



**UCR** Identifying a Solar Cell Misconception Held by Middle School Students

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**Background**

- ▶ Problem
  - ▶ Projected need for engineers (National Science Board, 2011)
  - ▶ Decreased higher education persistence in engineering degree (Ohland et al., 2008)
- ▶ Goal
  - ▶ Increase middle school student motivation and persistence in engineering careers



**Background**

- ▶ Student misconceptions
  - ▶ Based on prior experiences, not necessarily accurate
  - ▶ May not generalize across situations
  - ▶ Impedes learning
    - ▶ Students unaware that knowledge is wrong.
    - ▶ Persistent
    - ▶ New experiences misinterpreted
    - ▶ Resistant to instruction
  - ▶ Example: big things sink, small things float



**Background**

- ▶ Misconceptions hinder engineering design projects
- ▶ Example: designing a solar powered car
  - ▶ Will the car work when the sun is out but the temperature is low?



**Research Questions**

- ▶ Can we identify student misconceptions about the use of solar cells to generate power?
- ▶ How persistent are these misconceptions?
- ▶ Can students be guided to recognize the limitations of these misconceptions?



**Methodology**

- ▶ Sample
  - ▶ Eighth grade teachers ( $N = 4$ ) and their students ( $N = 136$ )
  - ▶ Focus on 1 classroom (1 teacher, 39 students)
  - ▶ All participated in Mathematics Engineering Science Achievement (MESA) program
- ▶ Measures
  - ▶ Written assessment
  - ▶ Individual interview
  - ▶ Student work

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### Procedures

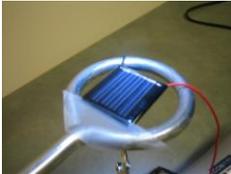
- › Undergraduate service learning course
  - › Focus on solar energy, formative assessment practices
  - › 3 visits to middle school: 1 whole class discussion, 2 small-group activities



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### Activity 1: Angle

- › Objectives:
  - › By the end of this lesson, students should know
    - › The amount of power generated by a solar cell is dependent on the angle between the light source and the solar cell
    - › A solar cell generates the most power when the angle between the light source and the surface of the solar cell is 90°



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### Activity 1: Angle

**Materials**

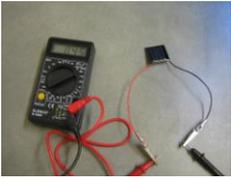
- › Solar cells
- › Light source
- › Ring stand
- › 2 clamp holders
- › Extension clamp
- › Extension ring
- › Protractor
- › Multimeter



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### Activity 2: Temperature

- › Objectives
  - › By the end of this lesson, students should know
    - › Solar cells convert light (not heat) to energy
    - › Solar cells work in low and high temperatures



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### Activity 2: Temperature

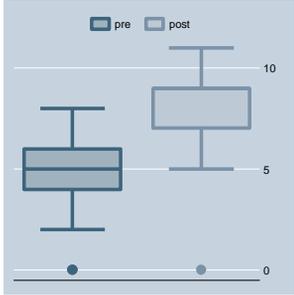
**Materials**

- › Solar cells
- › Light source
- › Ring stand
- › 2 clamp holders
- › Extension clamp
- › Extension ring
- › Hair dryer
- › Hand warmer
- › Ice pack
- › Multimeter



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### Findings: Written Assessment



$t(28) = 6.37, p < .001$

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### Findings: Written Assessment

› Solar cells convert...

	Pre	Post
a) Heat to electricity	63%	11%
b) Light to electricity	26%	89%
c) Light to heat	0%	0%
d) Energy to heat	11%	0%

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### Procedures

› Would heat from the sun affect the amount of power generated by the solar cell?

Code	Misconception	Student Response
0	Yes	Yes, it all depends on the heat. It would generate more power at night in Arizona because there is more heat.
1	Partial	The more light it absorbs, the more energy it gets. I don't know whether the heat from the sun matters.
2	No	Heat doesn't matter. One the experiment, I saw that if you put an ice pack of a hot towel, it doesn't make a difference for the energy generated by the solar cell. Temperature doesn't matter.

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### Findings: Interview

$t(14) = 8.57, p < .001$

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### Discussion

- › Identified student misconception about the use of solar cells to generate power
  - › Temperature influences amount of power generated
- › Misconceptions are persistent
  - › Overall knowledge of solar cells increased
  - › Not all students increase pre/post
- › Students can be guided to recognize limitations of misconceptions.

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### Next Steps

- › Why did some students change their conceptions and others didn't?
  - › Transcripts, audio recording of student-instructor interaction
  - › Link to student participation to student outcomes

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## Questions? Comments?

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