Human solar panel

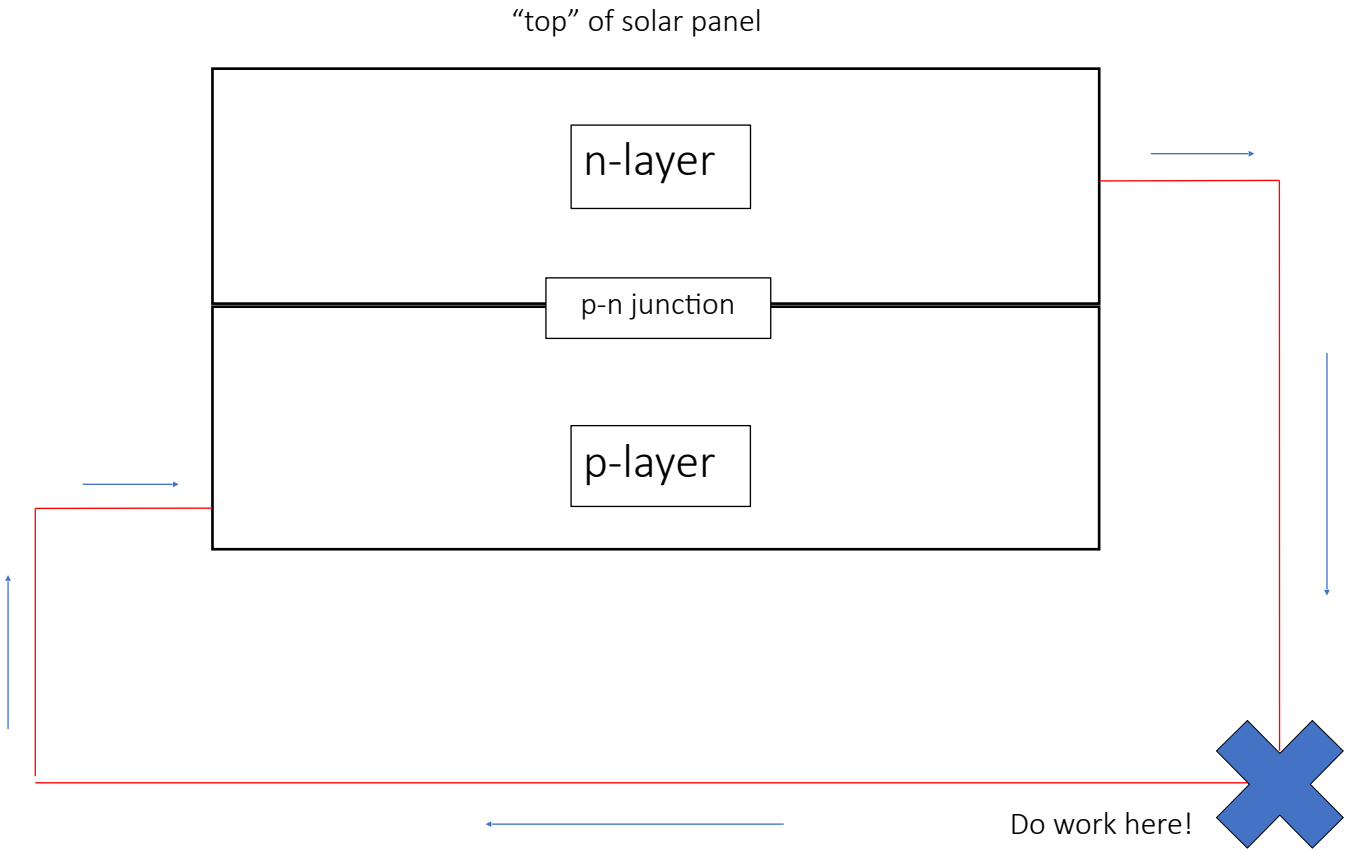
Note: See UNITE Us Level A lesson 'Solar Energy' for a similar procedure, and good graphics showing parts of a solar panel, and game set-up. For background information on how a solar panel works, and/or to use as another class activity, see "Solar Panel Scavenger Hunt" from REcharge labs.

Materials:

- ping pong balls
- chalk if outside or tape/other for marking space inside

Preparation:

- Find a large area to play the game. You will want to draw or mark out two large rectangular boxes that can each fit approximately half the number of students you have, so that all students will fit within both boxes.
- Draw or mark a line leaving from one box and entering the next box. This will represent the wire of your circuit.
- Optional: label the n- and p-layers, the n-p junction, and mark a spot on the line where students will do work



Activity:

- Discussion:
    - What is electricity? (the flow of electrons)
    - How do we get electrons to move?
    - Can anyone explain how a solar panel works?

- Parts of a solar cell/how it generates electricity (draw this out if possible, and can increase complexity based on age range):
    - Solar panels are made of two semi-conducting silicon layers filled with electrons, one n-layer (for negative 'character') and one p-layer (for positive 'character'). The n-layer is on top.
    - When the two layers are placed together at the time of production, electrons flow from the n-layer to the p-layer creating an imbalance in the charge, and an electrical field (now the n-layer has a slight positive charge and the p-layer has a slight negative charge)
    - The sun's radiant energy in the form of photons hits the cell, which 'knocks' the extra electrons free from the p-layer and 'excites' them – this allows them to move
    - Electrons always flow from areas where it is more negative to areas where it is less negative – thus the electrons will move from the p-layer, through the p-n 'junction' to the n-layer, and then through the circuit. They can only move one way through the junction.
    - You can make a circuit do work by adding in a light bulb, motor, etc. (something you want to power) – optional: demonstrate with small solar panel and LED light if available

- Solar panel game
    - Each student will represent an electron and will be assigned either to the n- or p-layer to start with. Make sure to have slightly more students in the p layer than in the n layer to start with
    - Teacher will be the sun and will throw photons of light (ping pong balls) at the solar panel electrons
    - Students cannot move their feet if they have not caught a ball. Only their arms
    - If you catch a ping pong ball
        - In the n-layer: move through the circuit wire (tape on floor) to the p-layer
        - In the p-layer: move though the p-n junction, into the n-layer, and through the circuit
    - To add in "work" to the circuit: at some point along the circuit, have the kids stop to do a jumping jack, a dance, a pushup, or something else to represent work. Another option is to have one student stand along the circuit and represent something that requires electricity, such as an alarm clock. When an electron

passes by that point in the circuit, that student can 'beep' because it is being powered.

- Variations for rounds:
  - Angle of the sun: teacher stands at different angles (not directly in front of the solar panel) to represent the sun moving across the sky as they throw the ping pong balls. Can also move around while throwing the ping pong balls. Ask the students: Do they think the solar panel will be more or less effective when the angle of the sun changes? What is the ideal angle?
  - Cloud cover: Pick one or two students to represent clouds. Their job is to stand in between the solar panel and the sun, and block the ping pong balls from the electrons. Ask the students: Do they think the solar panel will be more or less effective when it's a cloudy day? What other kinds of weather might affect efficiency?
  - For each round, you can calculate the efficiency of the solar panel. If you throw a discrete number of ping pong balls per round (i.e. 30), students can calculate the efficiency with the following calculation: # of balls caught /# of balls thrown * 100
- Discussion: What are the benefits to using solar energy? What are the challenges to using solar panels to generate electricity? What affects the efficiency of solar panels?