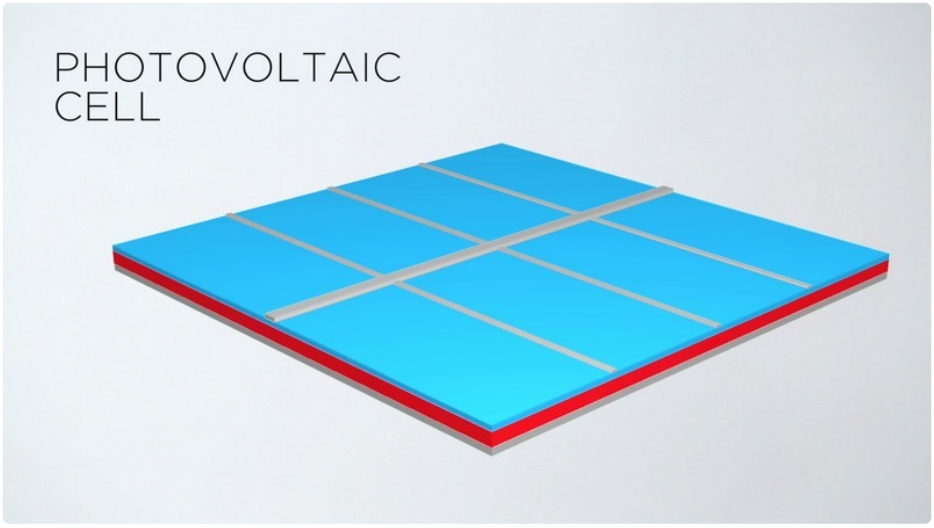
A diode uses two types of silicon stacked together to allow electrical current to flow in a single direction.



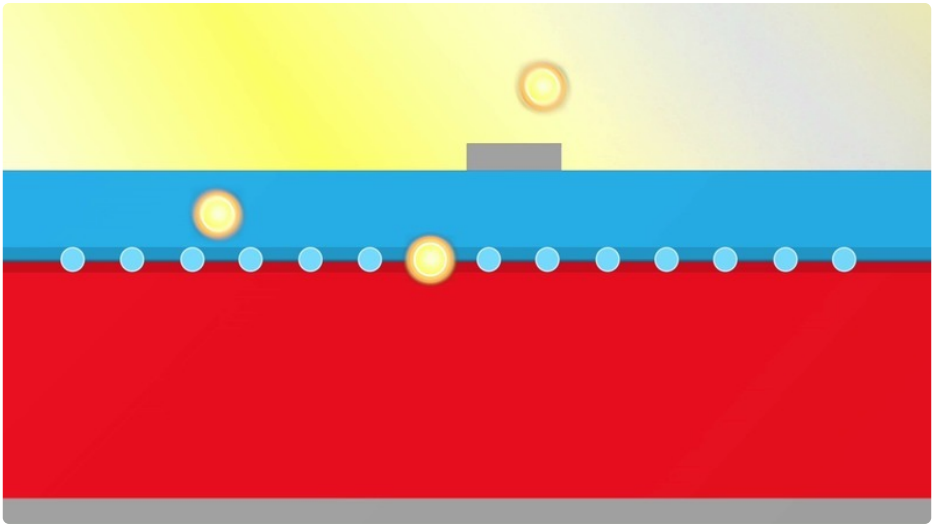
Negative, or N-type silicon, which has an excess of electrons and positive P-type silicon which has an excess of electron holes.



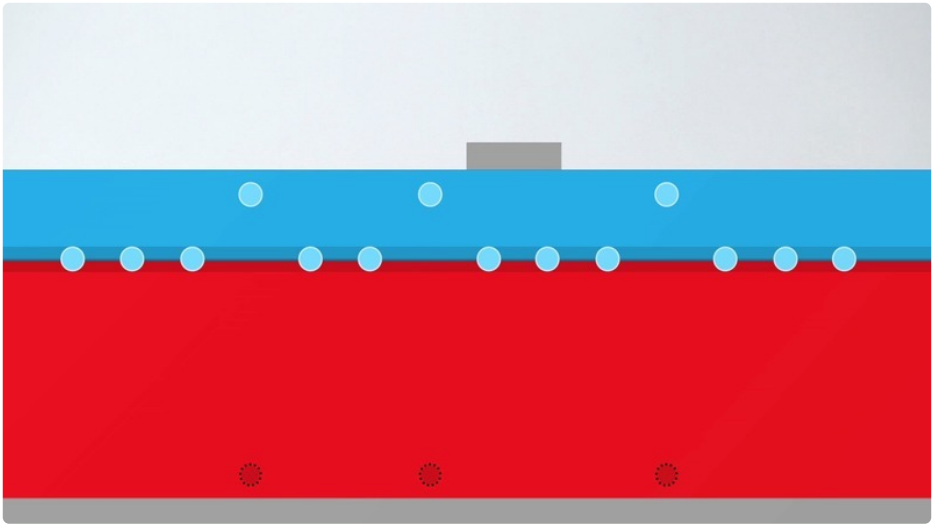
Similarly, a photovoltaic cell uses a wide, flat layer of p-type silicon covered by a thin layer of n-type silicon.



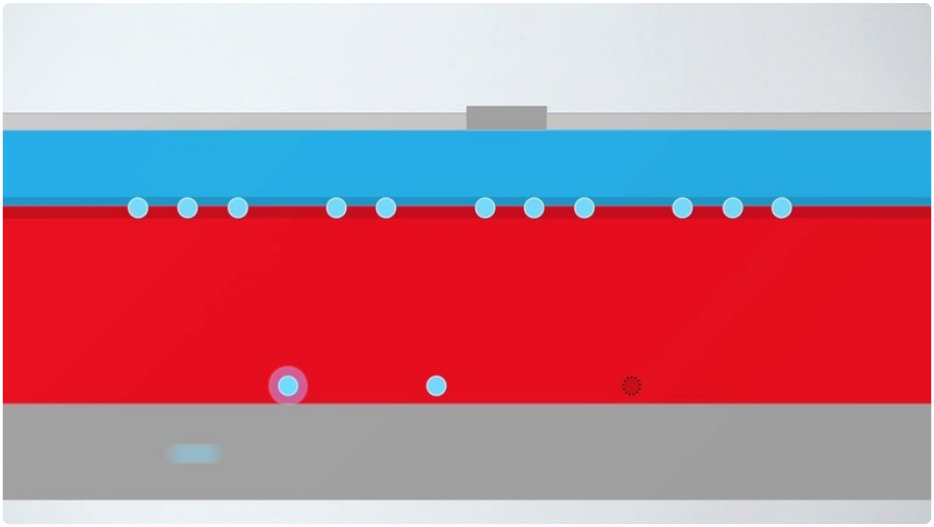
A single large flat metal conductor is connected to the bottom of the cell. And thin metal finger-like conductors are placed on top, which leaves most of the cells surface exposed to light.



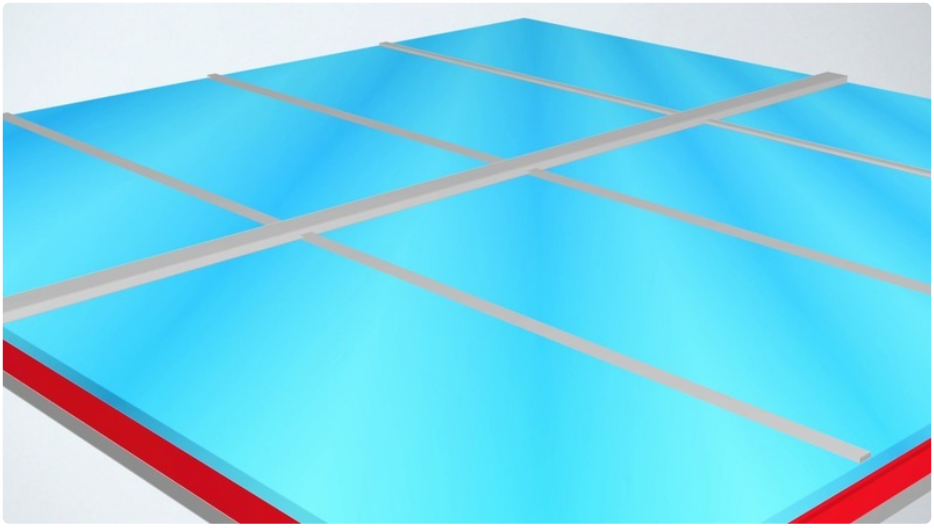
When light hits the surface of the cell, photons pass through the top layer and hit the junction between the negative and positive layers.



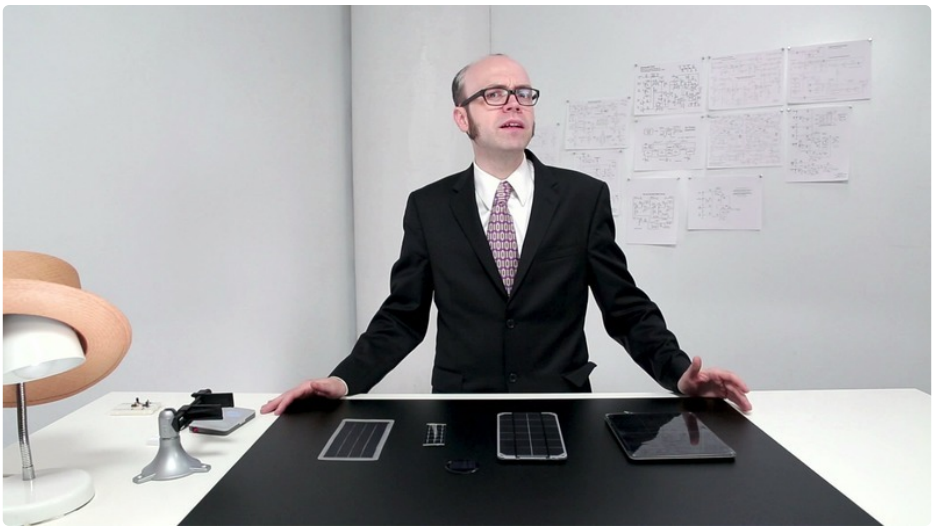
This knocks electrons out of their holes and towards the top of the cell, while those resulting holes are pushed down towards the bottom.



When we connect a circuit to the cell's conductors, Electrons leave the negative layer and travel through the circuit in order to reach the available holes down on the positive layer.



All the while, more photons are knocking electrons out of holes and the cycle continues.

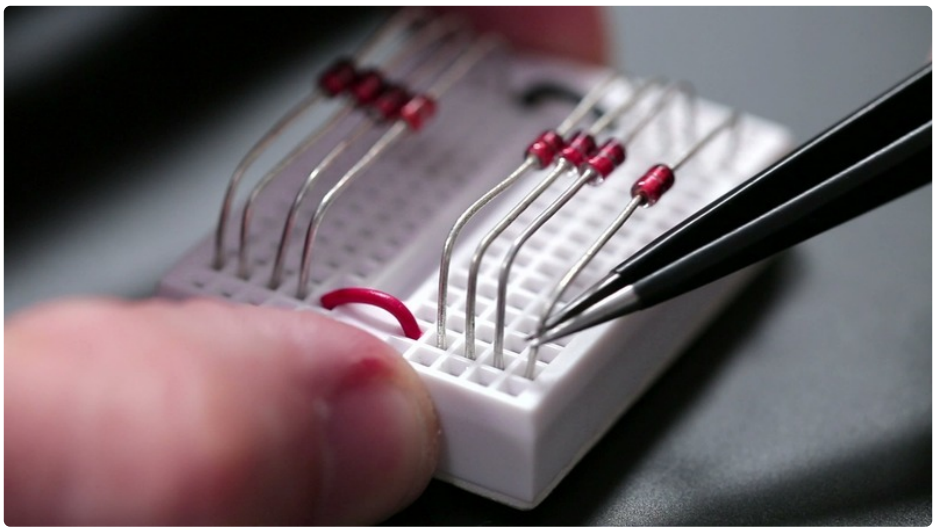


Hmmm. Well that's quite a bit different from what a diode does, eh?

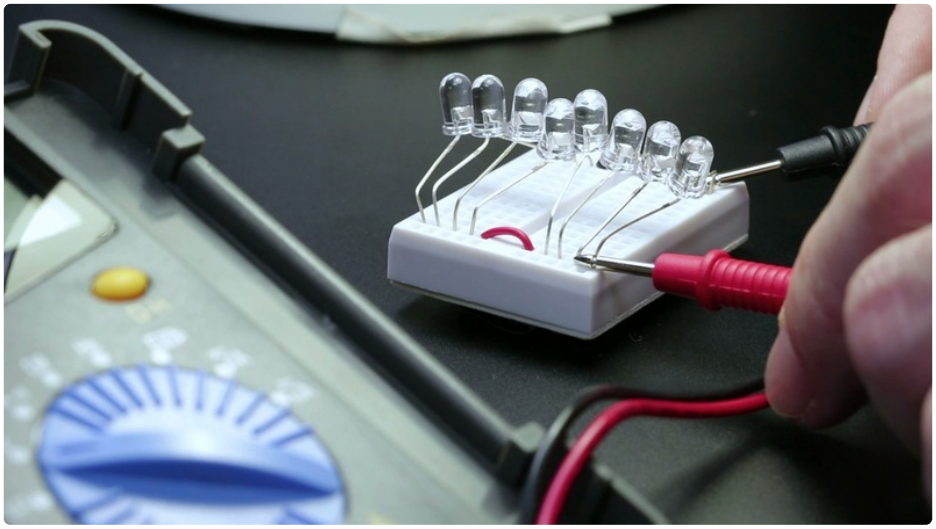
I mean, a diode can't generate electricity or even respond to light ...

... or can it?

Ok - here we have a bunch of silicon diodes. They're the "small signal" type so they have glass packages - which should allow light to pass directly to the silicon.



By wiring them all up in parallel and exposing them to light, we can see that in fact they do produce a little under 200 millivolts.



And what about Light Emitting Diodes?

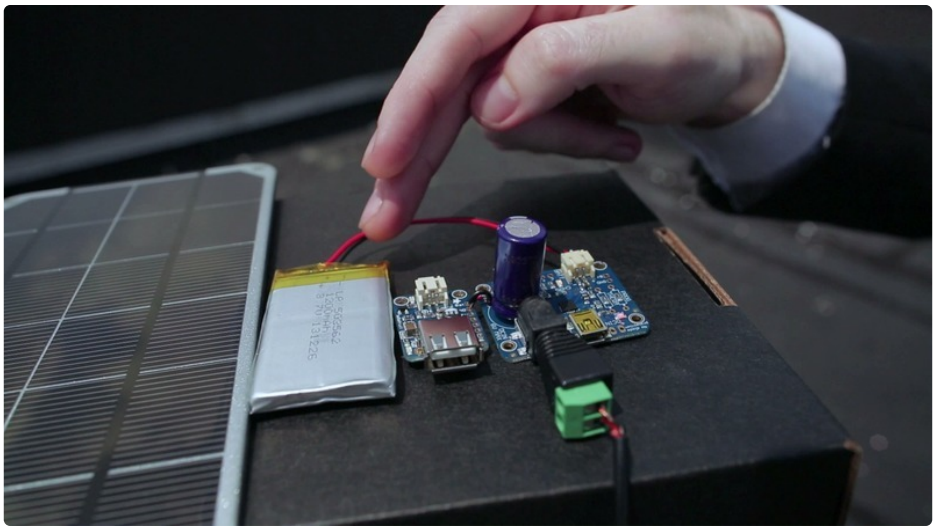
A row of 8 red LEDs produces about 1.4 volts.

These little tests won't produce much current - but they prove that diodes and LEDs do work in similar ways.

But I digress ...

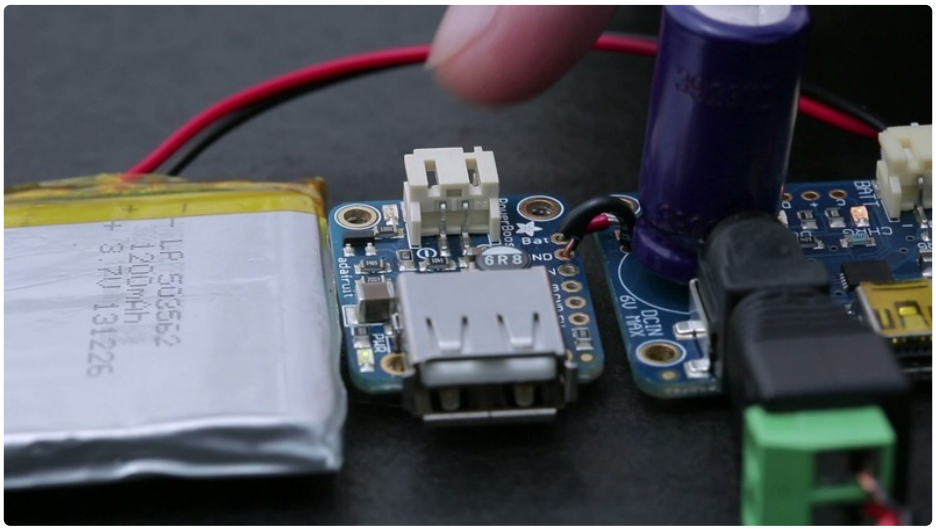
A single photovoltaic cell can provide a half a volt. My panel here has 2, 4, 6, 8, 10, 12 cells - so it can provide 6 volts.

But depending on lighting conditions, that output power can change quite a bit. So the best way to use it is as a means to charge a battery, and then use that battery to power ... whatever it is you need to power.



In order to charge this 3.7V LiPo battery, I'll take the output from my panel, and feed it into a specialized charging circuit ...

This circuit will manage the unstable output from the panel and provide a steady charge to the battery.



This small power boost circuit will convert the battery's 3.7 volts to a standard 5 volts suitable for use with USB devices, microcontrollers and what have you ...

In any case - even after understanding how it works, the ability to convert light into electricity is still a bit mind blowing to me.

So go make something solar powered - but umm ... don't wear a black suit on the roof - it's hot!

Can I get a towel from somebody?

Learn More

What is Solar Power?

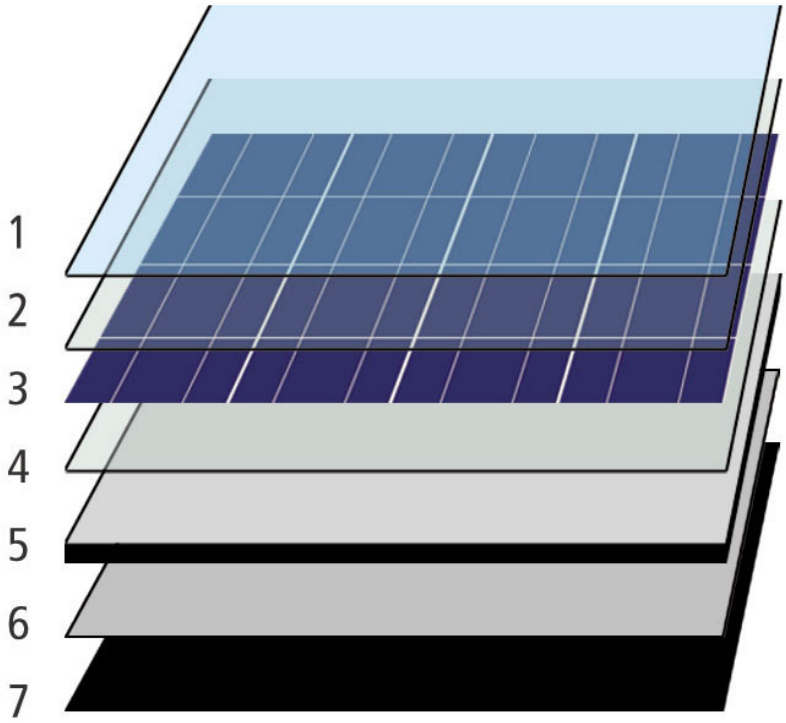
from Wikipedia (https://adafru.it/e0j)

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics convert light into electric current using the photovoltaic effect.

Photovoltaics were initially, and still are, used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array. They are an important and relatively inexpensive source of electrical energy where grid power is inconvenient, unreasonably expensive to connect, or simply unavailable. However, as the cost of solar electricity is falling, solar power is also increasingly being used even in grid-connected situations as a way to feed low-carbon energy into the grid.

Physics of Solar

Manufacuring



Learn about the materials and processes involved in solar panels manufacturing over at SolarWorld (https://adafru.it/e0k).