



## **Hands On Standards STEM in Action: Solar House Design Challenge (Curriculum Exchange)**

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**Dr. Johannes Strobel, Texas A&M University**

Dr. Johannes Strobel is Director, Educational Outreach Programs and Associate Professor, Engineering & Education at Texas A&M, College Station. He received his M.Ed. and Ph.D. in Information Science & Learning Technologies from the University of Missouri. His research/teaching focuses on engineering as an innovation in pK-12 education, policy of STEM education, how to support teachers and students' academic achievements through engineering, engineering 'habits of mind' and empathy and care in engineering. He has published more than 140 journal articles and proceedings papers in engineering education and educational technology and is the inaugural editor for the Journal of Pre-College Engineering Education Research.

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**Program Overview:** Hands-On Standards STEM in Action is an activity-based integrated science, technology, engineering and mathematics program made up of three suites of modules: the *PreK-Adventure Series*, the *Grades K-2 Exploration Series* and the *Grades 3-5 Challenge Series*. The modules are designed to develop students' critical problem-solving skills through age appropriate collaborative engineering activities and to be easy to implement and time-efficient for the teacher. The Grades K-5 modules meet Next Generation Science Standards (NGSS) and Common Core State Standards (CCSS) for their respective grade levels, while the PreK modules target readiness for NGSS standards foreshadowing content and practices.



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**Program Development:** ETA hand2mind in partnership with Texas A&M University and Purdue University

**A complete list of modules can be viewed and purchased at:**  
[www.hand2mind.com/brands/hands-onstandards/hands-onstandardsstemination](http://www.hand2mind.com/brands/hands-onstandards/hands-onstandardsstemination)

The Adventure Series PreK (ages 3-5)	The Exploration Series Grades K-2	The Challenge Series Grades 3-5
<p>In every module, children</p> <ul style="list-style-type: none"> <li>• Explore math and science concepts that inform an authentic engineering design challenge</li> <li>• Generate, record, and use their own data</li> <li>• Solve a problem with a fictional character while actively participating in the story</li> <li>• Collaborate and reflect on their solution</li> </ul>	<p>In every module, students</p> <ul style="list-style-type: none"> <li>• Investigate math and science concepts</li> <li>• Apply science concepts and mathematics to an authentic engineering design challenge</li> <li>• Observe, measure, and record their own data</li> <li>• Solve a problem with a fictional friend while actively participating in the story</li> <li>• Collaborate in a team</li> <li>• Reflect on their solution</li> </ul>	<p>In every module, students</p> <ul style="list-style-type: none"> <li>• Investigate math and science concepts by testing a hypothesis</li> <li>• Apply science concepts and mathematics to an authentic engineering design challenge</li> <li>• Observe, measure, record, and analyze their own data</li> <li>• Solve a problem for a fictional business using real-world trade-offs</li> <li>• Collaborate in a team</li> <li>• Communicate findings and/or reflections</li> </ul>
<p>Designed for 10- to 20-minute blocks of instruction for 70-80 total minutes per module.</p>	<p>Designed for 20- to 30- minute blocks of instruction for 90 to 180 total minutes per module.</p>	<p>Designed for 30- to 60- minute blocks of instruction for 150 to 300 total minutes per module.</p>
<p>Costs \$249 per module which includes:</p> <ul style="list-style-type: none"> <li>• Classroom activity materials</li> <li>• 4 step-by-step activity cards</li> <li>• Quick start teacher card</li> <li>• Story poster (print &amp; digital)</li> <li>• Classroom set of blackline masters and parent letters</li> </ul>	<p>Costs \$299 per module which includes:</p> <ul style="list-style-type: none"> <li>• Classroom activity materials</li> <li>• 6 Student Activity Books (Gr. 1-2) or Story poster (K)</li> <li>• Teacher Guide with assessment rubric</li> <li>• Blackline masters</li> <li>• Digital classroom lesson</li> </ul>	<p>Costs \$299 per module which includes:</p> <ul style="list-style-type: none"> <li>• Classroom activity materials</li> <li>• 6 Student Activity Books</li> <li>• Teacher Guide with assessment rubric</li> <li>• Blackline masters</li> <li>• Digital classroom lesson</li> </ul>
<p>PreK Modules:</p> <ul style="list-style-type: none"> <li>• Ron's Habitat Adventure</li> <li>• Ron's Ramp Adventure</li> <li>• Pam's Camping Adventure</li> <li>• Pam and Ava's Mapping Adventure</li> <li>• Gus and Nia's Shaking Adventure</li> </ul>	<p>Grade K-2 Modules:</p> <ul style="list-style-type: none"> <li>• Sidewalk Safety Exploration</li> <li>• Sunny Sandbox Exploration</li> <li>• Wild Feet Exploration</li> <li>• Sound Bite Exploration</li> <li>• Helicopter Hang Time Exploration</li> <li>• Shrinking Shore Exploration</li> <li>• Muddy Mats Exploration</li> </ul>	<p>Grade 3-5 Modules:</p> <ul style="list-style-type: none"> <li>• Squeaky Clean Magnets Challenge</li> <li>• Farmer Grady's Challenge</li> <li>• Earthquake Technologies Challenge</li> <li>• Solar House Design Challenge</li> <li>• Food Deserts Challenge</li> <li>• The Great Toy Design Challenge</li> <li>• Silly Straw Challenge</li> </ul>

# Hands-On Standards STEM in Action: Solar House Design Challenge (Curriculum Exchange)

## Highlighted Module: Solar House Design Challenge

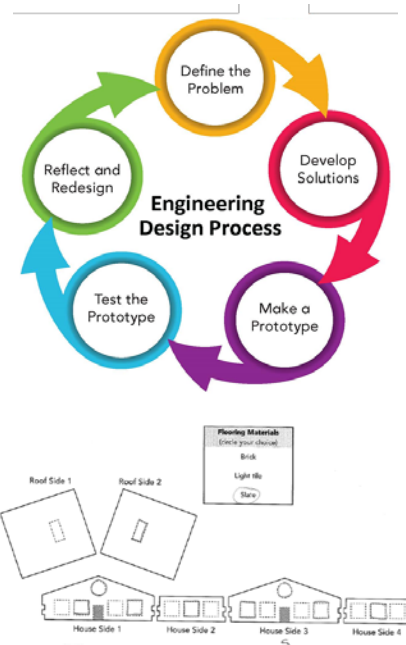
**Grade Levels:** Grades 3, 4, & 5 (Aligned to Grade 4 NGSS and CCSS Math and ELA standards)

**Overview:** Students are charged as engineers to help their client determine how to best use the sun to heat homes. The module builds students' understanding of energy conversion, passive solar energy, applying the area formula in a real world problem and budgeting while sharpening their critical thinking skills.

- **Define the Problem:** Students help their client investigate three types of flooring they are considering using in their homes. Students predict which material they think will have the greatest increase and the greatest retention of temperature. They conduct a fair test and then analyze the collected data. Students then engage in a class discussion about the movement of energy and review key vocabulary. Visuals and an interactive tool are provided to help illustrate the concepts for students. Students identify the criteria and constraints. (NGSS 4-PS3-2, 3-5-ETS1-1, 3-5-ETS1-3; CCSS 4.MD.A.2, SL.4.1)
- **Develop Solutions:** Students work independently and then in teams to use what they have learned about passive solar heating to create a design plan and develop a materials budget for their passive solar house. (NGSS 4-PS3-4, 3-5-ETS1-2; CCSS 4.MD.A.3, 4.MD.A.2, SL.4.1)
- **Make a Prototype:** Teams use their design plans to build their models. (NGSS 4-PS3-4; CCSS SL.4.1)
- **Test the Prototype:** Teams conduct fair tests to determine if their models meet the criteria of the problem. Students calculate the total open area on each side of the house and roof. Teams prepare and present their findings. The class then compares their designs to determine the relationship between the team designs that were most successful and the features of those designs. (NGSS 4-PS3-4, 3-5-ETS1-3; CCSS SL.4.1)
- **Reflect and Redesign:** Teams make claims supported by evidence about their model houses. Finally they use the test results and feedback from classmates to optimize the design of their model house. (NGSS 4-PS3-4, 3-5-ETS1-2, 3-5-ETS1-3; CCSS W.4.2, SL.4.1, SL.4.4)

**This module can be viewed and purchased at:**

<http://www.hand2mind.com/item/solar-house-design-challenge/1444>



House Side	Which direction does it face? Circle one.	Square Windows and Skylights		Round Windows		Total Open Area
		Area for one	Number of windows or skylights open	Area for one	Number of windows open	
House Side 1	N S E W	9cm <sup>2</sup>	2	19cm <sup>2</sup>	1	28cm <sup>2</sup>
House Side 2	N S E W	9cm <sup>2</sup>	1	9cm <sup>2</sup>		9cm <sup>2</sup>
House Side 3	N S E W	9cm <sup>2</sup>	2	19cm <sup>2</sup>	1	28cm <sup>2</sup>
House Side 4	N S E W	9cm <sup>2</sup>	1	9cm <sup>2</sup>		9cm <sup>2</sup>
Roof Side 1	N S E W	9cm <sup>2</sup>	0	0cm <sup>2</sup>		0cm <sup>2</sup>
Roof Side 2	N S E W	9cm <sup>2</sup>	1	9cm <sup>2</sup>		9cm <sup>2</sup>

4. Calculate the total area of windows and skylights open to sunlight from each direction. To do this, add the total area of the skylights facing each direction to the total area of the windows facing each direction:

Total open area of side facing:

North 28cm<sup>2</sup>, South 9cm<sup>2</sup>, East 19cm<sup>2</sup>, West 9cm<sup>2</sup>

