

Chapter 25



Angelica Tobias: The Engineering Design Process

I am a life long learner who just happens to be an educator! I have been a teacher for four years in the Chicago Public Schools. I just became the Science and Engineering Coach for Marvin Camras Children's Engineering school and am excited to support our amazing and hard working teachers! Go Team! My passion is STEM education, specifically in engineering since in my "previous career life" I was an electrical engineer. I literally see engineering everywhere! I'm so bad, that I collect (clean!) toilet paper tubes and other recyclables for future engineering projects! :-)

I also coach our after school LEGO Robotics club and engineering club. In my spare time (ha!), I like to collect toilet paper tubes.

The Engineering Design Process and The 3 Little Pigs

Grade Level: 1st - 2nd grade

Content Area Topic: Engineering

Content Area Standard(s):

NGSS:

- K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a need or improved object or tool.
- 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.

CCSS:

- R.1.2.1: Ask and answer questions as who, what, where, when, why and how to demonstrate understanding of the key details in text.

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Learning Objective(s):

Objective is to use the Engineering Design Process and apply it to a simple children's folklore story. The Engineering Design Process has 4 steps:

- Think - Ask: "What is the problem?" Imagine: "Think of many different ideas to solve the problem."
- Plan – Draw your best idea, which solves the problem. Label and write the materials needed.
- Create – Build your idea!
- Improve – Test it! Did it work? Start again to make it better!

Learning Target – I Can use the Engineering Design Process to solve a problem.

Suggested Time Allotment: Two (2) to Three (3), 40 minute periods

Sequence in Learning:

This lesson is from my Folklore and Engineering Unit. It integrates literacy and engineering and its objective is to make the engineering process accessible for younger students. Prior to this lesson, students would have been taught the Engineering Design Process (EDP) in this

unit and would already have the prior knowledge of the process. The 3 Little Pigs EDP lesson is part of a series of Folklore EDP lessons and can be used by it self or with the other lessons. Completion of this lesson will help students gain experience in applying the Engineering Design Process in other contexts.

Note: The Engineering Design Process is modified from the Elementary is Engineering Design Process, which has 5 steps (Ask, Imagine, Plan, Create, Improve). This EDP was modified for 1st – 2nd grade students by merging the Ask and Imagine step into the Think step.

Materials & Resources Needed:

- The 3 Little Pigs book by Paul Galdone
- Post –It Notes
- Engineering Design Process Graphic Organizer
- Poster Chart paper for shared thinking of EDP solutions
- Markers, Pencils, paper, crayons
- Building material: LEGO bricks, drinking straws, construction paper, play dough, tape, string
- Straw, sticks, bricks
- Fan

Vocabulary:

- Engineer: someone who uses math and science to solve a problem
- Engineering Design Process – Think, Plan, Create, and Improve
- Straw, Sticks, Bricks
- Compare – How are they the same?
- Contrast – How are they different?

Lesson Activities & Sequence:

- Teacher will have Engineering Design Process organizer up and visible. Teacher will review the Engineering Design Process (EDP) with the EDP anchor chart that details the 4 steps in the process. Teacher will review that engineers use the EDP to solve problems.

Teacher will explicitly tell children their learning targets for this lesson. Teacher will ask students (Ss) if they know the 3 Little Pigs story. Teacher will read the 3 Little Pigs story and pause at different places to make predictions and ensure understanding. Teacher should have the straw, sticks, and bricks out for students for a visual aid.

Example of some guiding questions:

- What material did the 1st/2nd/3rd pigs use to build his house?
- Do you think it is a good material to use? Why/why not?
- What do you think will happen when the wolf blows the house of the 1st/2nd/3rd little pig?

- What was the 1st/2nd/3rd little pig's problem?
- What are some possible solutions?

Retelling – Teacher will ask students to retell the story. Students can retell by 1) verbally telling the story, 2) Writing down their retelling, 3) Drawing down their retelling or 4) Using the LEGOS to retell. Teacher will assess the retelling of the story.

Teacher will explain to students that they will now apply the EDP to solve the little pigs' problem. Teacher will pass out Post It notes and tell students that they will use the Post It notes for the EDP and that they should write their names on every Post It note they use.

THINK - (Ask) Teacher will ask students to identify the problem that the little pigs had, and fill out a Post It identifying the problem either through words or pictures and post it under the THINK step in the EDP graphic organizer. Remind students to write their names for formative assessment purposes.

(Imagine) Teacher will ask students to think of many different solutions to solve the pigs' problem. All ideas should be encouraged and written down! Students will fill out a Post It with their ideas (solutions) and post it under the Think step of the EDP graphic organizer.

PLAN – Teacher will now ask students to pick out their best idea (solution). Students will post their best idea under the Plan step of the EDP graphic organizer. Students will draw their solution on the Post It note. Teacher should emphasize to students to label their drawing.

CREATE - Teacher will explain to students that this is the “Build It” step!. Students will now build their design with LEGOs, or the other material. Students will present and explain their prototype/model to the class. Teacher will set presentation norms/expectations. Students will then use a Post It note to write what they think the best or worst part was in their creating the model. Students will then post it under the Create step in the EDP graphic organizer.

IMPROVE – Students will test the strength of their design using the fan to Huff and Puff. Teacher will lead students to determine test criteria chart. Students will use a Post It note to write down if their design worked and if they need to improve it. Students will then post it under the Improve step in the EDP graphic organizer. Students can make changes to their design after testing so they can improve their design by cycling back through the Engineering Design Process.

Note: Because Legos are interlocking and will withstand any pressure or fan, most

designs will work. Teacher can still use the improve stage to ask students to add or change their design after some design reflection.

Proficiency:

Below are the multiple methods to assess whether students have met the objective.

Retelling – Verbal, written, drawn, acting/modeling with LEGO props
 EDP Graphic organizer – Students are able to write down and post their ideas correctly on the EDP graphic organizer. See rubric below.
 EDP - Students will be able to identify what step they are in the Engineering Design Process as they are working through the investigation.

House Design – drawn plan

Prototype Project – built LEGO model (Performance Task)

Oral – Students will be able to present their solution and explain their design and why they chose certain features of their design.

Engineering Design Process Rubric:

EDP Step	3 Proficient	2 Basic	1 Emerging
Think	Writes that problem was, the little pigs' houses were not strong enough (or similar) And has at least 3 – 4 solutions.	Writes that problem was the little pigs' houses were not strong enough Or has at least 2 solutions.	Skips step or writes only one solution.
Plan	Draws and labels the best solution clearly	Draws or writes the best solution	Either no solution drawn or can not explain solution
Create	Builds model that follows plan design and can describe 3 to 4 features of their design.	Builds model that partially follows plan design and can describe 1 to 2 features of their design.	Builds model that does not follow plan design
Improve	Writes down if their design worked AND what they would improve.	Writes down if their design worked OR what they would improve.	Writes a simple yes or no

Extensions –

Math Integration – How many LEGOs?

Literacy Integration – Story writing, retelling

Additional – Read different versions of the 3 Little Pigs. Compare/Contrast the different versions.

Feedback

Teachers As Learners:

What worked for the group as learners when they experienced the lesson? What worked was the literary connection and applying the concept of the engineering design process in the Three Little Pigs. They also liked the emphasis on imagination and “anything goes”.

What suggestions are there for the teacher to better help students with the lesson? My colleagues suggested that I provide visuals by putting pictures of the text on the EDP Anchor Chart. I usually do that in my classroom.

What did the teacher do well? My colleagues liked the shared reading and the student friendly text. They also thought it was a good balance of technical language.

Elements of Pretty Good Practice:

- Summarize the pedagogical strategies used that helped with the lesson’s delivery.
- Integrated Instruction: Literacy read aloud reinforces fluency, and engaged students through voices.
- Teacher circulated and provided feedback.
- Conversation: There was plenty of student-to-student discourse and Teacher-to-Student discourse.
- Assessment: Post Its were used as an assessment tool. The performance task of designing a better house was created from the viewpoint as Jr. Engineers so it was a different vantage point than the student point.
- Interactive Anchor Charts: Graphic organizer was created collaboratively with students. The engineering discipline was used for a performance task.

Modifications and Adaptations:

- In what ways can the lesson be changed to accommodate **my** personal teaching and learning contexts and/or learners?
- Use highlighter to follow along while you are reading.
- Bring the materials of straw, sticks, and bricks.
- Have students experience the “huff and puff” by bringing in a fan.
- Integrate atomic structure (“everything starts with atoms/molecules/matter) to previous lessons.
- Use a video clip of the story, for example, www.speakaboo.com

Adaptations:

- Conflict resolution in other fairy tales: Humpty Dumpty, Cinderella, etc.
- Listen to the story before the shared reading in students’ native language.

- Add non-linguistic representations to accompany steps of the engineering design process.
- Performance Task: Rewrite the favorite fairy tale integrating examples of energy.

Questions Arisen:

- Q How do you keep track of the Post It notes? A. I have students write their names and then I take a snapshot of the completed EDP graphic organizer.
- Q How long does the lesson normally take? A. The lesson takes about 2 to 3 days.

Peer Feedback:

What suggestions did your colleagues share related to your teaching demo?

Related Resources/Ideas:

Other books that can be used for the 3 Little Pigs are:

- The Three Little Wolves and the Big Bad Pig, by Eugena Trivizas
- The Three Little Javelinas, by Susan Lowell
- The True Story of the 3 Little Pigs! by Jon Scieszka

Other engineering design lessons for the 3 Little Pigs are:

- The Three Little Pig Design Challenge Webquest:
- <http://www.protopage.com/dakstem#Untitled/First>
- Engineering for the Three Little Pigs:
- http://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_earth/cub_earth_lesson1_activity1.xml

Engineering Design Process (Modified for 1st-2nd grade)

Visual Representation for Process:

