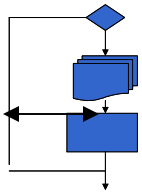
Listen to the characters and the story speak …
Creating Engineering Design Challenges

Item	Discussion
Creating an environment of learning  ***Teacher must become the guide in helping students learn "how to learn on their own"*** ***All students can learn … But not on the same day and not in the same way***	As facilitators and leaders of the classroom, we must foster an environment of learning and risk taking. Our culture should be of the habit of mind that emphases curiosity and persistence. Deep questions drive our thought underneath the surface of things, force us to deal with complexity. As teachers we should focus on strategic thinking and explicit instruction via modeling, practice and application. Nurturing thoughtful, skeptical, curious and thinking students. Foster the following thoughts: • Design work is never finished. It is a cycle of continuous improvement. • Each step of the design process is about exploring, generating ideas, and selecting ideas. • Thinking skills are the tools of engineers. Questions are at the heart of exploring. • Fail often in order to succeed sooner.
Based on *Thinking skills are the tools of engineers. Questions are at the heart of exploring.*	**Engineers design useful products and process for society based on science and mathematics.** *…Design Education encourages your students to see themselves as designers in their own right as they engage in the design process through active observation, critical discussion, the act of making, visual communication and presentation, and critique. The project-based focus of design is a great method of reinforcing teamwork and collaboration. Design also allows for multiple methods of problem solving—a seamless way to differentiate instruction…* **Cooper-Hewitt's Educators' Resource Center**
Skills needed	The students should be familiar with the role of an engineer, the design process, the science and math standards required for their grade level, and the skillful thinking process.
Teachers as thinkers and learners	Teachers should model their own thinking as an engineer when discussing the literature and support students to think when they read or act in teams as an engineer. They should model a common language and vocabulary of engineering when interacting with the students. Our questions should be said "out-loud" to show

Encourage children (and adults) to: • Look at things differently • Think divergently • Think creatively • Brainstorm ideas • Listen to others' ideas • Share their ideas • Be organized	students we are learners as well. **The KWL strategy** (Ogle, 1986): What do you know? What do you want to know? What have you learned? Serves to structure students' learning about a new topic and is a widely used learning routine in classrooms throughout the world. It is also a thinking routine since it activates prior knowledge, engages curiosity, and prompts reflection. They look for opportunities for student thoughtfulness. They use thinking routines to support and nurture students thinking. They model and make their own thinking visible, and they send clear expectations about the importance and role of thinking in learning. We refer to these components—language, environment, opportunities, routines, modeling, and expectations—as cultural forces. These forces, shape a classroom and a school to give it its unique feel
Starts with viewing through the "Engineering Lens"	The students and teachers should focus on thinking like an engineer when reading the literature. Questions of the story line, author and characters around the design of a product or process for society should be the instrument to begin. We should invite them to ask creative questions, make diverse observations, explore multiple viewpoints, and seek personal connections of the literature.
Documenting our thinking *organization of the notebook provides a quick retrieval of information*	We leave tracks of our thinking in our engineering note book and on post-it in our literature. We might record our questions, confusions, thoughts; highlight unfamiliar words or just something we want to remember. Our teams and class should construct a record of our thinking in creating the design for our literature to remember the process. This connects past learning and teaching to future teaching and learning. Sketches and drawing are important to record our ideas. Outline course material and identify where the text and lecture overlap and don't overlap. This will give you a starting point in developing connections between ideas presented in two different contexts. Make charts, diagrams, or tables of important concepts. A flow chart or a tree diagram may help you understand how different ideas fit together. Paraphrase and summarize important information. Use your own words to describe the material covered during lecture or in assigned reading. Pretend you're the teacher and are trying to figure out how each topic or question relates to each others. What are the connections between what you've heard in read in the textbook, or learned from your own experiences?

Key questions
Areas to probe:

- The geography, weather, culture, or history of the book's setting
- information about the author — her/his life and other works
- information about the time period portrayed in the book

Deep questions drive our thought underneath the surface of things, force us to deal with complexity.

Our students should start with questions that connect to the story or the characters. These questions can be:

- Based on your listening to the characters, what product could they use to make them better?, wiser? …
- What problems do the characters have that we can develop a product or process to help them?
- What item is mentioned in the story that we can design a better device for the story?
- What activity or item that focuses around science (habitant, weather, energy, materials) can we design a device to change or enhance the story?
- What science are we going to learn and can we connect it to our story?
- What events are happening that we can focus on?

Instead, students need questions to turn on their intellectual engines and they need to generate questions from our questions to get their thinking to go somewhere. Thinking is of no use unless it goes somewhere, and again, the questions we ask determine where our thinking goes.

Questions of purpose force us to define our task.
Questions of information force us to look at our sources of information as well as at the quality of our information.
Questions of interpretation force us to examine how we are organizing or giving meaning to information.
Questions of assumption force us to examine what we are taking for granted.
Questions of implication force us to follow out where our thinking is going.
Questions of point of view force us to examine our point of view and to consider other relevant points of view.
Questions of relevance force us to discriminate what does and what does not bear on a question.
Questions of accuracy force us to evaluate and test for truth and correctness.
Questions of precision force us to give details and be specific.
Questions of consistency force us to examine our thinking for contradictions.
Questions of logic force us to consider how we are putting the whole of our thought together, to make sure that it all adds up and makes sense within a reasonable system of some kind.

- Have students listen to their inner conversations and keep track of their thinking as they read.
- Use questions to clarify unfamiliar ideas and discover new information.
- use context clues and text evidence to crack open the new

	concepts and vocabulary
think-aloud strategy	Model for students the "think-aloud strategy" to help the students focus and identify design challenges in the story
	"Reading comprehension occurs when readers engage in an inner conversation with the text, merge their thinking with it, ask questions, infer, think about what's important, and summarize and synthesize." ***Stephanie Harvey and Anne Goudvis***

Exercises to find Design Challenges in the story

SEE-THINK-WONDER 1. What do you see? 2. What do you think about that? 3. What does it make you wonder?	THINK-PUZZLE-EXPLORE 1. What do you think you know about this topic? 2. What questions or puzzles do you have? 3. What does the topic make you want to explore?
"**What makes you say that?"** ·Claim / Support / Question ·Think Pair Share	

I SEE / I THINK / I WONDER

A routine for exploring literature to find design challenges and other interesting things

1. What do you think you know about this item in the story?
2. What questions or puzzles do you have?
3. What does the Literature or topic make you want to explore ?

WHAT KIND OF THINKING DOES THIS ROUTINE ENCOURAGE?

This routine helps student make careful observations and thoughtful interpretations; to stimulate curiosity and set the stage for inquiry.

WHEN AND WHERE CAN IT BE USED?

Use this routine when you want students to think carefully about why changes are occurring that could lead to a design challenge for a character in the story.

WHAT ARE SOME TIPS FOR STARTING AND USING THIS ROUTINE?

Ask students to make an observation about this portion of the story and follow up with what they think might be going on or what they think this observation might be. Encourage students to back up their interpretation with reasons. Ask the students to think about what this makes them wonder about what's happening at this point in the story.

The routine works best when a student responds by using the three stems together at the same time, i.e., "*I see…, I think…, I wonder ….* " However, you may find that students begin by using one stem at a time, and that you need to scaffold each response with a follow up question for the next stem. The routine works well in a group discussion but in some cases you may want to have students carry out the routine individually on paper or in their heads before sharing them out as a class. Student responses to the routine can be written down and recorded so that a class chart of observations, interpretations and wonderings are listed for all to see and return to during the course of study.

1. What do you see?
2. What do you think about that?
3. What does it make you wonder?

This routine is adapted from the Visible Thinking project, Harvard Project Zero.