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

Mrs. Elizabeth Gajdzik, Purdue University, West Lafayette

Elizabeth Gajdzik is the Assistant Director of the Institute for Pre-College Engineering (INSPIRE) in the School of Engineering Education at Purdue University. She received both her B.S. in Interdisciplinary Studies with a specialization in mathematics education and M.S.Ed. in Curriculum and Instruction with an emphasis in mathematics education from Baylor University. Prior to her work at INSPIRE, Elizabeth was a district curriculum math specialist in San Antonio, TX and a middle school mathematics teacher at a Title 1 school in Waco, TX.

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.
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-onstandardssteminaction

<table>
<thead>
<tr>
<th>The Adventure Series</th>
<th>The Exploration Series</th>
<th>The Challenge Series</th>
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<tbody>
<tr>
<td><strong>PreK (ages 3-5)</strong></td>
<td><strong>Grades K-2</strong></td>
<td><strong>Grades 3-5</strong></td>
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<tr>
<td>In every module, children</td>
<td>• Explore math and science concepts that inform an authentic engineering design challenge</td>
<td>In every module, students</td>
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<td></td>
<td>• Generate, record, and use their own data</td>
<td>• Apply science concepts and mathematics to an authentic engineering design challenge</td>
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<tr>
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<td>• Solve a problem with a fictional character while actively participating in the story</td>
<td>• Observe, measure, and record their own data</td>
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<td>• Collaborate and reflect on their solution</td>
<td>• Solve a problem with a fictional friend while actively participating in the story</td>
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<tr>
<td>Designed for 10- to 20-minute blocks of instruction for 70-80 total minutes per module.</td>
<td>Designed for 20- to 30- minute blocks of instruction for 90 to 180 total minutes per module.</td>
<td>Designed for 30- to 60- minute blocks of instruction for 150 to 300 total minutes per module.</td>
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<tr>
<td>Costs $249 per module which includes:</td>
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<tr>
<td>• Classroom activity materials</td>
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<tr>
<td>• 4 step-by-step activity cards</td>
<td>• 6 Student Activity Books (Gr. 1-2) or Story poster (K)</td>
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<tr>
<td>• Quick start teacher card</td>
<td>• Teacher Guide with assessment rubric</td>
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<td>• Story poster (print &amp; digital)</td>
<td>• Blackline masters</td>
<td>• Blackline masters</td>
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<td>• Classroom set of blackline masters and parent letters</td>
<td>• Digital classroom lesson</td>
<td>• Digital classroom lesson</td>
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PreK Modules:
- Ron’s Habitat Adventure
- Ron’s Ramp Adventure
- Pam’s Camping Adventure
- Pam and Ava’s Mapping Adventure
- Gus and Nia’s Shaking Adventure

Grade K-2 Modules:
- Sidewalk Safety Exploration
- Sunny Sandbox Exploration
- Wild Feet Exploration
- Sound Bite Exploration
- Helicopter Hang Time Exploration
- Shrinking Shore Exploration
- Muddy Mats Exploration

Grade 3-5 Modules:
- Squeaky Clean Magnets Challenge
- Farmer Grady’s Challenge
- Earthquake Technologies Challenge
- Solar House Design Challenge
- Food Deserts Challenge
- The Great Toy Design Challenge
- Silly Straw Challenge

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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