PHYSICAL SCIENCE LAB –SOLAR POWER

1. **DESCRIPTION**: In this event students will demonstrate their knowledge and process skills needed to solve problems and answer questions regarding alternative energy sources. In part one they will design a solar collector that will gather energy from a single light source with the greatest efficiency. For Part 2 they must keep a log of design modifications and data collected which will be submitted during part 2 of the event. There will be no impounding for this event.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 Minutes

2. **EVENT PARAMETERS**: Students must bring a writing implement and a non-programmable calculator. All reference materials to be used during part two of the competition must be secured in a 3-ring binder. The materials must be 3-hole punched and inserted in the binder so that regardless of orientation no materials can fall out. Students will also make available to the supervisor during part 1 labeled data tables and logs with their team name and number clearly written on the outside. If students have no log they will be scored according to the formula, but ranked behind all those who do have a log.

3. **THE COMPETITION:** The competition will consist of two parts.

   a. **Part 1**: During the first part of the competition (that may be run concurrently with Part 2) students will demonstrate the efficiency of their solar collector.
      i. The solar collector may be constructed of **any material** (e.g., cardboard, aluminum foil, reflective fabric or material, glue, tape, mirrors, tiles and lenses). The collector must allow easy access for inserting their beaker of water and a thermometer/probe. The solar collector must be labeled with team number and name.
      ii. Students will have 5 minutes to set up their solar collector. Each team will be given a 250 ml beaker containing 100 ml of water from a common source. The students will place the beaker inside the collector. The solar collector with beaker must be able to fit into a 35 cm cube when set up for testing.
      iii. No other energy source (electrical, chemical, fire, etc.) will be allowed. No substances may be added to the water or the container. No chemicals producing exothermic reactions may be used.
      iv. Each station will have a lamp with a clear 150 watt incandescent bulb mounted above the area where testing takes place. The distance from the bottom of the bulb to the top of the imaginary cube in which the collector is placed will be announced at the site. The bottom of the bulb will be no closer than 5 cm to the top of the imaginary cube. Using the data from their charts students will estimate the change in temperature. That prediction will be recorded on their score sheet and will help determine their final score.
      v. The supervisor will use a probe/digital thermometer to measure and record the initial temperature of the water to the nearest tenth of a degree Celsius. The light source will then be turned on and a stopwatch started. At the end of 10 minutes the thermometer/probe will be read and recorded to the nearest tenth of a degree to determine the gain in temperature.

   b. **Part 2:** Students will be presented with questions and/or hands-on tasks at stations. Stations will require them to draw and label diagrams to demonstrate knowledge of introductory concepts, record observations, make predictions, interpret data, generate inferences, solve problems and formulate and evaluate hypothesis. The following topics may be included:
      i. Basic information and definitions about energy, work, heat and heat transfer, temperature, temperature scales, thermal energy and insulation.
      ii. General information about renewable energy including but not limited to solar, wind, hydroelectric, tidal, ocean thermal energy conversion (OTEC), and geothermal.

iii. General information about energy conservation practices including but not limited to recycling, reusing, and using materials with greater efficiency.
iv. Mathematical relationships and equations used in determining heat loss and gain, specific heat, and heat transfer.

4. **Scoring:** The team with the highest final score that follows all of the rules wins. The final score will be the sum of the Test Score and the Device Score. The Test Score will be the percentage of questions answered correctly, and the Device Score will be equal to actual increase in temperature produced by the device minus the difference between the actual increase and the students' estimated increase, divided by the Baseline Increase. The Baseline Increase will be the greatest degree of temperature change achieved by any device at the Competition. Ties will be broken by pre-selected questions from Part 2. Teams whose device fails to meet specifications will be ranked below those that do.

$$\text{Device Score} = \frac{\Delta T - |\Delta T - \text{estimated } \Delta T|}{\text{Baseline Increase}}$$

Example: The scores below are from an imaginary competition involving five teams.

	A	B	C	D	E	F
Team #	Predicted ΔT	Actual ΔT	Difference	Subtotal: B-C	Baseline Increase (Highest ΔT)	Device Score D/E*100
1	5.5	5.0	0.5	4.5	5.0	90
2	4.5	4.4	0.1	4.3	5.0	86
3	3.5	3.5	0.0	3.5	5.0	70
4	3.9	3.4	0.5	2.9	5.0	58
5	3.0	3.1	0.1	3.0	5.0	60