

Course Title: **The Missing Link: Using Engineering Design and Thinking Skills to Connect Literature, Science, and Math**

Dates & Times: July 20 & 21, 8:30-3:30

Instructors: Karen DeRusha, MED, William Wolfson, BSEE, MS

Contact Information: kderusha@comcast.net
billw@engineeringlens.org

Course values: (Our expectations for how the participants should approach this Learning):

Excitement	Continuous learning	Playfulness
Enthusiasm	Renewal/ Celebration	Trust/ Integrity
Encourage Constructive Dissent	Respect	Learning through mistakes
Risk taking	Collaboration	Innovation

Description: Engineering need not "stand alone" in the curriculum; indeed, it can and should leverage existing curricular elements -- in particular literature! This workshop will offer hands-on opportunities for Educators to explore practical ways to use engineering design and thinking skills to enrich the study of literature, science, and mathematics. In this curricular approach students respond to literature through engineering design projects by identifying needs that the characters have, by identifying multiple possible solutions, and by exploring and refining those solutions through prototyping and revision. For example, kindergarteners might respond to The Three Little Pigs by designing a house for one of the little pigs (or perhaps a means of blowing down a house for the wolf!); fifth graders might respond to the book Island of the Blue Dolphins by identifying needs and solutions for Karana, the marooned main character of the novel.

Creative and critical thinking, meta-cognitive reflection, and questioning are the tools for a project-based learning environment to engage children and make learning relevant. While learning about engineering as defined in the frameworks, participants will practice strategies to build creative, collaborative, and community-minded classrooms of the 21st century.

Objectives:

By the end of this course, participants will be able to:

- Explain the relationship between science and technology/engineering.
- Provide examples of the types of tasks that engineers perform.
- Describe the steps of the engineering design process.
- Show the connection between thinking skills and engineering.
- Create a lesson plan(s) that will excite and engage children in activities that integrate the engineering curriculum framework requirements with literature, math, and science

Technology/Engineering Standards:

- Identify materials used to accomplish a design task based on specific properties.
- Identify appropriate materials and tools to construct a prototype safely.
- Identify problems that reflect the need for shelter, storage, or convenience.

- Describe different ways to represent a problem.
- Identify relevant design features for building a prototype of a solution to a problem.

Literacy Standards:

- Recount stories and determine their central message, moral, or lesson.
- Describe how characters in a story respond to major events and challenges.
- Identify elements of fiction (e.g. characters, setting, plot, problem, solution).
- Engage effectively in a range of collaborative discussions.
- Report on a topic, sequencing ideas logically and using appropriate facts and descriptive relevant details to support main ideas.
- Speak clearly at an understandable pace.

Course Requirements:

For PDPs... Students will create a simple outline that lists the chosen book, possible design challenges and a sequence of at least 3 to 4 lessons, including a possible connection to the science curriculum. Please submit electronically to Bill and Karen. Outline is due on August 4.

For one credit ... Using the planning format provided, students will plan a sequence of at least four lessons that include strategies taught in class and may require the solution to connect to science curriculum. These four Lesson will share the common planning needs to include:

- Learning goals
- Frameworks addressed (including science curriculum connection when relevant)
- Prior knowledge
- Vocabulary specific to design process
- Materials, including a brief description of the piece of literature to be used
- Procedure:
 - At least one strategy from the following steps of the design process: Priming, generative thinking, convergent thinking, defining. (See “Task Flow Map)
 - Specific thinking skills that will be emphasized (such as creative and critical thinking, analyzing, synthesizing, metacognitive thinking)
- Proposed method of assessing children’s learning

You may use or refer to the planning template. Please submit electronically to Bill and Karen. Lesson planning is due on August 4.

Course Expectations – Students are expected to participate actively in discussions, group work, and reflections.

Grading Criteria: - Students will be assessed based on classroom activities and their personal effort. Major breakdown of the criteria are shown below:

Activity	Description	% of total
Individual assignments	This includes developing lesson plans.	50
Team work	Ability to work with others, communicate effectively, and give and receive constructive feedback.	20
Classroom discussion	Whole class discussions and reflections	15
Supporting a learning environment	This measures the attitude of the individual in making suggestions, taking risks in activities, and supporting the learning atmosphere.	15

Course session	Topic	Activities/Learning
Day 1 Morning	<p>Understanding of the engineering discipline.</p> <p>Engineer Career(discipline):</p> <ul style="list-style-type: none"> • Engineer • Senior Engineer • Principal Engineer • Chief Engineer <p>Project Engineer Test Engineer Component Engineer Product Engineer Industrial Engineer Quality engineer Manufacturing Engineer Software designer Service Manager/Engineer Application Engineer Sales Engineer</p>	<p>What do engineers do? Draw an engineer Discuss stereotypes Definition of an engineer What do scientists and mathematicians do? Strand 4 Science Framework Venn diagram: science, engineering, technology Mass Framework/ what's missing</p> <p>Engineering Products Engineering is all around us. Participants evaluate different types of household products to see how engineering is used to design and build them. Group reflection: <i>how can this activity be adapted to do with children?</i></p>
	<p>The missing link ... Engineering design and thinking skills</p>	<p>Explain flow maps of the design process from the MA Framework and how thinking skills are the tools of engineering</p>
Day 1 Afternoon	<p>Engineering/literature connection with <i>The Three Pigs</i> (Tie to the Framework)</p> <p>Story mapping Problem framing Brain-Writing Shaping Decision making</p>	<p>Finding the Design Challenge: Table groups review story and begin to generate a list of characters' needs/problems (decide to "work for" the pigs, society, or the wolf) Connection to Literacy ... Story Maps Constraints ... Science connection Generative portion: Using creative thinking, develop many possible solutions Convergent Portion: Using critical thinking, converge on a few best ideas for solutions. Defining: Create Gallery sketches of the two solutions. Table sharing: Teams share gallery sketches of solutions, including science and math connections.</p>

<p>Day 2 Morning</p>	<p>Engineering/literature connection with <i>Owl Moon</i></p> <p>Story mapping Characters' values Questioning Problem framing Brain-Writing Shaping Decision making</p>	<p>Repeat the strategies learned on Day 1, with the addition of characters' values and targeted questioning.</p>
<p>Day 2 Afternoon</p>		<p>Table groups build solutions generated for <i>Owl Moon</i> (time permitting)</p>
	<p>Follow-up assignments</p>	<p>Class discussion about components of lesson plans and expectations for follow-up assignments. Sample lesson plan. Discuss qualities of literature suitable for finding design challenges.</p>
	<p>21st Century Skills</p>	<p>Brief discussion of 21st Century Skills and how the interdisciplinary, collaborative process they have just used in class is representative of 21st Century Skills.</p>
	<p>Reflection</p>	

Rubric:

Rubric for our assignments:				
	(1)	(2)	(3)	(4)
	Beginner	Basic	Proficient	Expert
Assessment Outcomes	Little or no evidence of the outcome	Beginning of or some evidence of the outcome	Detailed and consistent evidence of the outcome	Highly creative, inventive, mature presence of outcome
Supporting a learning environment	Shows minimal interest in class activities	Shows interest in activities and evidence of some understanding of thinking strategies	Engaged in activities and shows good understanding of thinking strategies; beginning to adapt strategies to lesson planning	Very engaged in activities; shows strong understanding of thinking strategies and how to adapt them to lesson planning
Classroom Participation	Participates infrequently	Participates sometimes; makes appropriate contributions to discussions and activities	Participates frequently; adds value to discussions and activities	Participates frequently; makes strong connections to topics and extends thinking beyond what is presented
Individual assignment	Assignment is completed; quality varies	Assignment completed; meets requirements	Assignment completed thoughtfully and completely	Assignment completed thoughtfully; includes innovative and original thinking
Team work	Participates marginally	Participates sometimes; makes appropriate contributions to group work	Participates consistently; adds value to group work	Participates consistently; pushes group to extend thinking beyond what is presented