Lesson Plan: The Fourth Little Pig Engineering Design Challenge
By Mandi de Witte

Target Grade: 2nd
Teacher Prep Time: 15 minutes
Lesson Type and Time:
• Lab - 1 hour
• Post-Lab – 30-45 minutes (can be done as part of the lab, or later that day or the next day in the classroom)

Lesson Overview: Using the story of the three little pigs as a backdrop, second grade students will be challenged to become engineers to design, build, and test their own house for a “fourth” little pig. Students must decide which materials will work best to build a strong house that can stay standing in the “wind of the wolf,” which is actually an electric fan! After drawing and discussing their design, students will apply math skills through using pretend money to buy materials from “the store” to build their house. Applying content knowledge about material properties as well as teamwork, time and supply management, and problem solving will be essential during this lesson.

Objectives: Students will be able to:
• Work as a team to decide on the materials best suited to build their house, and budget appropriately to purchase those materials.
• Work as a team to design and build a house made of their chosen materials.
• Test their house against the wind of the wolf, and make changes to the house as needed.
• Compare the different materials used for the house designs in the class, decide what worked best, and what did not work very well.
• Predict and explain whether the teacher’s house, built from similar materials, will be able to stand.

NGSS:
• 2-PS1-2 – Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*
• K-2 ETS1-2 – Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it to function as needed to solve a given problem
• Science and Engineering Practices
  o Engaging in argument from evidence.
    ▪ Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).
    ▪ Construct an argument with evidence to support a claim.
• Disciplinary Core Ideas
  o Different properties are suited to different purposes.
• Crosscutting Concepts
  o Structure and Function
    ▪ The shape and stability of structures of natural and designed objects are related to their function(s)

Where this lesson fits in:
This is an integrated lesson that includes science, engineering, math, and language arts. Students have already learned to describe and classify different kinds of materials by their observable properties (2-PS1-1) earlier in the year. In the weeks leading up to this lesson, the students read the Three Little Pigs.
and *the True Story of the Three Little Pigs* during language arts and discussed the different materials used to build each house in the story to prepare for the engineering design challenge.

**Materials:** *Note – amounts needed will vary based on class size and number of groups*

- Student lab sheet – one per student
- *the Three Little Pigs* and *the True Story of the Three Little Pigs* books
- Paper Money – fake $1, $5, and $10
  - "$100" per group, pre-counted in envelopes
  - About $100 extra in “change” for the store
- Plastic Trays – one per group
- Electric Fan with laminated picture of a wolf taped on
- “Store Inventory” each group will decide what they want to buy from “the store” material list on student worksheet and at right:
  - One package Small Index Cards
  - 1-2 Rolls Aluminum Foil
  - 1-2 Balls Yarn
  - 1 small Package Modeling Clay
  - 20-30 8.5 x 11 pieces Construction Paper
  - One package Big Index Cards
  - 100-200 Plastic Straws
  - 100-200 Lego Pieces, Assorted
  - 1-2 rolls Masking Tape
  - Meter stick for measuring yarn and tape

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**Teacher Prep:**

1) Create heterogeneous student groups of 3 or 4 students each
2) Make copies of student worksheets
3) Sort paper money into envelopes, $100 per group
4) Tape Wolf cutout to fan and set up a “building test space” on a counter with electricity. Houses will be tested one foot from the fan. *See picture at right.*
5) Set up “the Store” with materials that students can buy, separated by price.
6) Build the “teacher” demo house for after the lesson. It should be stable enough for the door and walls to remain standing, but make it so that the roof blows off.
7) Immediately before lesson, turn on projector with doc cam to display student worksheet.

*Note: do not have any materials on student desks at the start of the lesson besides the student worksheet*

*"The wind of the wolf" testing station setup*
Lesson Sequence:

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| 7 minutes| **Introduction & Connection to Story**  
Pass out worksheets to each student. Display top of student worksheet on the projector. Asking students to follow along, read the first paragraph of the worksheet aloud. Stop after the first two questions in the introductory paragraph, and give time for students to think-pair-share their answers. Have a copy of *The Three Little Pigs* handy for reference.  
*Which materials were blown down by the wolf? Straw and sticks - they are too lightweight and the wolf could blow them away*  
*Which material was strong enough to stay standing? Bricks - they are strong and have cement to hold them together*  
Today your team will build your own house for a fourth little pig using different materials. Will your house be strong enough to protect the fourth little pig? (Rhetorical) |
| 10 minutes| **Objectives and Engineering Process**  
1. Call on non-volunteers to read each objective for the lesson.  
2. Read “What is an engineer?” to the class as they follow along. Ask students to raise their hands if they know anyone who is an engineer, and ask what kind of work they do.  
3. Tell students that most engineers follow a certain set of steps when working on a project. Have students repeat each step after you, and write as you write on the paper. “Ex: A is for asking questions / Ej: P es de preguntar” In English it is “the ABC’s of Engineering,” in Spanish it is the acronym “PICDEDA” – see KEYs at end of this lesson plan.  
4. Tell students that it will be important to follow these steps to be successful today. |
| 7 minutes | **Instructions**  
Have students turn to page two. Read the instructions aloud regarding materials and design. Explain that just like in real life, engineers have money, supply, and time constraints that they must work with. They will have $100 and 30 minutes to design, buy, build, test, and refine. Answer any questions, pass out money envelopes, and then set a timer for 30 minutes allowing students to begin. Have poster of engineering steps visible for reference. |
| 30 minutes| **Work Time**  
1. Students will begin brainstorming by drawing a sketch of their ideas. Once each teach member has completed their drawing, they may get their tray and buy their materials at the store. Students must use teamwork to build their house. Try not to help students too much. Instead, ask questions such as “What material will work best for the walls? The roof? What makes you say that? Do you think it will remain standing in the wind? Why or why not? What can you change or add to make the structure more stable?” Remind students of the importance of teamwork.  
2. Give students a warning at 10 minutes and 5 minutes. Once a team is done, ask them to bring their tray with their house to the wolf’s testing station. If it stays standing, congratulate them, and ask them to begin the conclusion questions on page 3.  
3. If a group’s house blows over, ask them to take it back to their table and make adjustments to make the house stronger and more stable. |
| 20 minutes| **Conclusion (can be done immediately after or within one day)**  
1. Give students about 3 minutes to answer questions 1-4 on page 3. Ask 2-4 students |
to share out their answers to question 4.

2. Ask students to turn to page 4, and look around the room at the different houses. Say, “Different materials work better for different purposes. What materials can you identify that worked well for each building structure, such as the door, roof, or walls? Write this down on your paper.” Give students time to think, pair, then share with the class what they think worked best, and why. Prompt students to provide evidence from their houses.

3. Now say, “Now that we have thought about which materials worked best for certain building structures, are there any that we can prove did not work so well? Write this down on your paper.” Give students time to think, pair, then share with the class what didn’t work for their buildings, and why. Prompt students to provide evidence from their houses.

5-10 minutes **Cleanup** *(can be done immediately after or within one day – do not clean up houses until students have had the chance to look at them for their conclusion)*

1. Pick up one of the students houses to model. Model taking apart the house to show them which materials should be trashed/recycled into appropriate bins (used index cards = recycle, used tape = trash, etc.) and which items should be returned to the store (LEGOS, paper money, etc.)

2. Set a timer for 4 minutes for students to clean up.

20 minutes **Application** *(can be done immediately after cleanup, or within several days as a follow up)*

1. Tell students that you have built your own house that you want to test. Ask them to think about their own experiences, and look back at what they wrote on pages 3 and 4 about how the different materials worked. Ask students to independently answer questions 1-4 on page 5. Provide them with at least 5 minutes to do so. Then, allow them to share with classmates in pairs, and then with the class. Always prompt students to provide evidence from the lab activity when they are making their predictions about the house.

2. Test the teacher house in clear view of all students. It should remain standing, but the roof should blow off. Ask students if this would protect the pig, and why or why not? After a short discussion, ask students to independently answer questions 5 and 6.

### Keys and Student Sample Work:

**The ABC's of Engineering**

A is for asking questions  
B is for brainstorming  
C/D is for creating/designing  
E is for experiment  
F is for fun and learn from failure!  
Repeat!

**Los pasos de los ingenieros:**  
P es de preguntar  
I es de imaginar  
C es de crear  
D es de diseñar  
E es de experimentar  
D es de divertido!  
A es de aprender del frasco  
¡y repetir!
Materials: Just like the three little pigs and real engineers, you and your team must decide which materials you want to use. You will have $100 to spend on supplies for your house. Each material costs a different amount, and has different properties, such as strength, flexibility, texture, and hardness. Which materials will you buy and use to build your house?

Design Rules: Your house must:
- be able to stand on its own (cannot tape down to tray)
- have 4 walls, a roof, and a door your pig can fit through to enter and exit
- be built on a tray

Design Plan: Use the space below to draw and label a design of your house using the materials you plan to buy. Explain why you are choosing these materials. Once you have a design, bring it to the store to buy your materials.

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I am choosing the **legos** for the **floor** sides, because they are like bricks.

I am choosing the **tape** for the **sides** and **roof**, because it holds it together.

Results and Conclusion: Use the space below to draw your final house design. Label the materials you used for each part of your house.

1. Did your house stand in the wind from the wolf? **yes it did**
2. What materials did you use? **legos, index cards, tape, foil**
3. How much money did you spend? **$100**
4. In 1-2 sentences, explain why you think your house was or was not able to withstand the wind. The legos are strong like bricks and gave a good bottom for house. Index cards are think paper and we taped it not move. Foil roof we folded over house for a good roof because we ran out of tape.

Comparing Houses in the Class

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<td>Aluminum Foil</td>
<td>Roof</td>
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<td>Yarn</td>
<td>Door</td>
</tr>
<tr>
<td>Modeling Clay</td>
<td>Side</td>
</tr>
<tr>
<td>Construction Paper</td>
<td>Floor</td>
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<tr>
<td>Large Index Cards</td>
<td>Edge</td>
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<tr>
<td>Straws</td>
<td>Corner</td>
</tr>
<tr>
<td>Legos</td>
<td>Chimney</td>
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What materials worked best for each building structure? Why?

The masking tape worked well for the edges because it holds the house together.

The legos worked well for the floor and sides because they are strong and fit together with no tape.

The clay worked well for the corners because it helped stick parts together.

What materials did not work well for each building structure? Why?

The yarn did not work for the sides because it is too wiggly and blew away.

The construction paper did not work for the walls because it is too thin and big.

Application: Your teacher has built a house to protect the fourth little pig from the wolf. Observe your teacher's house, and compare it to the houses you and your classmates built. Do you think your teacher's house will protect the pig? Why or why not? Use the sentences below to show your thinking.

1) I predict that my teacher's house **WILL NOT** stand in the wind of the wolf.

2) My teacher used **index cards** for the **sides**, which will help it stay up. I think this because on our house, it worked.

3) My teacher used **construction paper** for the **roof**, which will stay on. I think this because it looks like a real house roof.

4) My teacher used **straws** for the **corners and play**, which will make it strong. I think this because it looks like it will keep it down not blow away.

5) Did your teacher's house protect the pig? **no**!

6) In 1-2 sentences, explain why you think your teacher's house was or was not able to protect the pig. My teacher's roof blew off because she did not make her roof tape to the bottom of the house. You need tape to hold thing together!