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TASK TITLE: Engineering | Three Little Pigs Engineering Design Challenge

1. Learning Intentions & Connections	
MATHEMATICS	In this task, students will engage with mathematical skills such as counting quantities of objects, taking measurements, and describing measurable attributes of an object by designing and constructing their own structures with various materials. This process will allow students to think about quantities of objects as they determine how many units of each material they will need for their structures. This correlates with the Tennessee state standard for math labeled K.CC.B.4 which states, "understand the relationship between numbers and quantities; connect counting to cardinality." Students will engage with this process on a deeper level because they will be determining the number of objects they need themselves, and manipulating the objects while counting them. This task also allows for engagement with the skill of measuring objects and describing their measurable attributes such as length and height. This correlates with the state standard labeled K.MD.A.1 which states, "describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object." This task allows for a lot of meaningful engagement with this skill as students will have to think about measurable attributes during both the designing and constructing processes. They will need to engage with questions such as how long, wide, and tall their structures should be. They will then keep those measurements in mind as they construct their houses. This allows for deeper conceptual understandings because it puts the students in the driver's seat when it comes to thinking about measurements and bringing them to life. Both the floor and the ceiling tasks engage with the previously stated mathematical concepts because both allow students to design and build structures by counting materials as well as thinking about and manipulating measurable attributes of structures. (TN Department of Education, 2017)
STEAM	Along with mathematical skills, students are also engaging in the science and engineering practices

outlined in the Tennessee Science Standards. Students are:

- “1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information”

Through this authentic learning task, students are learning to investigate and explain causal relationships and conditions. Students test different variables in order to compare, predict, and explain events such as how size, dimensions, and energy (wind power) can impact their structures. Students plan as well as engage in trial and error in order to gain better understanding of this narrative as well as real-world problem experienced to combat/innovate potential solutions.

Some of the specific Tennessee Standards we want students to address in the activity include:

“2.PS2: Motion and Stability: Forces and Interactions

2) Evaluate the effects of different strengths and directions of a push or a pull on the motion of an object.

2.ETS1: Engineering Design

1) Define a simple problem that can be solved through the development of a new or improved object or tool by asking questions, making observations, and gather accurate information about a situation people want to change.

4) Compare and contrast solutions to a design problem by using evidence to point out strengths and weaknesses of the design.

2.ETS2: Links Among Engineering, Technology, Science, and Society

1) Use appropriate tools to make observations, record data, and refine design ideas.”

We believe our activity is an effective math lesson as it challenges students to apply their math knowledge to be successful and prevent/solve a problem. It offers an authentic learning opportunity for students to see the relevancy of the subject and topics as the literary origins and support connects to real-world problems faced everyday in nature and more severely during natural disasters. Realizing the functionality and significance of the math application should increase initiative and effort to learn and master the math skills needed to solve and provide solutions to such relevant, important, and sometimes

	devastating events. (TN Department of Education, 2017)	
LITERACY	Students will recount the story of the “Three Little Pigs” and use their knowledge of the story’s plot and resolutions to construct a structure/home of their own that is resistant to or unaffected by wind. Students will demonstrate their comprehension of the story by applying what they have learned about the different materials used in the story to select and make decisions about the design of their structure. Students should be able to orally explain their reasoning behind design decisions using the story for support as well as from their observations gained from attempts at performing the task. We will assist and guide students throughout the task by prompting them to answer questions orally about key details and major events from the story aligned with the Tennessee English Language Arts Kindergarten Standards listed below. “K.RL.KID.1 With prompting and support, ask and answer questions about key details in a text.” “K.RL.KID.2 With prompting and support, orally retell familiar stories, including key details.” “K.RL.KID.3 With prompting and support, orally identify characters, setting, and major events in a story.” At the end, if time permits, we would like students to engage in oral self-reflection, answering questions like “did your structure withstand the wind,” “whose structure withstood the most,” “why do you think their design was the most effective,” “what would you change about your structure to make it stronger,” etc. (TN Department of Education, 2017)	
2. Task		
CORE TASK	FLOOR	CEILING
*This section is written as the instructions will be explained to our students Today, we are going to build our very own house for one of the Three Little Pigs to live in! Like the pigs, we will have three	We recognize that many students will be eager to take complete control in their design process; however, we also recognize that some	While we anticipate that all students will engage in the Core or Floor (Core + support) task, our hope is that many students will desire to engage

different materials that we can use to build our houses: straws, popsicle sticks, and blocks. We can use a mixture of materials so we can determine through experience which materials will work well together to build a stronger structure. Within this process, we will count how many materials of each type we used (For example: “I used 6 blocks, 4 straws, and 8 popsicle sticks). After we finish our houses, we will use a measuring tape to see how tall and wide our houses are. Can we design a house that will survive the blow of the Big, Bad Wolf? Like the Three Little Pigs faced the Big, Bad Wolf, we will have to face the Big, Bad Hair Dryer to see if we can survive its winds (cold, low-speed setting). (Mid-Columbia STEM Education, 2017).	students may struggle to engage in this process. For students who are struggling to engage, we will provide the opportunity to collaborate with other students (as well as our team of 5). We will model working to build our own structure so we can more easily bring in students who may struggle to get started. While we will be facilitating the activity, we would encourage student involvement as much as possible by having the students assist in picking out the materials, counting the materials, and building the structure. In summary, the floor activity will be the Core task with support. Through our experiences in conducting the tasks, students were able to count when they counted with someone else.	in the ceiling task. The ceiling task will be the opportunity to redesign their structures. Students will be provided blank paper and pencils in case they would like to draw out their design. Students will then follow the Core task instructions to design and create their second structure. At the completion of the second structure, students will utilize measuring tape and the hair dryer test to compare the effectiveness of their second structure.
TASK MATERIALS	The resources we will need to complete this task are building blocks/legos, straws, popsicle sticks, tape, measuring tape, blank paper, pencils, and hair dryers (we can bring our personal hair dryers).	

3. Anticipated Solutions or Strategies & Responses

TASK SOLUTIONS or STRATEGIES	Assessing Questions	Advancing Questions
Solution/Strategy for CORE task: - students will try a variety of material combinations to make the sturdiest house possible. - students will try to make a tall house - students will try to make a wider house Students used materials that they were more familiar with. (a very common approach) Students thought that by using more materials, their house would be sturdier. Students thought a lot about how their houses looked as opposed to structural integrity. - Students thought about specific colors of blocks and straws as opposed to its ability to withstand the blow of the Big, Bad Wolf	1. What do you notice about the structure we are building? 2. Is our structure tall or short? 3. Is our structure narrow or wide? 4. What materials and how many materials are we using to build our structure? 5. What shapes are in your house?	1. Is it sturdier to have a taller, thinner house or a shorter, wider house? 2. Which materials seem more sturdy to build with? 3. Can we put different materials together to make a sturdier house? 4. Why did you choose your selected materials? 5. What house was strongest in the Three Little Pigs? What material could you use that's similar to that one?
Solution/Strategy for FLOOR task: Students may take a longer time to realize the characteristics of a sturdy structure. Students will not re-assess and change their plan. Students may ask a lot of questions about what to do next/ rely on scaffolding.	1. The answer would involve characteristics of the sturdiest structure. 2. A sturdier structure is usually shorter. 3. A sturdier structure is usually wider. 4. The amount and type of	1. shorter, wider house 2. 3. yes 4. What could you add to make the structure stronger?

	material is dependent on the structure. 5. Have you used all of your available materials?	
Solution/Strategy for CEILING task: - When given the opportunity to engage in a redesign process, students may completely leave out the items used on the previous house if they did not withstand wind. - Students recognize the importance of symmetry in their designs (may say: it has to be even or balanced)	1. can you draw a structure that holds up to wind? 2. what materials will you use?	1. what kinds of materials hold up to wind more? 2. is it better to use more materials?
4. Wrap Up		
Student Success	If they can count the number of materials they use, they will be at the floor. If they understand that broader, shorter structures withstand the “wind” better than tall, skinny structures and that “bricks” or legos are more sturdy, they will understand the core of the activity. In our experiences, our students were able to engage in counting; however, many of our students were not able to articulate why they chose their specific materials. If they can pre-plan and map out a house with a shorter, broader structure and legos, they will have hit the ceiling of the task.	
Summary Statement	We will talk about the mathematical elements of dimensions and counting, and how that is important to the building’s structure. Knowing how to count dimensions is important to building a structurally sound building, so engineering and math are tied together.	

Resources

Mid-Columbia STEM Education. (2017). Three Little Pigs STEM Design Challenge and Standards Connections. Retrieved February 18, 2019, from [https://www.midcolumbiastem.org/Lists/IDEA Tools/Attachments/25/Three Little Pigs-STEM Design Challenge and Standards Connections.pdf](https://www.midcolumbiastem.org/Lists/IDEA%20Tools/Attachments/25/Three%20Little%20Pigs-STEM%20Design%20Challenge%20and%20Standards%20Connections.pdf)

TN Department of Education (2017). *Science*. Retrieved February 22, 2019 from
<https://www.tn.gov/education/instruction/academic-standards/science-standards.html>