Lesson Created by Kirk Robbins

Teaching Engineering with Picture Books

Grade 4: *Rosie Revere, Engineer* by Andrea Beaty Illustrated by David Roberts

Engineering Design: Learning Collaboration and Grit

Overview of Lesson and Text

This picture book and lesson is intended to provide students with some foundational ideas about engineering and collaboration. Students will use the literacy skills they are learning in CCSS ELA (using text-based evidence, identifying theme, speaking and listening) to comprehend the text. In the book, Rosie has to work through her fears of failure and eventually her Aunt helps her see that failure can often times be productive. This is a key part of engineering (and learning in general)… we all need to be better at identifying the small successes in our failures. In engineering we also need to be good at identifying **Failure Points**. When we notice what is not working correctly, we can fix it and optimize the solution. The book also promotes the idea of grit… "The only true failure can come if you quit."

This book also connects with ideas in **Second Step** and you can connect to the following lessons/ideas in the grade 4 **Second Step** materials:

- Lesson 1 Empathy and Respect (Use Rosie as an example for defining empathy and respect)
- Lesson 5 Understanding Complex Feelings (Rosie experiences more than one feeling at the same time)
- Lesson 14 Avoiding Jumping to Conclusions (Where might Rosie be jumping to conclusions in the story?)

Long-Term Targets Addressed (CCSS and NGSS)

I can use details and examples from a text to explain what the text says. (RL. 4.1)
I can determine the theme of a story. (RL. 4.2)
I can engage effectively in a collaborative discussion. (SL.4.1)

Supporting Learning Targets	Ongoing Assessment
• I can use details and examples from *Rosie Revere Engineer* to explain what engineers do. • I can work with others to solve engineering problems. • I can persevere when things get hard.	• Teacher observation • Student written explanation

Agenda	Teaching Notes
1. Engage A. What do engineers do? (15 minutes) **2. Explore** A. Interactive Read Aloud of Rosie Revere Engineer (20 minutes) B. Looking closer at the text using Text Dependent Questions (20 minutes) C. Developing a Close Reading Anchor Chart (10 minutes) **3. Explain** (Closing and Assessment) A. Is Rosie an Engineer? (10 minutes) **4. Extend** (optional) A. Conduct an engineering design challenge B. Paired Reading- Informational Text	NOTE: In this module, students will revisit their understanding of what engineers do and begin to dig into the critical concept of "grit" in doing engineering. A key question here is- "What do we do when an idea doesn't seem to work?" Do we quit? Or do we stick with it and more importantly learn something from the failure. In engineering when we are solving problems we identify FAILURE POINTS and we need to be on the lookout for these FAILURE POINTS as an opportunity and not as a reason to quit. • In the opening (Engage) students will uncover their current understanding of what engineers do. This is important for comprehending the story and wrestling with the themes of the text. Students will also watch a short video on engineering. • The interactive read aloud is an excellent opportunity for students to engage in Speaking and Listening skills •

Lesson Vocabulary	Materials
Engineer, problem, proud, embarrassed, perplexed, dismayed, invention, machine	• *Rosie Revere, Engineer* Book • *What Do Engineers Do?* Probe • *What is Engineering?* video • Chart paper • Markers • Supplemental documents: Question sheet and Vocab Sheet

Engage	Meeting Students' Needs
A. What do Engineers Do? (10 minutes) • Tell students: "Today, we are going to learn how to be better engineers. Turn and Talk with a partner- What do you think engineers do?" • Have a few students share with the whole group. (Be on the lookout for partial ideas about what engineers do such as "They make things, fix things, repair things, work on cars, etc) Do NOT correct these ideas at this point. • Show students the *What do Engineers Do?* Probe. Give students the probe to answer individually. (2 minutes) • Tell students: "Now we are going to watch a video about what engineers do. Look for evidence in the video that supports an answer on the *What do Engineers Do?* Sheet. Watch the video *What is Engineering?* • Ask students: "What do engineers do?" (Solve Problems!) • Today we are going to read a story about a girl. I want you to be thinking about whether she is solving any problems and working like an engineer. Share the learning targets.	• ELLs may be unfamiliar with more vocabulary words than are mentioned in this lesson. • Check for comprehension of general words (e.g., law, peace, etc.) that most students would know.

Explore	Meeting Students' Needs
A. Interactive Read Aloud FIRST READ - Show the cover of *Rosie Revere Engineer* and read the title. – Read the text aloud without much commentary or questioning. This first read is a scaffold to help students access the text. * We learned that engineers solve problems. Is Rosie an engineer? Use detail from the text to support your answer. * Invite students to Think-Pair-Share, encouraging them to go back into the text and find the relevant details and/or the answer. – Cold call on a couple of pairs to share their thinking. Be prepared to contain the sharing to the text and the video. – Make public notes on an anchor chart "Is Rosie an Engineer?". You may want to make a t-chart for evidence that supports the claim that "Yes, she is an engineer" and "No, she is not an engineer" – Tell students that we are going to look closer at the text and then we will return to this question later.	• The first read is to help students identify the gist of the story • Reading aloud to students who cannot access the text independently helps them reach the target. • For students needing additional support and ELLs, consider providing smaller chunks of text, sometimes just a few sentences for a close read. Teachers can check in on students' thinking as they speak about their text. • Invite students to Think-Pair-Share, encouraging them to go back into the text and find the relevant details and/or the answer.

Explore (continued)	Meeting Students' Needs
B. Looking closer at the text using Text Dependent Questions • Reread the pages about Zookeeper Fred. From "The uncle she loved most was Zookeeper Fred…" to ".. and after that day kept her dreams to herself." • Ask students for a thumbs-up if they think they can tell something about what they read. Praise the thumbs-up and say: "Tell your neighbor what you think this is mostly about." • Ask students a big-picture question about this section: "Why is Rosie embarrassed?" Allow students to discuss ideas with a neighbor. Invite students to share out. Clarify as needed to ensure that students understand that Rosie is embarrassed because of Fred's laughter and knee slapping when seeing her invention. If needed, clarify the meaning of "embarrassed, perplexed, and dismayed" in this context. • Then reread the 2 pages where Great-Great-Aunt Rose laughs at Rosie's cheese copter and consoles her. From "Then Rosie heard laughter…" to "Before it crashed, Rosie…before that… it flew!" • Model for students how readers wonder to themselves about places where they are confused. Show students how you keep reading or back up and reread to fix your confusion. (This part is confusing because of Rosie's confusion in the text.) Help students understand what is happening here. • For example, ask: "I'm confused about something. Why was Great-Great Aunt Rose laughing at Rosie? And then why did Aunt Rose hug Rosie?" Model how to return to the text and determine the meaning from context. "What do the words baffled and perplexed mean?" • Finish rereading the rest of the story. Then ask your students: "What is the theme of this story?" Have students do a Turn & Talk. Listen for student responses and then do a whole group debrief in Part C below.	•

Explore	Meeting Students' Needs
C. Developing an Anchor Chart (10 minutes) • Work with students to reflect on the theme of *Rosie Revere Engineer*. Create an anchor chart with potential theme ideas and evidence from the text that supports that theme. • Tell students, "This year when we are doing some engineering, what do we want to remember from this book that will help us to work together effectively?" (You may decide to make an anchor chart of these ideas OR add to the existing anchor chart) • OPTIONAL- Direct students to write a letter of advice to themselves in the future. What advice do you have for working successfully as an engineer?	• Anchor charts provide a visual cue to students about what to do when you ask them to work independently. They also serve as note-catchers when the class is co-constructing ideas.
EXTRA Text-Dependent Questions • The word *perplexed* means confused. Why was Rosie perplexed when her Aunt Rose "hugged her, and kissed her, and started to cry"? • The word *flop* means a failure. What does the author mean when she says, "Your brilliant first flop was a raging success!" • The book ends with the sentence, "With each perfect failure, they all stand and cheer, but none quite as loudly as Rosie Revere." • The book starts with Rosie being shy and "not daring to speak". What events in the book led to Rosie changing so much by the end?	• Use these questions to dig deeper into the text depending on your time and student engagement.

Explain	Meeting Students' Needs
A. Revisiting Engineering (15 minutes) • Ask students, "What do engineers do?" (Solve problems!!!) • Tell students, "Now you are going to answer an important question- Is Rosie Revere actually an engineer in the story? Use the anchor charts and our discussions to help you write an answer." • Tell them that they will continue to learn about engineering this year and will have several opportunities to solve problems.	• Developing self-assessment and reflection supports all learners, but research shows it supports struggling learners most. • Provide ELLs with a sentence starter to aid in language production. For example: "I think Rosie is an engineer because _____."

EXTEND (Optional)	Meeting Students' Needs
A. **Engineering Design Challenge** The best option would be to engage in an existing Engineering Design Challenge from your instructional materials such as: • Designing an electro magnet that lifts paper clips from Magnetism and Electricity • Designing a "burglar alarm" on a binder that triggers when the binder is open from Magnetism and Electricity • Design a playground using **Bridges in Mathematics** Grade 4 Unit 8 Playground Design You may also engage in a "stand-alone" Engineering Design Challenge such as: • The Marshmallow Challenge • The Paper Tower Challenge • Rosie Revere Engineer Copter Challenge B. **Paired Reading: Informational Text** *Girls Think of Everything* by Catherine Thimmesh p. 47-50 on Becky Schroeder who invented glow in the dark paper.	• Sometimes struggling students will be more successful during engineering design challenges than during other academic content. Make sure to make a space for them to be successful… and be prepared for some of your academically successful students to struggle a bit with a more open/unstructured task. • Pairing informational text can help prepare students for SBAC assessment tasks. • Paired readings are selected to highlight women/girls in engineering.

Grade 4: *Rosie Revere, Engineer*
Supporting Materials

Overview and Background Information on Engineering in the Next Generation Science Standards

The following information provides background on Engineering Design in the Next Generation Science Standards. You are not expected to teach all of these ideas using this one picture book! This information is here for your own understanding as a teacher. The text, ***Rosie Revere, Engineer*** provides an excellent way to teach students about the importance of effective collaboration and grit. These skills can sometimes get "buried" in the actual standards documents but they are crucial to success in effective engineering problem solving.

Important Terminology and Text from Appendix I of NGSS

Technology: *we broadly use the term "technology" to include all types of human-made systems and processes—not in the limited sense often used in schools that equates technology with modern computational and communications devices. Technologies result when engineers apply their understanding of the natural world and of human behavior to design ways to satisfy human needs and wants.*

Engineering: *We use the term "engineering" in a very broad sense to mean any engagement in a systematic practice of design to achieve solutions to particular human problems.*

Science: *is generally taken to mean the traditional natural sciences: physics, chemistry, biology, and (more recently) earth, space, and environmental sciences*

Engineering Design in the Framework

The term "engineering design" has replaced the older term "technological design," consistent with the definition of engineering as a systematic practice for solving problems, and technology as the result of that practice. According to the Framework: "From a teaching and learning point of view, it is the iterative cycle of design that offers the greatest potential for applying science knowledge in the classroom and engaging in engineering practices" (NRC 2012, pp. 201-2). The Framework recommends that students explicitly learn how to engage in engineering design practices to solve problems.

The Framework also projects a vision of engineering design in the science curriculum, and of what students can accomplish from early school years to high school:

> *In some ways, children are natural engineers. They spontaneously build sand castles, dollhouses, and hamster enclosures, and they use a variety of tools and materials for their own playful purposes. …Children's capabilities to design structures can then be enhanced by having them pay attention to points of failure and asking them to create and test redesigns of the bridge so that it is stronger. (NRC, 2012, p. 70).*

By the time these students leave high school, they can "undertake more complex engineering design projects related to major global, national, or local issues" (NRC, 2012, p. 71). The core idea of engineering design includes three component ideas:

3 Components of Engineering Design:

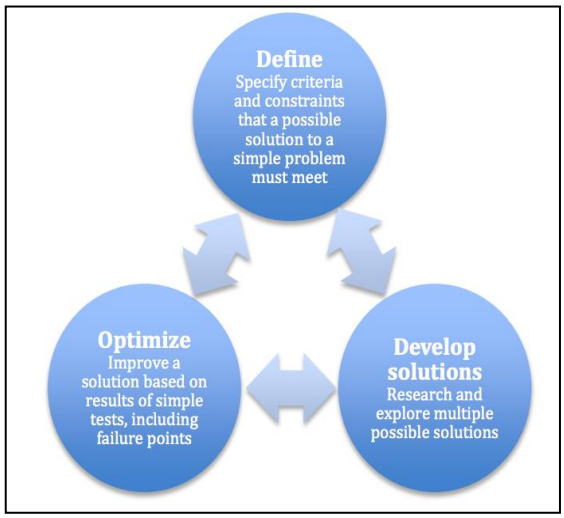
A. **Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.

B. **Designing solutions to engineering problems** begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.

C. **Optimizing the design solution** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important.

Engineering Design in Grades 3-5

At the upper elementary grades, engineering design engages students in more formalized problem solving. Students define a problem using criteria for success and constraints or limits of possible solutions. Students research and consider multiple possible solutions to a given problem. Generating and testing solutions also becomes more rigorous as the students learn to optimize solutions by revising them several times to obtain the best possible design.



Engineering Design as Core Ideas 3-5 (ETS)

____ **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

____ **3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

____ **3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

NGSS Performance Expectations with Engineering connections

(There are 6 PEs with engineering connections in grades 3-5)

____ 3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.

____ 3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

____ 3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

____ 4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

____ 4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.

____ 4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Word/Phrase	Definition	This helps me know what this word means …	Connections to *Engineering*
engineer			
problem			
proud			
embarrassed			
perplexed			

Word/Phrase	Definition	This helps me know what this word means …	Connections to *Engineering*
dismayed			
invention			
machine			

***Rosie Revere Engineer* Journal**

Questions

1. What do engineers do? (Use evidence from the video you watched to support your answer.

2. What is the theme of the book, *Rosie Revere Engineer*?

3. Is Rosie Revere actually an engineer? Use specific details from the story to support your answer.

What Do Engineers Do?

Which of the following is the best description of what engineers do?

_____ Engineers solve problems

_____ Engineers make things

_____ Engineers invent new products

_____ Engineers fix machines

_____ Engineers do experiments

_____ Engineers build bridges and airplanes

_____ Engineers drive trains

Describe your thinking. Provide an explanation for your answer.