

Designing Paper Baskets: A PictureSTEM Curriculum Module (P12 Resource Exchange)

Kristina Maruyama Tank, Iowa State University

Kristina M. Tank is an Assistant Professor of Science Education in the School of Education at Iowa State University. She currently teaches undergraduate courses in science education for elementary education majors. As a former elementary teacher, her research and teaching interests are centered around improving elementary students' science and engineering learning and increasing teachers' use of effective STEM instruction in the elementary grades. With the increased emphasis on improved teaching and learning of STEM disciplines in K-12 classrooms, Tank examines how to better support and prepare pre-service and in-service teachers to meet the challenge of integrating STEM disciplines in a manner that supports teaching and learning across multiple disciplines. More recently, her research has focused on using literacy to support scientific inquiry, engineering design, and STEM integration.

Prof. Tamara J. Moore, Purdue University, West Lafayette

Tamara J. Moore, Ph.D., is an Associate Professor in the School of Engineering Education and Director of STEM Integration in the INSPIRE Institute at Purdue University. Dr. Moore's research is centered on the integration of STEM concepts in K-12 and postsecondary classrooms in order to help students make connections among the STEM disciplines and achieve deep understanding. Her work focuses on defining STEM integration and investigating its power for student learning. Tamara Moore received an NSF Early CAREER award in 2010 and a Presidential Early Career Award for Scientists and Engineers (PECASE) in 2012.

Mrs. Elizabeth Gajdzik, Purdue University, West Lafayette

Elizabeth Gajdzik is the Assistant Director of the INSPIRE Research Institute for Pre-College Engineering in the School of Engineering Education at Purdue University. She received her B.S. in Interdisciplinary Studies with a specialization in mathematics 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 mathematics instructional specialist in San Antonio, TX and a middle school mathematics teacher at a Title 1 school in Waco, TX.

Mrs. M. Terri Sanger, Purdue University

Mrs. Anastasia Marie Rynearson, Purdue University, West Lafayette

Anastasia Rynearson is a Purdue Doctoral Fellow pursuing a degree in Engineering Education at Purdue University. She received a B.S. and M.Eng. in Mechanical Engineering at the Rochester Institute of Technology. Her teaching experience includes outreach activities at various age levels as well as a position as Assistant Professor in the Mechanical Engineering Department at Kanazawa Technical College. Her current research interests focus on early P-12 engineering education and identity development.

Dr. Brianna L Dorie, Purdue University, West Lafayette

Brianna Dorie is a postdoctoral researcher with INSPIRE at Purdue University. Her research interests center around broadening participation in engineering, learning in informal environments and STEM integration to improve learning. She also has taught and developed engineering curriculum for summer camps, after-school programs, K-2 classrooms, and first year engineering experiences.

Emma Mann,

Emma F. Mann is an undergraduate student in multidisciplinary engineering at Purdue University. She has been working as a research assistant on the PictureSTEM project through the UPRISE program in the INSPIRE Research Institute. Her involvement with this project has furthered her understanding of engineering education so that she can make an impact on young learners in STEM when she is working as a professional engineer.

Designing Paper Baskets

A K-2 Curriculum Module



Kristina M. Tank, Iowa State University

Tamara J. Moore, INSPIRE, Purdue University

| kmtank@iastate.edu | tamara@purdue.edu |

www.PictureSTEM.org

This curriculum module is part of the PictureSTEM Project, which employs engineering and literacy contexts to integrate science, technology, and mathematics content instruction in meaningful ways.

Description of Designing Paper Baskets Unit

This 5-day unit geared towards the early elementary grades (K-2) consists of five pairs of literacy and STEM integration lessons that work together to build the foundation for an engineering design challenge. Each of the lessons require approximately 30 minutes of class time and build upon each other. In this unit, students explore the science concept of physical properties and the mathematics concept of patterns and counting as they weave a variety of materials together in order to carry both dry and wet rocks. Students test different types of paper and then get to choose which materials they think will be best for the challenge – carrying rocks.

Engineering Design Challenge

Max and Lola want to give people who visit their rock collection a basket to collect their own rocks; however, they will not be able to make enough for everyone. Students explore patterns and investigate the strength and properties of paper before applying them to design a paper basket.

	Lesson 1:	Lesson 2:	Lesson 3:	Lesson 4:	Lesson 5:
Literacy Activities	Book: <i>If you Find a Rock</i> Strategy: Identify beginning and ending sounds of words	Book: <i>I Get Wet</i> (Part 1) Strategy: Blend three letters in sound boxes that represent the phonemes of a word	Book: <i>I Get Wet</i> (Part 2) Strategy: Summarize text using interactive writing	Book: <i>Pattern Fish</i> Strategy: Identify rhyming words	Book: <i>Rock, Jeans and Busy Machines</i> Strategy: Summarize narrative text with interactive sentence writing
STEM Activities	Identify properties of paper samples and sort using those properties	Water drop test, wax and water test	Test the strength of dry/wet paper with rocks	Relate patterns to weaving, create a basket plan, build a model	Test baskets with wet and dry rocks and communicate

Lesson Summaries

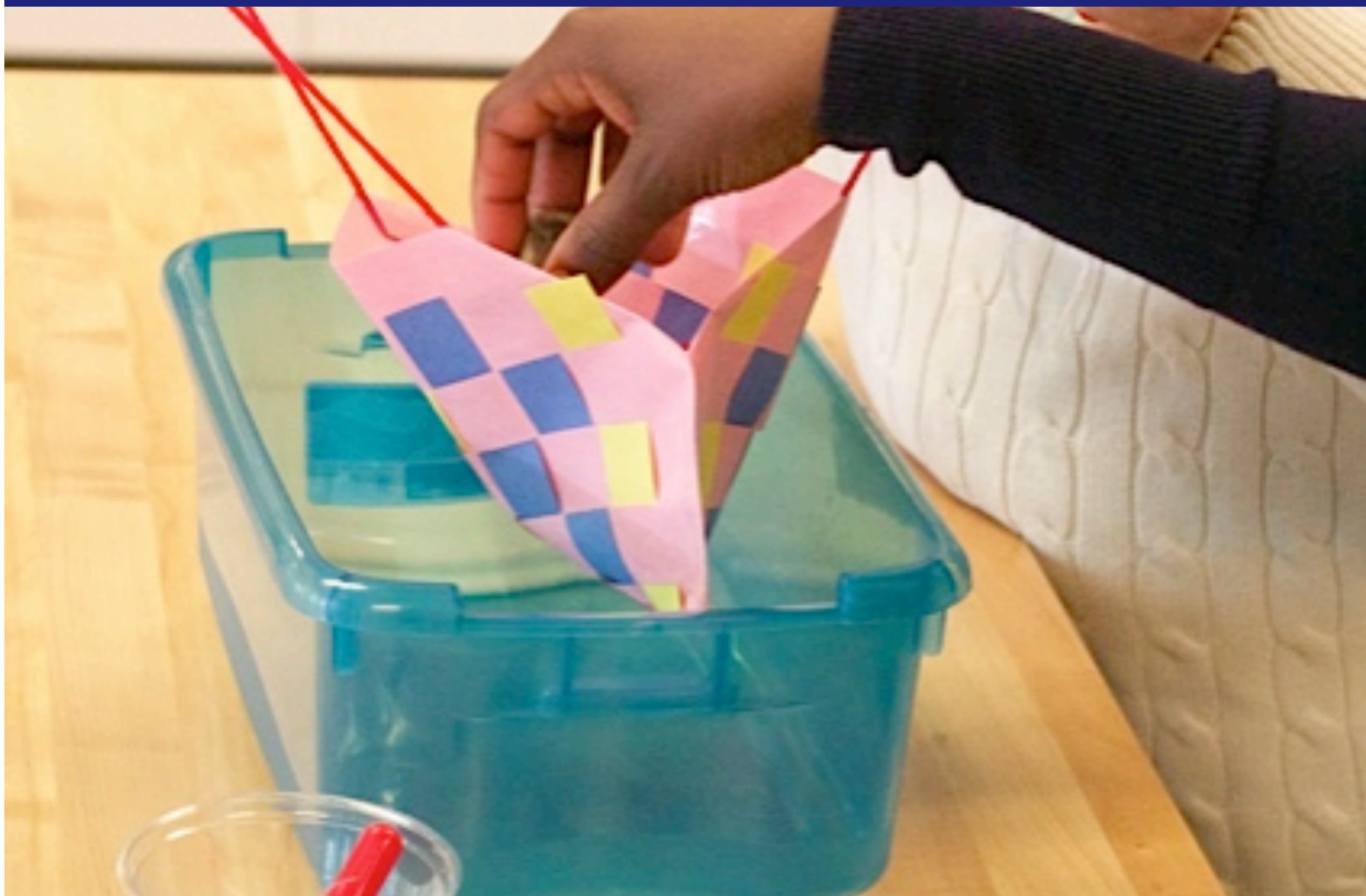
- **Lesson 1** – After being introduced to the engineering design challenge, students look at different things that can be done with rocks as they read the book *If you Find a Rock* by Peggy Christian. This lesson introduces students to collecting rocks and why rocks can be fun and interesting, while also getting students to think about how rocks can be organized by size, color or use. After setting the context of rock collecting, students dive deeper into the science concept of physical properties as they explore the properties of paper samples that will be used during the design of their baskets.
- **Lesson 2** – Students are introduced to water as they learn about some of the properties through the nonfiction science text, *I Get Wet* by Vikki Cobb. Through this text, students build their phonemic awareness skills while also learning about water. After reading part of the nonfiction text, students investigate water's effect on different types of papers by conducting a water drop test on regular and wax-coated paper.
- **Lesson 3** – In this lesson, students continue to learn about the properties of water as they work to interactively create summary sentences about the nonfiction science text that they have been reading together. Students will then explore some of the ideas that they have about water and paper as they use rocks to test the strength of the different papers that will be available during the design challenge. Students will sort papers based on their strength when wet and when dry.
- **Lesson 4** – Students are introduced to rhyming and patterns through a book called *Pattern Fish* by Trudy Harris. After reading, connections are made between the patterns in basket weaving and the patterns presented through the book. This helps students to identify patterns used in simple basket weaving, and understand why alternating patterns are important, before use their knowledge of patterns to complete weavings in pairs. Students will also use the properties of paper to make decisions about which papers to use as they plan for their basket design.
- **Lesson 5** – In the final lesson, students read about construction engineering as they are practicing the blending of three phonemes words presented in the story. Students are given the chance to build and test their basket designs when wet and when dry, before a cycle of sharing, redesign and retesting. Finally, students use what they learned during designing and testing to write letters to Max and Lola in which they make recommendations for their basket design.

Additional project members: Brianna L. Dorie, Elizabeth Gajdzik, M. Terri Sanger, Anastasia M. Rynearson, Emma F. Mann



PictureSTEM

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The PictureSTEM Project is developing an instructional module at each grade level, K-5, which employs engineering and literary contexts to integrate science, technology, and mathematics content instruction in meaningful and significant ways. These transformative new models for STEM learning use picture books and an engineering design challenge to provide students with authentic, contextual activities that engage learners in specific STEM content as well as integrate concepts across disciplinary boundaries. These curricular units have gone through an extensive design research cycle to ensure a quality product.