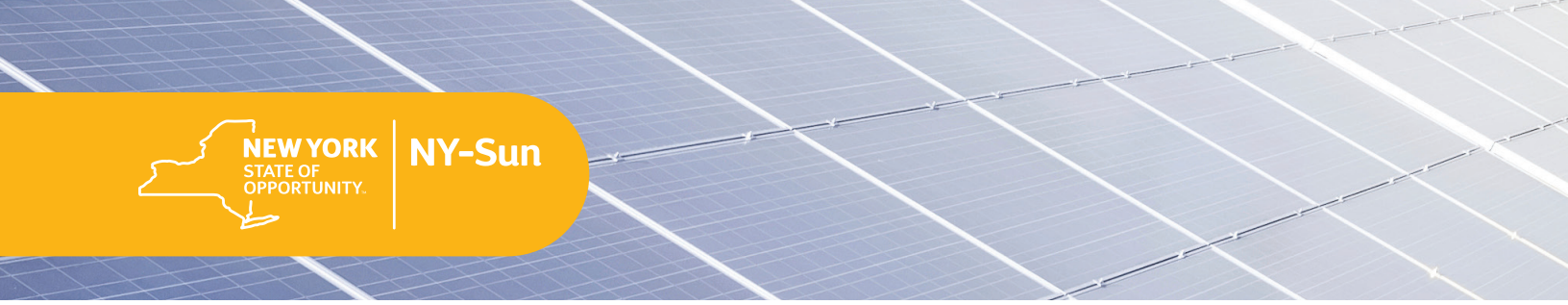

Introduction to Photovoltaics and Solar Energy Lessons

This series of 35 lessons is designed to give K-12 educators a simple yet thorough way to explain and demonstrate the basic principles of photovoltaics (electricity from solar cells) to students of all ages.

These hands-on experiments with miniature solar cells begin with ways of testing voltage, current, and light energy. This leads to lab lessons that deal with the study of power and efficiency and with their application in series and parallel circuits. Also included are Earth Science sun studies and lessons on biological solar energy storage.

The following approximations and formulas will enable the educator to understand the basics of electricity in the silicon solar cell. This will prepare them to quickly and easily understand and answer students' questions regarding the experiments.

- All pieces of silicon solar cells are about 0.5 volts, whether that cell is a broken piece or a 36-square-inch solar cell. The mini-cells are about 1.5" by 2.25" or 3.38 square inches (19 square cm) under the plastic bubble cover; they are 0.5 volts.
- Current in amps depends on area and efficiency. % Efficiency = Output Power/Input Power x 100. Solar input power at high sun is 1000 watts (W)/square meter or 0.06 W/square inch. Because 3.38-square-inch mini-cells are about 10% efficient, the current is about 400 milliamps or 0.4 amps (about 0.12 amps/square inch).
- Knowing the voltage (V) and current (I) yields watts of power (P). Because V x I = P, the power of the mini-cell is 200 milliwatts or 0.2 Watt.
- These experiments with solar cells use a 100 Watt incandescent light bulb. The bulb needs to be placed two inches (five cm) from the cell to simulate high sun. Because the plastic bubble cover will warp and bend after 30 seconds of exposure to a 100 W bulb, turn off the bulb before the 30 seconds elapses. Compact fluorescent and LED light bulbs do not produce the same amount of light energy as incandescent bulbs. However, tiny individual LEDs are great for testing solar cells because they will light up above 2 DC volts and only use about 20 milliamps of current each.
- The manufacturers of mini-cells solder smaller pieces together either in series or in parallel to obtain different voltages and currents. If the pieces are soldered in series, the 0.5 volt cell voltage is multiplied by the number of pieces to get 1.0 V, 1.5 V, 2.0 etc, all at 400 milliamps (mA). If the pieces are soldered together in parallel, the current is multiplied by the number of pieces to get 800 mA, 1200 mA, 1600 mA etc, all at 0.5 volt.
- Solar cells in glass panels for rooftops are usually in series combinations of 16-, 25-, or 36-square-inch cells. These larger cells are still about 0.5 volts, and the current still depends on the area. The 16-inch cells are about three amps, the 25-inch cells are about five amps, and the 36-inch cells are about seven amps. You can approximately calculate the voltage, current, and power for any glass panel by counting the series string and multiplying by 0.5 volts and determining if the panel has 16-, 25-, or 36-square-inch cells.

NY-Sun, a dynamic public-private partnership, will drive growth in the solar industry and make solar technology more affordable for all New Yorkers. NY-Sun brings together and expands existing programs administered by the New York State Energy Research and Development Authority (NYSERDA), Long Island Power Authority (LIPA), PSEG Long Island, and the New York Power Authority (NYPA), to ensure a coordinated, well-supported solar energy expansion plan and a transition to a sustainable, self-sufficient solar industry.