

LEVEL	Middle School / High School
NUMBER OF TEAMS	Regional Design Day - up to 3 teams per school; MESA Day - 1 team per school
TEAM MEMBERS	2-6 students

OBJECTIVE

Design a residential PV system using currently available technologies. Address at least three solar-energy challenges and use credible evidence to show how the design is expected to improve performance compared with a reasonable baseline system.

PV CHALLENGES & MODEL REQUIREMENTS

THE ARIZONA CONNECTION

In Arizona, sunshine is part of everyday life - and it can also be a source of energy. Solar panels use sunlight to produce electricity for homes, schools, businesses, and communities. But simply putting solar panels in the sun does not mean a system is working as effectively as it could.

In this challenge, your team will think like engineers: How can we make better use of Arizona's abundant sunlight? You will design improvements to a residential solar-energy system, use evidence to test your ideas, and show how your design could improve its performance.

Photovoltaic (PV) is the technical term for technology that converts sunlight directly into electricity. Solar panels are made of photovoltaic cells, so engineers often call a solar-electric system a PV system.

- **Address at least three challenges that can affect the performance of a residential photovoltaic (PV) system. Challenge areas may include PV efficiency, dirt/dust, high temperatures, wind/storm conditions, solar angle/tracking, shade, and animal impacts. Teams may also identify a PV challenge not listed here if they provide credible research or other documentation showing that the issue can affect residential PV performance. Addressing more than three does not automatically earn extra points.**
- Digital, physical, and working physical models are permitted. Model type does not receive a scoring multiplier.
- Every model must show the residence/site, PV panel location, orientation/angle, and an identified accurate scale.
- Physical models must be freestanding. A working model should demonstrate relevant system function without continuous team intervention.
- Establish a reasonable conventional/baseline PV system and use testing, calculations, modeling, comparisons, published data, manufacturer information, or other credible evidence to show expected improvement. A physical test and a mandatory 2× improvement are not required.

JUDGING PROCEDURE & PRESENTATION

- Maximum presentation time: 7 minutes. Judges stop the presentation at 7 minutes; there is no overtime point penalty.
- Judges may ask questions for up to 3 additional minutes.
- Teams should explain the challenges selected, the proposed system, evidence of improvement, limitations, and engineering decisions.

SCORING - 100 POINTS

Category	Points
PV Design & Engineering Solution	30
Testing, Data & Analysis	25
Presentation & Engineering Defense	20
Engineering Design Poster	25
TOTAL	100

COMPETITION JUDGING RUBRIC - 75 POINTS

Area	Pts	What judges consider
Design: challenges addressed	10	At least three challenges are clearly identified and addressed.
Design: quality/feasibility	10	Solution is technically reasoned and feasible.
Design: integrated system	6	Features work together as a coherent residential system.
Design: innovation	4	Thoughtful or creative engineering choices.
Evidence: testing/data	10	Credible evidence evaluates expected improvement.
Evidence: analysis	7	Team interprets evidence and connects it to design decisions.
Evidence: multiple features	5	Evidence addresses multiple important design features.
Evidence: communication	3	Data/evidence are understandable.
Presentation: explanation	7	Clear explanation of system and decisions.
Presentation: reasoning/evidence	6	Evidence is used to defend the design.
Presentation: Q&A	5	Students demonstrate understanding.
Presentation: organization/participation	2	Organized presentation and meaningful participation.

SPECIFICATION & SAFETY

Physical models are inspected during the designated check period. Correctable model or safety issues must be corrected before the model may be used. An ordinary specification failure does not automatically eliminate otherwise eligible poster or presentation scoring. Serious or intentional violations or unsafe conduct may result in full disqualification.

TL;DR

- Design a residential photovoltaic (PV) system that addresses at least three identified challenges to solar-energy production.
- Use currently available technology.
- Create a scaled model showing how and where the system would be installed.
- Use research, calculations, modeling, testing, or other credible evidence to demonstrate how the design is expected to improve PV performance.
- Present and explain your engineering decisions to the judges.
- Create an Engineering Design Poster documenting Explore → Design → Test → Iterate.

READ THE FULL SPECIFICATIONS. The TL;DR is a quick reference and does not replace the complete rules.

ENGINEERING DESIGN POSTER - 25 POINTS

Submit one 36 in. high × 48 in. wide landscape poster as a PDF. It is due by 5:00 p.m. at least two weeks before MESA Day; Arizona MESA will announce the exact date and submission process.

Template: [Arizona MESA Engineering Design Poster Template](#). Recommended, but not required.

Include the project/prototype name, school, team member names, school logo, MESA logo, and the team's Explore → Design → Test → Iterate engineering story.

Area	Pts	What judges look for
Explore	5	Understanding of the challenge, criteria/constraints, research, and ideas considered.
Design	5	Selected approach, key features, and design decisions.
Test	6	Relevant testing/data/evidence and what the team learned.
Iterate	6	Evidence-informed changes, retesting/evaluation, and improvement or next steps.
Communicate	3	Clear, organized communication that makes the engineering easy to understand.

IMPROVING PHOTOVOLTAIC (PV) DESIGN CHALLENGE - JUDGE SCORESHEET

School: _____ Team: _____

Judge: _____ Level: ☐ Middle School ☐ High School

PROJECT & PRESENTATION SCORING - 75 POINTS

Area	Max	Score
Design: challenges addressed	10	_____
Design: quality/feasibility	10	_____
Design: integrated system	6	_____
Design: innovation	4	_____
Evidence: testing/data	10	_____
Evidence: analysis	7	_____
Evidence: multiple features	5	_____
Evidence: communication	3	_____
Presentation: explanation	7	_____
Presentation: reasoning/evidence	6	_____
Presentation: Q&A	5	_____
Presentation: organization/participation	2	_____
PV Design & Engineering Solution	30	_____
Testing, Data & Analysis	25	_____
Presentation & Engineering Defense	20	_____

POSTER & FINAL SCORE

Project & Presentation Score	_____ / 75
Engineering Design Poster	_____ / 25
FINAL SCORE	_____ / 100

PV Design & Engineering Solution (30) + Testing, Data & Analysis (25) + Presentation & Engineering Defense (20) + Engineering Design Poster (25) = 100 points

JUDGE NOTES
