SECTION 2 ACTIVITIES

Activity 6: Series and Parallel Wiring

ACTIVITY TYPE: Worksheet

OVERVIEW: Students understand the effects of building electrical circuits to increase voltage and amperage.

GOAL: Students learn how to construct circuits to meet the particular requirements of a load

SUBJECTS: Math, Science, and Earth Science

TIME: 30 minutes

SETTING: Classroom

MATERIALS: Series and Parallel Wiring Worksheet

KEY VOCABULARY: ampere, array, parallel wiring, photovoltaic cell, photovoltaic module, photovoltaic series, volts, and watts.

CORRELATIONS TO STANDARDS	
NATIONAL	**Science as Inquiry – 1:** Abilities necessary to do scientific inquiry.
IDAHO	**Science – Goal 2.3:** Understand the total energy in the universe is constant. **Science – Goal 1.2:** Understand concepts and processes of evidence, models, and explanations.
OREGON	**Science – Energy:** Describe differences and similarities between kinds of waves, including sound, seismic, and electromagnetic, as a means of transmitting energy.
WASHINGTON	**Science – Application 3.1 Designing Solutions:** Apply knowledge and skills of science and technology to design solutions to human problems.

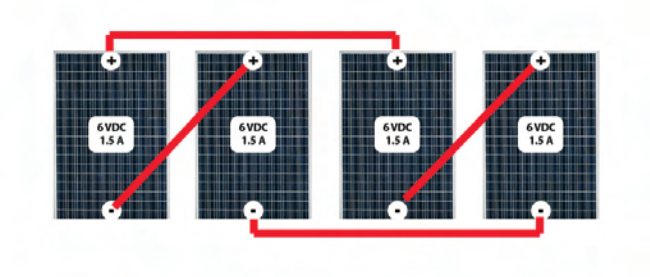
ABOUT THE AUTHORS: Founded in 1998, Bonneville Environmental Foundation (BEF) is essentially a non-profit business. Through the sales and marketing of green power products (known as carbon offsets) BEF gives individuals and businesses a way to participate in solving our most pressing environmental issues. All of the net revenues, or "profits," that the organization makes are reinvested in projects that restore damaged watersheds and support the development and understanding of renewable energy technologies such as solar, wind, and biomass.

Series and Parallel Wiring Worksheet

When circuits are wired in series, the voltage of each panel is added together, but the amperage remains the same. When circuits are wired in parallel, the voltage of each panel remains the same and the amperage of each panel is added. This wiring principle is used to build photovoltaic (PV) modules. The PV cells in a module can be wired to any desired voltage and current. Photovoltaic modules can then be wired together to create PV arrays.

Complete the diagrams below by wiring the solar panels together in series or parallel to generate the required voltage. Connect positive leads (+) to positive leads and negative leads (-) to negative leads to wire the PV circuits in parallel. Connect positive leads to negative leads to wire the PV circuits in series.

Example: DESIGN A 12V SYSTEM USING FOUR 6V PV MODULES

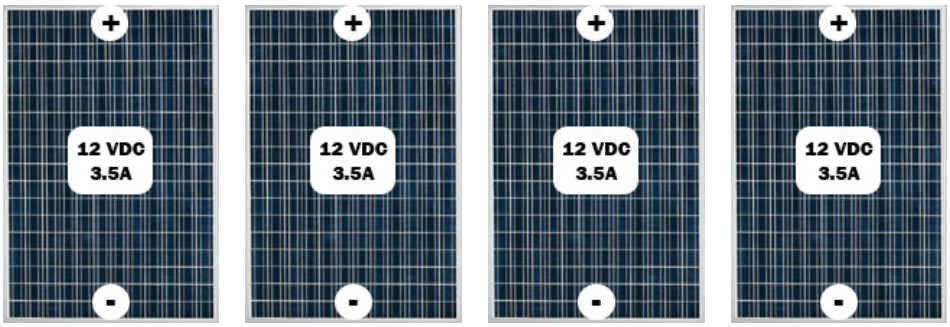


Total Volts = 12
Total Amps = 3

To generate the correct voltage for the circuit in the example:

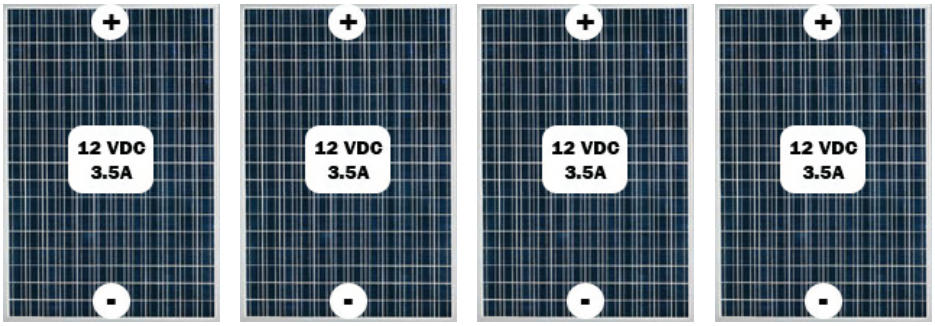
1. Two sets of two panels are connected in series (positive to negative). The voltages add together and increase to 12 volts.
2. These two groups of two panels are connected together in parallel (positive to positive, negative to negative). The voltage remains at 12; however, the current of the two groups of panels adds together bringing the final amperage (current) to 3.

1. DESIGN A 12V SYSTEM USING FOUR 12V PV MODULES



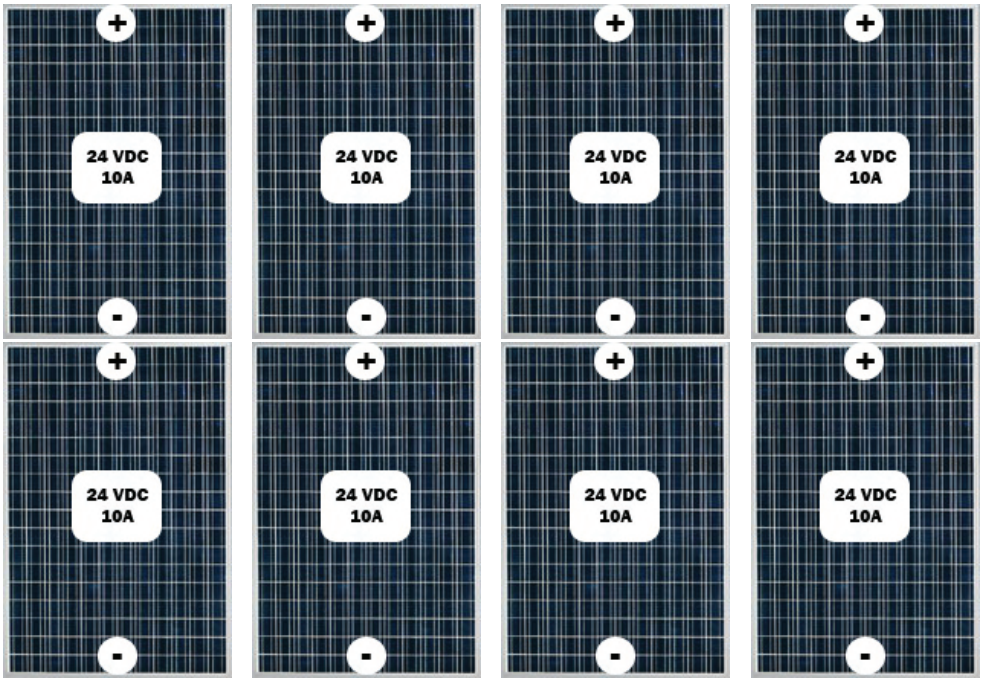
Total Volts =
Total Amps =

2. DESIGN A 24V SYSTEM USING FOUR 12V PV MODULES



Total Volts =
Total Amps =

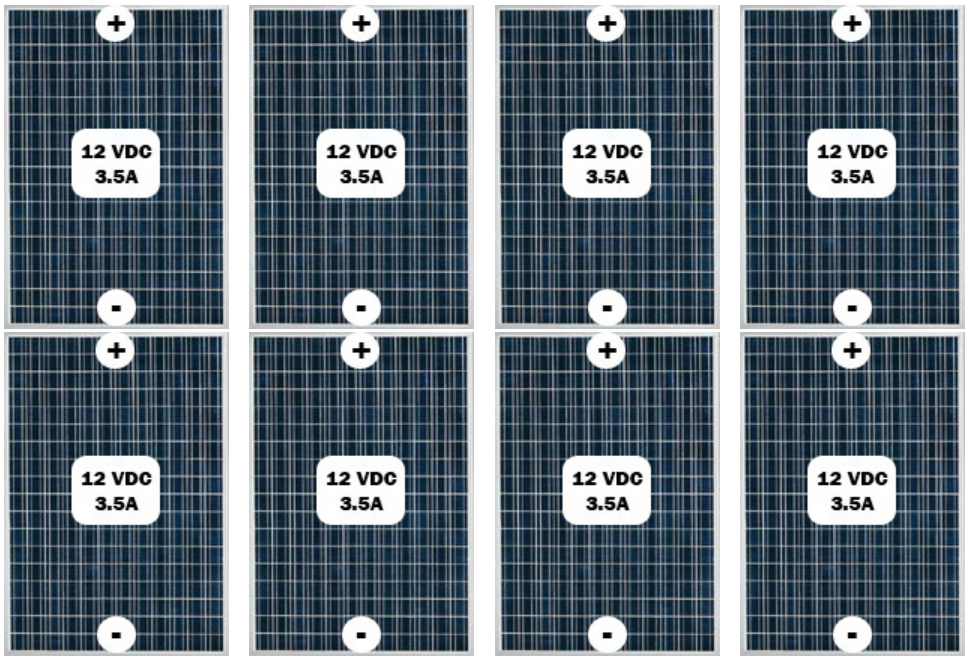
3. DESIGN A 48V SYSTEM USING EIGHT 24V PV MODULES



Total Volts =
Total Amps =

source: Bonneville Environmental Foundation (BEF)

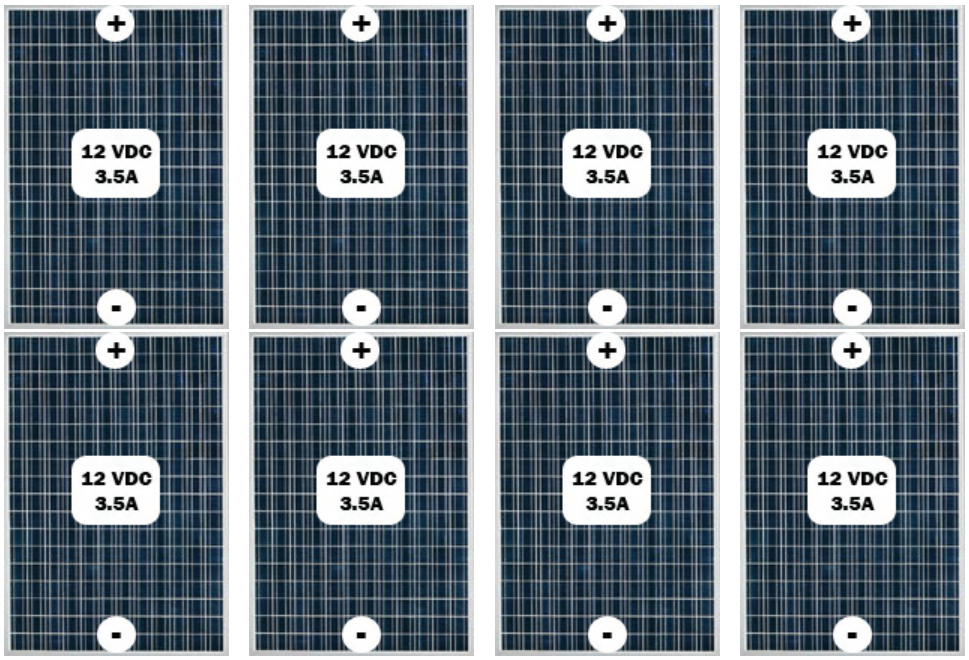
4. DESIGN A 24V SYSTEM USING EIGHT 12V PV MODULES



Total Volts =

Total Amps =

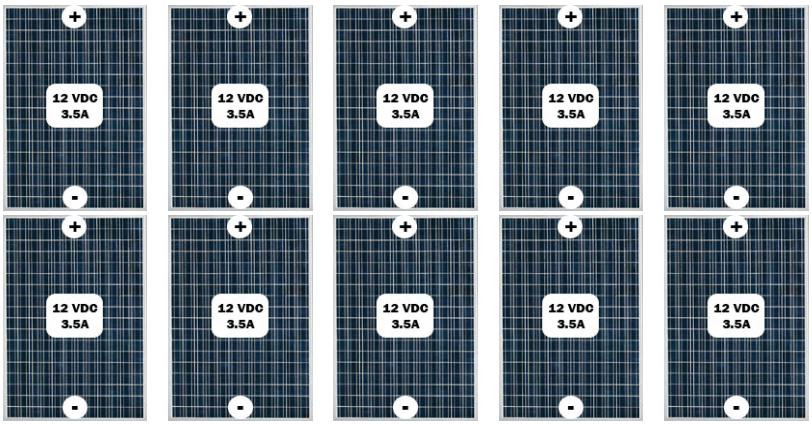
5. DESIGN A 48V SYSTEM USING EIGHT 12V PV MODULES



Total Volts =

Total Amps =

6. DESIGN A 24V SYSTEM WITH TEN 12V PV MODULES



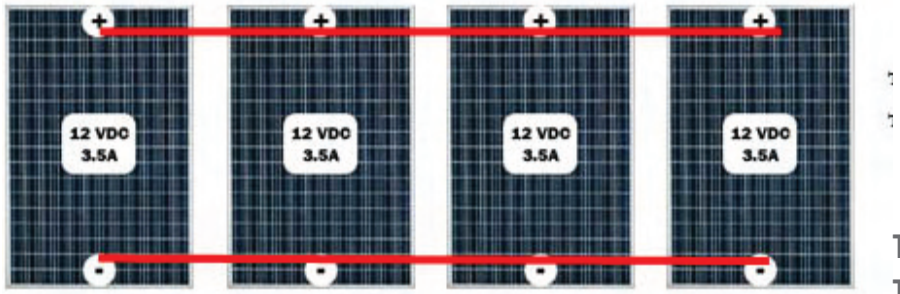
Total Volts =
Total Amps =

source: Bonneville Environmental Foundation (BEF)

Series and Parallel Wiring Worksheet

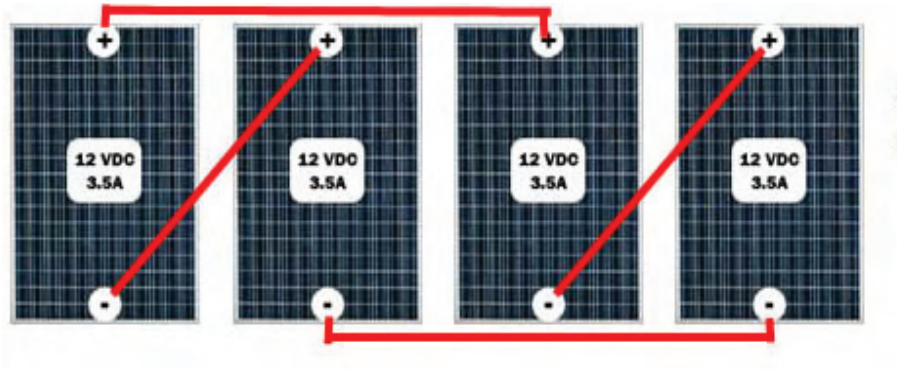
ANSWER KEY

1.



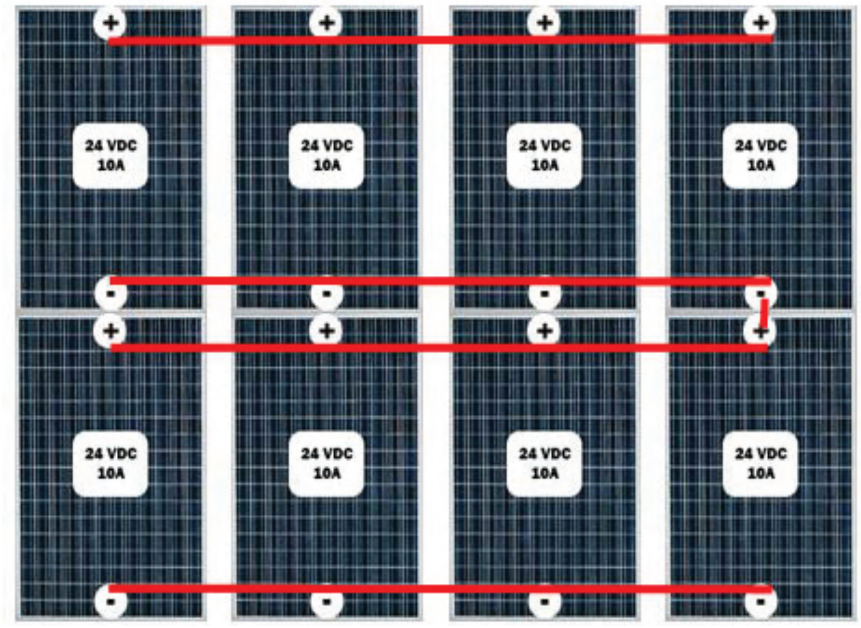
Total Volts = 12
Total Amps = 14

2.



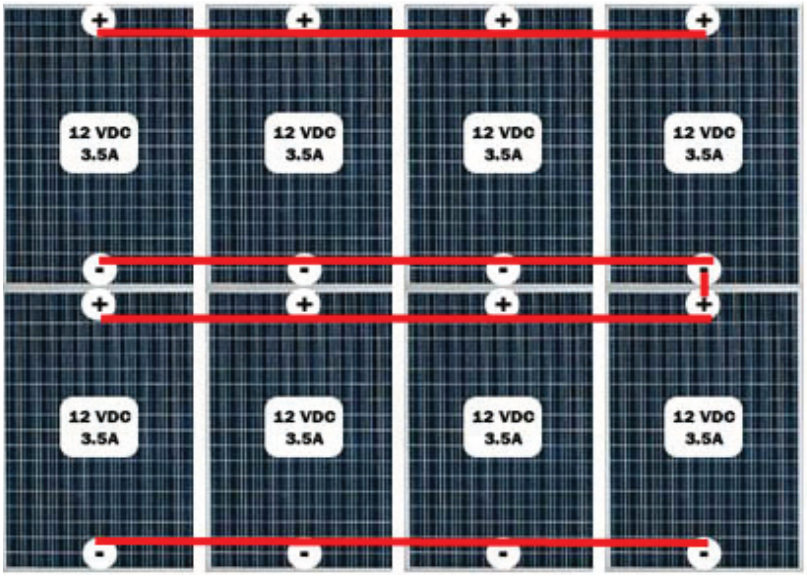
Total Volts = 27
Total Amps = 7

3.



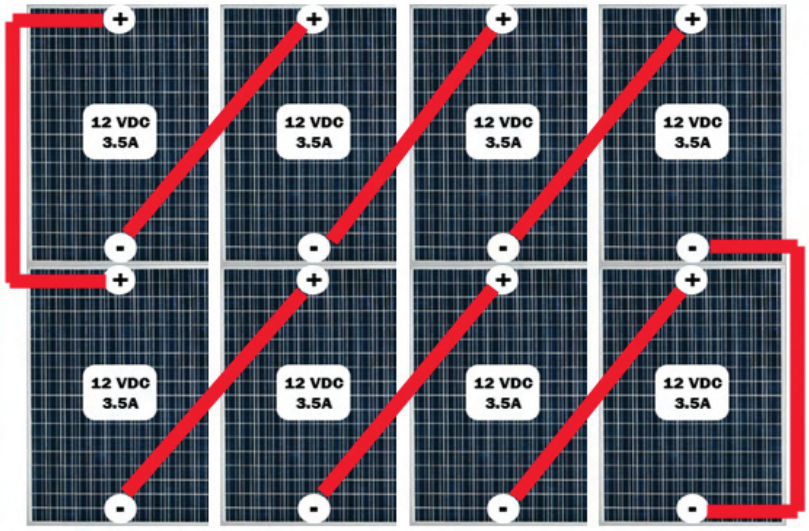
Total Volts = 48
Total Amps = 40

4.



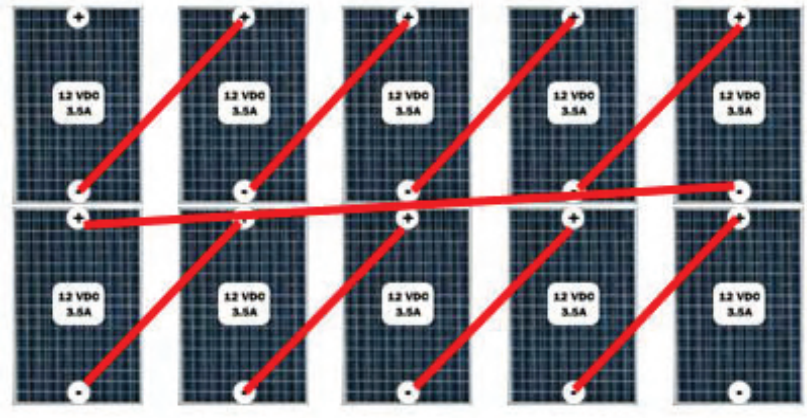
Total Volts = 24
Total Amps = 14

5.



Total Volts = 48
Total Amps = 14

6.



Total Volts = 120
Total Amps = 3.5