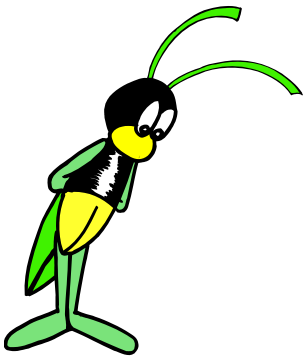
WHAT REALLY BUGS' ME

Problem Finding & Solving



Submitted by:

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New Book … What BUGs me

Early Book for 3-5th grade readers

Title: What really bugs me!

Concept: Starting from a problem (BUG), a group of friends learn how to solve the problem and create a design solution for it.

Learning outcome:

Children will understand the vocabulary of creative problem solving and doing a design. They should be able to draw a flow map of the process and create a sketch of their design.

Visual: pictures and the book should look like a student's notebook. Have pictures that look like drawing done by the owner of the notebook. Drawing of what his/her friends look like, some changes that reflect trying something and them changing based on the outcome.

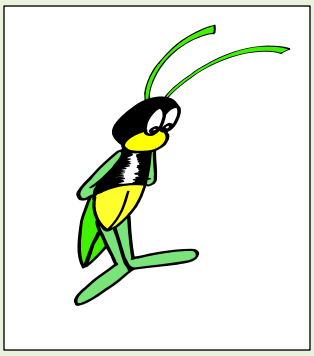
The Beginning of being an Innovative person in life

Audience: Students.. Parents. Teachers

Outline:

A group of kids that get together after school each day at the park, one of them starts an exciting adventure when he talks about what "Bugs him". What was the problem that appeared? Did other children have BUGs of their own?

- Discovery /Beginning
- Research
- Forming a learning team
- Framing the problem
- Developing the requirements
- Brainstorming many solutions
- Narrowing and Deciding



9/30/2025
There is an organization called The New England Society for Children's book writers and illustrators. NE SCWBI
It might be helpful to look at their website and offerings (Events, seminars, advice about publishing. They can be a resource for how to reach agents and editors at various publishers).

https://www.scbwi.org/regions/newengland
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont (New England) – SCBWI

Elly

Eleanor Rubin
ELEANOR RUBIN: DREAMS OF REPAIR (CHARTA 2011)
http://ellyrubinjournal.typepad.com
http://www.ellyrubin.com

Discovery/Beginning:

It was a rainy afternoon that found the group of friends under an overhang at the school playground. The rain came down quickly with large drops that stopped their game. The drops made a nice sound on the metal roof above the group but that did not stop the disappointment in the group that they had to stop playing . The sound made it exciting and the cool breeze felt nice after all that running during the game, but something was not right.

Matthew was the first to speak. "**This really BUGs me** when this happens. I just don't like to stop in the middle of a game when you don't expect it".

Hannah spoke up and said "I haven't heard that word before; what does it mean; where did you learn it". I think my mother uses it a lot at the engineering company she works at. It is a problem you have that needs to be solved. My father says he had to learn some new vocabulary words to talk to my mother, but I guess that happens with any job. Well in that case, Hannah said, "I also have a BUG". "I always have a problem with my alarm clock because I don't know what time it's set to ring". Then Cal said, "that his BUG is taking off his shoes at the door of his house".

Research:

Everybody started to talk about their BUGs. When it quieted down, Matthew said “we ought to speak to Mr. Lu at school to discuss with him what we should do about all these BUGs”.
It was fortunate that they all were in Mr. Lu’s Literacy class at school. The first day they were free to talk, the group approach Mr. Lu and discussed how they all had Bugs’ and asked him what they should do about it. He asked the group if he could have some time to think about what they said and discuss it next week. But, in the meantime, Mr. Lu suggested that each keep a notebook with them at all times and jot down when something bothered them or was a new experience. This way each of them, over the next week, will come up with few items that they can share. Elizabeth thought this was a neat idea because she likes to keep notes about what interesting things she does. The other day she remembered that she learned to skip rope with Dahlia and how much fun it was. It was like her special vault where you can look back and recall interesting points in her life.

Mr. Lu thought about what just happened after the group left his room. He felt proud of his students for taking the initiative to bring him their thoughts. He was excited to support them in their quest about solving problems. It brought memories of when he was young and exploring things in Literature. He remembered how he would find characters in books that had problems that he liked to help by solving their problem. As he grow older, he saw that the process of Innovation in our society was very much like finding problems and coming up with solutions.
He founa the excitement of picking a character he wanted to help with in the story gave him more interest in reading the book. He even got some of his friends who liked the same caricature in the story to work with him in finding the problem the caricature had and help solve it. Why wasn’t these bugs his students are finding like the problems the character faced in the story? Mr. Lu decided that he would find his notes on the stories he read to share with his students.

Forming the Team:

During the following week, the group could not wait to update their book and to see Mr. Lu. The group agreed to become the "BUG team" and work together like they do on their sports team. They agreed to make Matthew their leader and be more responsive to each other and make up a list of one BUG from each of them and pass it to all for review.

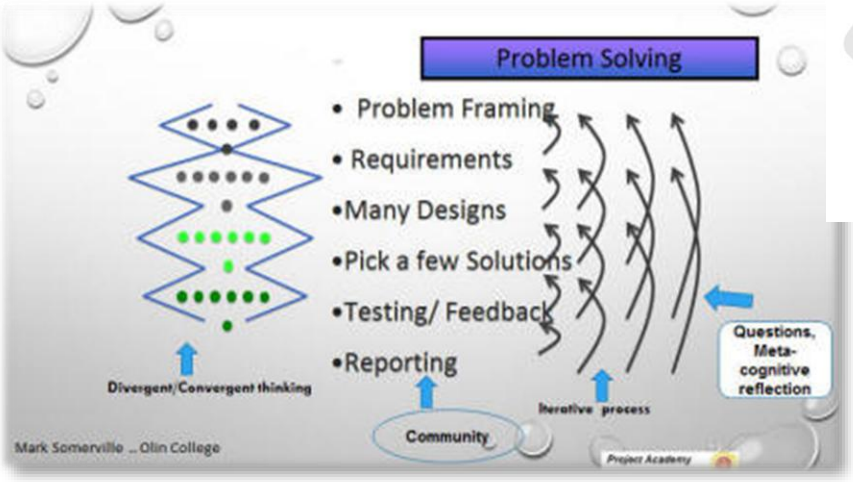
Changing from a sports team to a problem-solving team

- How is a sports team and problem-solving team similar?
- What agreements we need to make?
- What are our values and norms?
- What is our goal?
- How do we use questions in our process of working as a team?
- How do we treat our relationship with others?

The Team

		? 	
Emma	Dahlia	Matthew	Hannah
			
Elizabeth	Cal	Madeline	

Problem-Solving Process:



Add about the problem solving is a process (series of steps) it is iterative and each step has both divergent and convergent thinking

Look up the words

Elizabeth decided that she wanted to record the history of the groups venture with this BUG thing. She recorded in her journal the list the group came up with.

Name	Main BUG
Matthew	Stopping in the middle of a sports game
Emma	Wants a list of clothes to wear based on her mood when she gets up in the morning
Cal	having to take off his shoes at the door of his house
Dahlia	My juice box is warm when I take it out of my lunch box
Elizabeth	The first part of climbing a tree is difficult. I want to make it easy to climb the tree.
Madeline	The baby chicks from my brother's room come into my room
Hannah	I have a problem with my alarm clock because I don't know what time it's set to ring

With this list, They were even more excited to talk to Mr. Lu about want is next for them.

“Can you think of exciting, or silly ways to solve these BUG’s of your friends?”, asked Mr. Lu.
First, I found out where the use of the word bug came to be for a problem Mr. Lu said. It happened many years ago when a piece of equipment failed when Engineers tried to do a test. They first thoughts that a real bug got into the equipment and that made it fail. So, from then on, Engineers called problems BUGs.

From this list we should decide which BUG we will work on. Mr. Lu thought about his youth growing up in Taiwan and how he had a group of friends that did things together. Was his group as collaborative as this group he wondered?
The team were excited to work together to create more possible solutions and build on ideas that others have. Many times, when I hear an idea from one of our friends, it makes me think of another possible solution. They took the list of BUGs and added a discussion column to add more detail to help them sort which BUG to work on.

We have to be careful to understand what problem the person is really having before we rush to solve the issue.

The group went off that week to look at all the BUGs and see what they can modify any to make it more common. The group agreed to pick one BUG to work on that seem to fit the groups need.

List of BUGs with discussion:

Person	Main BUG	Discussion
Matthew:	An unplanned stoppage in a game	Not everybody is bothered by this.
Emma:	List of clothes to wear based on your mood when you wake up	Everybody could see the use of this
Cal:	having to take off his shoes at the door of his house	Some mothers do not do this
Dahlia:	My juice box is warm when I take it out of my lunch box	We all bring juice to school

Person	Main BUG	Discussion
Elizabeth:	The first part of climbing a tree is difficult. Make it easy to climb the tree.	A real problem for all
Madeline:	The baby chicks from my brothers room come into my room	A problem for Madeline but not anybody else. Group says she should close her door.
Hannah:	has a problem with her alarm clock because she does not know what time it's set to ring	Is a good problem but most of us don't use an alarm clock.

It came down to two (2) BUGs that the group felt that they would like to work on. They decided to do the juice problem first as some of the team felt that designing a method to climb a tree might not be appreciated by their mothers or fathers.

Add more items about being a team, I.E What are our goals, Listening more to each other.

Framing the problem: Starting the Design effort … Framing (Defining) the problem

The friends got together after Mr. Lu's class to discuss what they were going to do about solving the issue of keeping the juice cool.

Mr. Lu saw the group discussing their next steps and suggested they follow a simple creative problem solving process. It starts with knowing what problem you are solving, finding lots of possibilities, narrowing the possibilities and then design and testing your solution. He thought to himself how he was inspired by Albert Einstein, the physicist, who said it is very important to spend the time on problem framing (what is the real problem) before you rush to finding solutions. "How do we state the problem" said Cal. 'Can we freeze the juice as a solution' asked Elizabeth? 'Will freezing the juice cause problems with the juice container or damage the juice'? Asked Elizabeth. 'How long does it have to last being cool' wondered Madeline. It seems that there were lots of things the group needed to discuss to decide on the specific problem before they worked on solutions. 'Is there

something that we can buy in the store to solve the problem" said Madeline again.
Matthew said, "Many times we go and try to find a fix (solution) to what we think the problem (Bug) is but it is not the right answer". "Let me give you an example of what happened with me last year. I told my father that I was lonely, being a great dad, he went off and tried to solve the problem by organizing a few play dates for me. Although they were fun, I still felt the same. My mother asked me some questions and it comes out that my being lonely was really I wanted to find some friends that had the same interests as me to play with". "But how do we do this;" said Hannah?

Everyone looked at each other when Emma said, "maybe we can use questions to ask Dahlia about her Bug to see if there is something else that is the real problem". "That is a great idea" said Hannah. I want to go First!!! She thought for a minute … "So Dahlia, you said that your juice box is warm when you go to drink it with your lunch? Is that the problem"? (Clarifying the problem) "
Yes when I put the straw into the juice box it is warm", said Dahlia. "Does it make a difference what type of juice it is" asked Elizabeth. "No" say Dahlia. Matthew then summarized the facts we know (…presenting the facts of the case):

- It happens between when her mother packs the juice box and when she has it in school for lunch.
- The juice does not taste good warm.

"What does warm mean" asked Emma? Is it a certain temperature? Shouldn't we know it so we can test our solution. Also, how long is the time between packing the lunch box and lunch time. Matthew then said "we have lots of questions such as the temperature of the day and its effect on the juice. What about the initial temperature of the juice, how does that effect the final temperature"? We need to create a **list of Requirements that we want our solution to meet.** This will be how we measure the different solutions we come up with.

Developing the Requirements

Then Cal broke the spell when he said "what's the big deal, just drink water from the cold water fountain" When Mr. Lu heard the story, he thought of the word "**Empathy … Walking in someone shoes"** that Cal did not display. We have to listen to others when we look for reasons. Mr. Lu

thought this was not only important in problem solving but in living your life. A good lesson to learn. He decided to discuss with the students to have them discuss and learn life-skills a part of the Bug process as an important skill for them. How to do this he wondered?

Add a few more values

Everyone agreed that they now had a problem to solve and they would do it together the next time they meet. They agreed that the problem or bug they had to solve was " **How to prevent the juice box from getting to a certain temperature by 12PM starting at a temperature= () at time ?** They felt it was important to express it as a question. It was couple of days before they met again was exciting for many of the team. Ideas would pop into their heads at all times. One of the groups, Madeline even went and used her note book to capture her ideas because she was forgetting some of the good ones.

At school, they all agreed to meet at Dahlia house to try and come up with a list of possible fits. Dahlia said "she would see Mr. Liu and ask him what they could do to get lots of ideas to fits the problem".

Picture:

Finding lots of potential solutions…

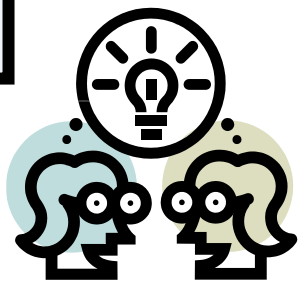
When they meet, Dahlia told the group what Mr. Lu had said to her. "He explained about Brain Storming and Brain-Writing as a way to get good ideas". Mr. Lu "said that each of these methods could help us get many potential ideas". He said "that to do it right, we had to follow some rules". The rules weren't hard to follow but we had to do it. The rules were:

Rule 1: Postpone and withhold your judgment of ideas

Rule 2: Encourage wild and magical ideas

Rule 3: Lots of ideas counts at this stage, not how good they are

Rule 4: Build on the ideas put forward by others



No idea was bad/wrong and we should not judge what each of us said when we gather the possible solutions to the problem. We should not be limited in our ideas but think magical about possible solutions. Also we should look for quantity and not worry about being right or the best idea. We should try to build on ideas from each other and all of us had equal worth. This sounded like some good advice from Mr. Lu. When we brain-storm, someone writes the ideas we have and puts them up on a wall with sticky note paper.
The brain–writing was very similar to brain-storming but we wrote the ideas on a card and passed the card to the next person on our right. We would read the card and then write our idea on another card. These kept getting passed around until we reached our goal. This all sounds complicated but I think we can do it. Mr. Lu could see the excitement in the group and thought of his love of science coming from his excitement in doing experiments when he was younger. He wondered how can we keep children excited about learning. He thought that this might be the start of his group of students becoming lifelong learners. Seeking new ways in learning as they grew older.
The team decided that we need to listen more to each other and have trust in our team-mates. These are values that will help us in all our classes.

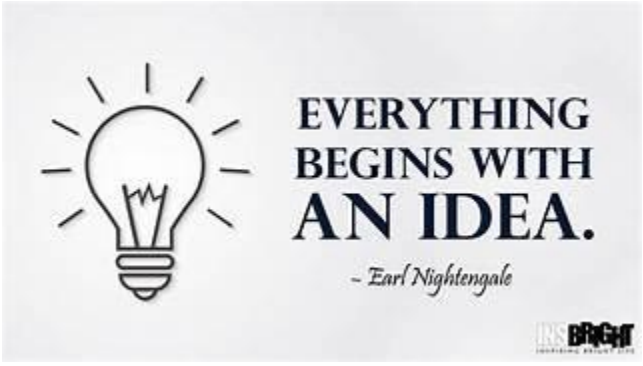
: The team got together the next afternoon after school as they were all excited about trying this out. Many of the group had some ideas and couldn't wait to tell the others. "How are we going to do this" asked Matthew? "We need some rules", said Emma who had been thinking about this said; "we need someone to be the person to write each idea on a sticky note when it's said". We should go in turn and we should put the rules up on the wall so all will see them. Hannah said "she would like to be the person to put the ideas on the sticky note as she like to spell different words". Cal said "he would like to be the person or facilitator who made sure we following the rules and our discussion followed the questioning approach". It seems to the group like when they play a game, they decide on rules and choose who is going to do what in the game

The group agreed upon the problem of the following:
How to prevent the juice box from getting warm when lunch time came about. This meant for 6 hours, assume Dahlia took her lunch at 6AM and had Lunch at 12PM. We also had to figure out what at what temperature the juice box needed to be above for Dahlia to say it was OK. Cal said he had a temperature gauge so they could measure the juice at different points to see which one was the minimum level for being OK. They agreed that they would measure a glass of juice temperature starting from the refrigerator over a 30 minute time to see at what temperature the juice was not cool enough for Dahlia. Dahlia would take a sip every 5 minutes and say if it was still cool for her. Once we have this temperature, said Matthew, we have a way of testing whether we have solved the problem. If our design keeps the juice cooler than the temperature from 6AM to 12PM, we have a solution. It is interesting, said Madeline, that by thinking about the problem, we came up with the test method to see if our design works.
Picture: Showing the test and agreeing on ?? degrees F

The group met in Dahlia's house to do the brain-storming to get lots of ideas. They reviewed the rules and started:

Build a very small refrigerator to keep the juice cold
Freeze the juice box before putting it in the lunch box
Put the lunch box in a cooler at school
Have your mother delivery the juice just before lunch
Drink cold water from the water fountain at school.
An insulating sleeve that keeps the juice cool
A straw that cools the juice when you drink thru it
Special juice box that keeps the juice at the correct temperature.
A special lunch box that keeps the juice cool using a freezing pack

Once we had the list of possible design solutions, Mr. Lu said we should discuss which one or two which best fits our needs. We should also look at combining some of them
To make a better possible solution.



Discussion around ideas

Idea	Discussion
Build a very small refrigerator to keep the juice cold	Seems too magical for the team to do
Freeze the juice box before putting it in the lunch box	Promising idea, but would the box take freezing with out breaking and would the juice be too cold?

Idea	Discussion
Put the lunch box in a cooler at school	Have to get school permission which would be difficult
Have your mother delivery the juice just before lunch	My mother works so this is out
Drink cold water from the water fountain at school.	I don't like water with my lunch
An insulating sleeve that keeps the juice cool	Sounds like a promising ideas
A straw that cools the juice when you drink thru it	Sound magical
Special juice box that keeps the juice at the correct temperature.	This would be interesting to get the juice company to design a box that does this
A special lunch box that keeps the juice cool	This could be done with an ice pack in the box

The group settled on the following two ideas to continue to work on:

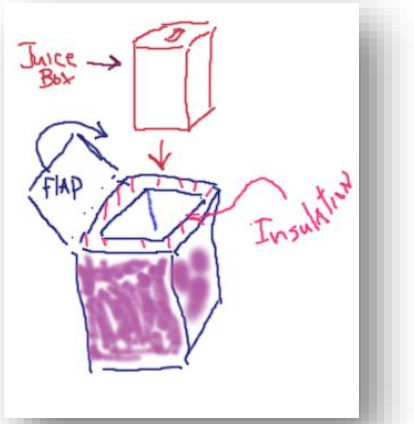
1. putting it in an insulating sleeve.
2. designing a lunch box that had space for the juice box and an ice pack.

How are we going to decide ?

Everybody was excited that they actual had two good ideas to work on. This problem solving is lots of fun and we are getting results said Matthew. But Madeline asked how do we pick which one to work on. How about if we had a list of requirements that we want for our design said Cal! Emma was confused about what a requirement was and how it applied to our activity. Matthew said that in his history class they studied how some inventors made lists of things they wanted to have for their designs. This could be like the requirements.

Dahlia thought about safety and said that could be a requirement like no sharp edges to cut your finger. Another one could be that we use ready available material and don't have to find special things to build our design. The group was cooking with ideas about requirements they need to think about for their design. This will help us when we begin our design said Matthew. They quickly came up with three more areas; it should be re-usable, Not cost lots of money and be easy to use.

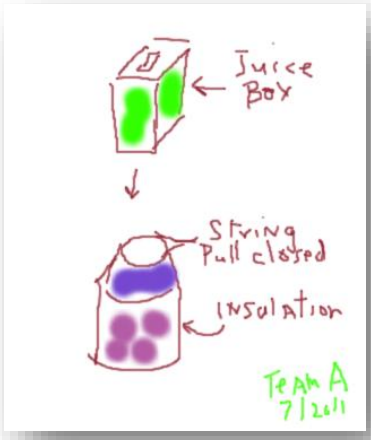
Requirement	Importance
Safety	Very important
Available material	Important
Reusable	Very Important
Cost	
Ease of use.	
Insulation	
Flexibility	



Looking over the requirements it appears that the insulating sleeve is the item we should try to design.

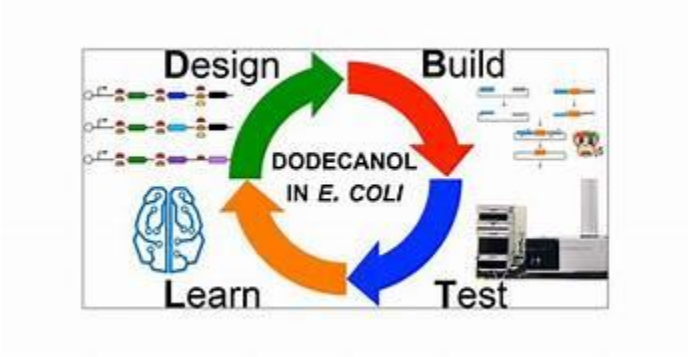
creating the blue-print "Sketch"

Mr Lu said that before we build anything we should sketch out our design with a drawing and annotation showing what things are. The group split up into two teams and created their drawings. Looking over the two concepts they seemed similar except the top cover. The group agreed that a string closure was the best approach. They need to figure out the insulation for the product.



The group was very proud of their sketches and all wanted to bring home a copy to show their parents. Mr Lu was also impressed. He noted that it would be good to date the sketches and sign our names on the paper. This way we have a record of the time and who did the work. Also, when we have to change our drawing, we would put a new date so we had a record of the history of the design.

Design, Build and Test



Elizabeth said her mother did a lot of sewing and they might have fabric and insulating material for the group to build its' product. We ought to think about a list of materials we would need to do this project, Emma said. Madeline took her notebook and started to create a list of materials. We will need fabric, insulation material, glue, string, seizers, a temperature meter, and a clock. What makes an insulator good or bad? "Do we have the measurements for the juice box that we can give to my mother" asked Elizabeth. I think we need some buttons to add a little style said Emma who always was thinking of her moods and its effort on her dress. "How are we going to know if it works" said Matthew? Cal said that after they build the first version, they would get a juice box and put it in the refrigerator for a day and then put it in the case they designed. Every hour they would measure the temperature of the juice box in the case to see how it stays cool. Emma asked what things we have to worry about to make the test true to real life? If it's a hot day, that would affect the juice box temperature versus being a cold day for school. "Do we know what temperature is cool?" Asked Emma

Testing and reporting

Matthew said that they should break up into three teams and get the following information:

- What temperature is it when it goes from being cool to warm?
- What are the measurements for the thermal sleeve?
- What is the ambient temperature that we should use when we test the sleeve?

Making our presentation to Mr. Lu and other teachers:

Matthews father had given us an outline for the presentation. It was from his mother that they used in her company to sell ideas to others. They call it

the elevator speech in that you need to make it short and has all the important things to cover.

- Intro-About us
- Problem you are solving
- Product/Services you are providing
- Uniqueness
- Benefits
- Summary/Next steps

Constraints on the story:

1. Each page has to create some suspense that is answered by the next page
2. Need to develop a vocabulary (highlighted words) of key words in the story
3. Need to ask **Bloom higher order** thinking questions around the story.
4. Picture on the page that shows where this fits into the total picture. (like a road map)
5. A game the students can play around the theme.
6. Less than 40 pages (text plus picture)= 20 text pages
7. Teacher's templates, examples
8. Poem or other literacy activities

Additional items:

Page: Vocabulary
Page: Higher order thinking questions
Page: Reflection
Page: Games
Create your own list of what bugs you

Flow map of the Problem-Solving Process

Review of Book:

BLOOM'S REVISED TAXONOMY

Using the updated **Bloom Taxonomy,** we can create questions around the 6 levels, starting from the lowest level to the higher order thinking skill:

Elements	Verbs	Questions
Creating Generating new ideas, products, or ways of viewing things	Designing, constructing, planning, producing, inventing.	Compose an engineering song, skit, and poem or rap to convey the story in a new form.
Evaluating Justifying a decision or course of action	Checking, hypothesising, critiquing, experimenting, judging	Assess whether or not you think this really happened.
Analysing Breaking information into parts to explore understandings and relationships	Comparing, organising, deconstructing, interrogating, finding	Differentiate between how the child reacted and how you would react in each story event.
Applying Using information in another familiar situation	Implementing, carrying out, using, executing	Construct a theory as to why this was special for the child.
Understanding Explaining ideas or concepts	Interpreting, summarising, paraphrasing, classifying, explaining	Summarize what the story was about.
Remembering Recalling information	Recognizing, listing, describing, retrieving, naming, finding	Describe where this took place.

Mr. Lu found his notes from his early years in school that he can now discuss this with his fellow teacher of using problems in stories the character in stories have to teach problem solving, math and science

Mr Lu spoke to his colleague Mrs Newman who was the math and science coordinator for the school teachers. He told her how this class students were excited about solving problems (called Bugs) that they are experiencing in their everyday life and how this could similar to problems that characters in stories are experiencing. Mr Lu thought that teachers could get students to pick a character in the story and help solve that problem using the math and science they were learning

They decided to talk to the group of students next week about using this concept next week and connect it to the children's Bug team effort. The design challenges are like the Bugs the team are solving so this expands the concept to solving problems in many aspects of life.

Where to start?

"Engineering design challenges" are created by actionable items in the story and lead to inquiry based team projects that have a design theme. As an example, in the story "Island of the Blue Dolphins", the village leaves canoes on the side of a hill for escaping a potential attack. The heroine in the story has a difficult time getting one of them down the hill and into the water. A "design challenge" for the students could be to design a system to make it easier for her to lower the canoe.

The students can pick the character they are working for in the story to create a design challenge. As an example they might want to work for the wolf in the 3-pigs to find a way to catch the pigs.

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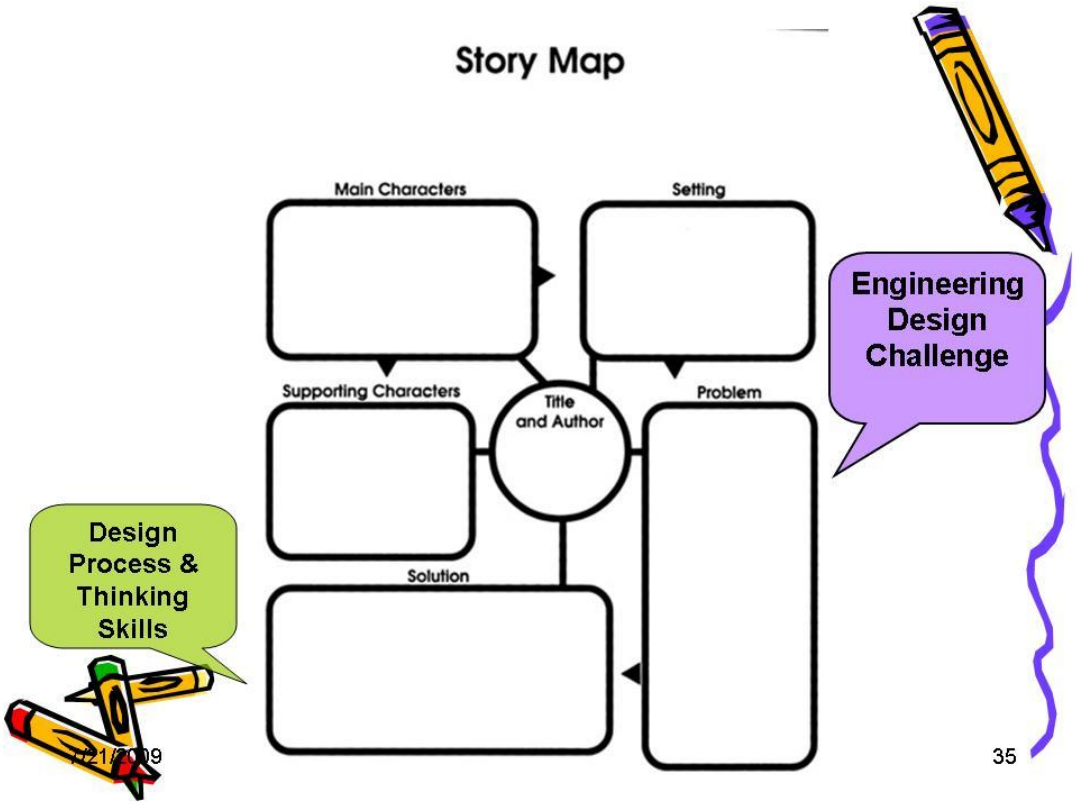
"Engineering design challenges" are created by actionable items in the story and lead to inquiry based team projects that have a design theme. As an example, in the story "Island of the Blue Dolphins", the village leaves canoes on the side of a hill for escaping a potential attack. The heroine in the story has a difficult time getting one of them down the hill and into the water. A "design challenge" for the students could be to design a system to

make it easier for her to lower the canoe. Another example from Goldilocks would be for children to work for the Bears and design a security system to keep Goldilocks out of the house.



Approach:

A teacher normal engages the students with the literature they are reading by asking skillful questions and using meta-cognitive reflection to bring out interesting areas of the story line. What we are adding is an engineering lens on the process to focus those questions from an engineering designer's viewpoint.

Define an approach for what you want the leaning outcome to be.

- Do we want to emphasize the learning of the engineering design process?
- Do we want to focus on a science strand within a design process?
- Do we want to focus on teaching a thinking skill? Ie creative process

Pick a science strand to connect with, either one that you just studied (used for reinforcement) or one that you are going to study (great Segue).
With an engineer's perspective, use the normal teacher's skills to engage students in the story. … Look at "story map" for ideas, think of engineering key words (create, improve, identify, investigate, etc.). Think of the science you just studied.
Develop design challenges with the students. Have a few in mind to channel the students towards these.
Integrate the engineering design and the science. If you picked the science you just studied, you can ask the students to sort their design challenges around that science. If you are going to focus on the up-coming science lesson, guide your students to view the design challenges around that science. This will give you the teacher, a good segue into the new science lesson.
Use the 8 step design process or modified PreK-2 grade version. Remember that the design process is cyclical in nature and keep cycle you have additional knowledge to make better decisions.

What makes a good Design challenge?

- Fun to do.
- Serve a useful purpose.
- Fit with the science being studied.
- Have the tools and material to complete.
- Can do a lot with paper.

Teacher Strategies
• Engage the students in the story by using questions that the students identify some design challenges. Look for conflicts, changes in the story line and places where a new item could help one of the characters. • How can someone's quality of life be improved? How can we make a certain task easier?, How can we improve upon an existing product? • Focus on key words that relate to science and engineering such as, habitat, weather, materials & tools, devices to help society, survival, plant material, and the environment.

• Challenge the author's assumptions in the story line by looking with the engineering view. • Have students brainstorm and decide on challenge they will work on. • If the author was an engineer, what would be added to the story? How can the students enhance this?
• Form teams based on strengths of the individuals to work together • Have students select roles that they will do as part of the team. Focus on engaging the individuals.
Can we add additional literacy skills to this exercise? Keeping a design note book, making reports and presentations.
What are the major points of the author, can we design something useful that would help the story? Do we want to limit the materials used to the time period of the story? (brings in more historical understanding)

Science and Mathematics connections: Using the Massachusetts Frameworks

The elementary school day is a busy day, with many subjects that teachers have to cover in the curriculum. Engineering can provide an important role to build thinking skills as well as coordinate the connection of literature with the science and mathematics curricula.

How do teachers relate the design challenge to the science they need to teach?

When we find a design challenge in a story and begin to develop it, we are doing the 4th strand of the science framework by utilizing the design process and tools. But generally we want to include one of the other three strands of science. We base this on the definition "***Engineering is about designing useful products & processes for society using all disciplines, but mainly science & mathematics".***

- earth and space
- life science
- physics and chemistry

What we know An engineering design project needs to use many other disciplines to create a design that provides useful value for society. Science is major contributor to most design projects. The Massachusetts Science framework provides the guidance for what science we should be learning based on the grade level we are at.

How does it fit into the engineering process? The engineering design process as defined in the framework is a higher order thinking skill that the students need to follow to create their product or paper design. In step two(2) we are asked to "Research the problem or need" where we determine what are the items we need to do to create our design. It is here where we begin to see the science that our design challenge is based on. When we get to step three(3), we start to understand the science to develop possible solutions. The students will begin to see the need to learn about the characteristics of the science to help develop solutions. They will develop the ideas of creating a hypothesis and design experiments to use the science. They will need to understand what a variable is and its effect on the design process.

Approach to create science learning through the design challenges. In many stories we sometimes have a common theme for the design challenge that we can help define the science about it. As an example, many stories will generate a design challenge around creating a habitant for an animal or humans. The habitant could be varied by making it stronger, better for the environment or other attributes. We can generalize about what the science is for this and thus port it to other appropriate stories.

Analytical analysis plays a different role in children's engineering than it does in traditional engineering, while engineering design and the design process play similar pivotal roles. For millennia, analysis was not part of engineering; rather custom and craft formed the analytical base. For a child to design and fabricate a toy car, a model of a whale, a terrarium, it is not necessary that they know static, dynamics, and strength of materials; rather that they consider the constraints and specifications of the problem statement and employ their knowledge and creativity. The analysis portion has it strongest links to science and mathematics; indeed that is a vital link between the disciplines. It is during this part of the design process, often when children reflect on their product's performance, that they apply their knowledge of scientific principles and mathematical conceptualizations. For

instance, they will understand force and friction when constructing, testing and evaluating axles; diameter and circumference when checking how far their vehicle moves.

Engineering links most closely with the physical sciences, but the elementary program predominantly focuses on life and earth sciences and the human body; so we must not only interconnect with the physical sciences, e.g. electricity, magnetism and simple machines, but also with living things, by designing models of ants and butterflies, homes for snails, rain forest plants and animals. In creating the models, students will need to understand and apply their knowledge of say, the rain forest, its structure and the various plants and animals that live at different levels. The design itself may require scaling a 150-foot tree to 15 inches, or an anthropoid from ten centimeters to thirty centimeters. "Skills required for mathematical reasoning are also fundamental to the design and construction process. “Estimating and computing using formulas are examples of skills that can be meaningfully incorporated in the planning and testing of a design" (Dunn and Larson, 1990, p. 28).

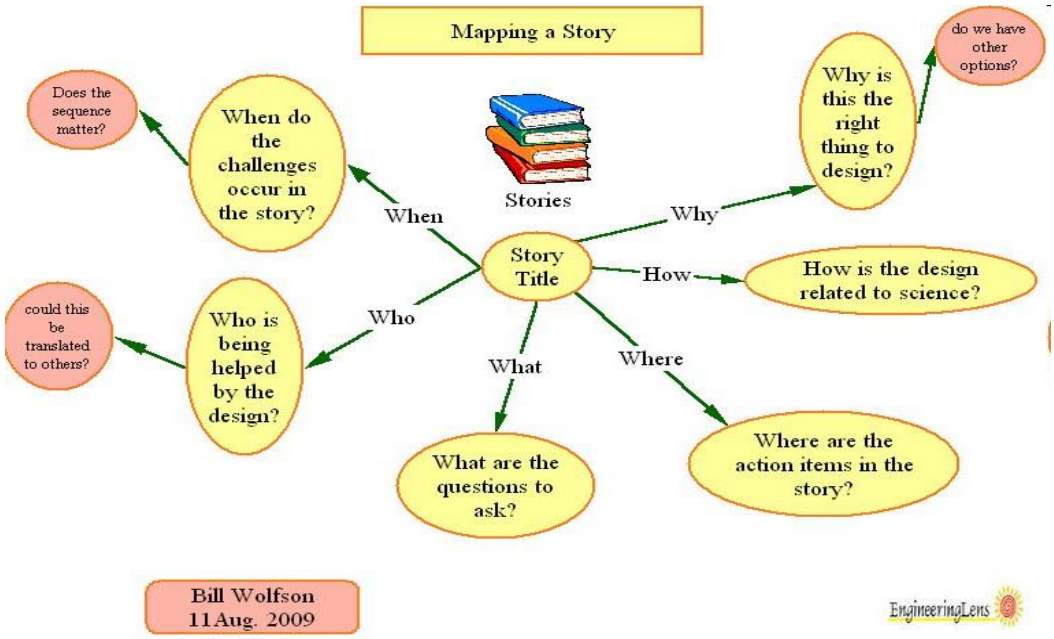
The design and analysis of the product, the artifact, are components in which only part of the learning occurs. It begins as the student researches the problem, journaling questions and insights along the way. An important mathematical concept design brings to the forefront is geometrical understanding. Visualizing in two and three space and making sketches and drawings are part of the design process. It is also an important part of elementary school mathematics.

Using Existing tools:
Existing tools that the teacher uses within the classroom supports the use of the design process as well.

- The design can be guided through the use of a design portfolio. This is much more than a collection of student work; it provides a design process framework for the student as well as documenting key points of the process. The design project is developed to solve a problem whose genesis is often found in another area of the curriculum, such as reading, science, or social studies. This provides the context for the solution and creates a motivation for designing a device. Students in upper

elementary are often required to write a short essay describing the context of their solution.

- The design map software tools that are used extensively in school also play a role to analyzing the story and finding the Engineering Design Challenges that play a central role. **Inspiration® and Kidspiration™**



The design process is inherently constructivist; it cannot be prescriptive and be designed. It is the belief of many elementary school science educators that a constructivist learning environment is most effective, fitting with students' developmental learning styles. Elementary school teachers use a variety of assessment techniques. Children's engineering requires assessment strategies that look to understandings, not memorizations, which are important for developing the thinking skills and problem solving skills necessary in a variety of academic disciplines.

Thr following literature selections are organized into four categories: fairy and ethnic tales, picture books, historical fiction and fiction chapter books. Each selection includes appropriate grade level range, story summary, and possible design challenges. Some selections also include extensions.

EXAMPLE STORIES

Fairy and ethic tales:

"3-Pigs"	"Goldie Locks"
"One Grain of Rice" by Demi (Math fairy tale)	Hansel and Gretel

Picture Book:

"The Carrot Seed" by Ruth Krauss	"Owl Moon" by Jane Yolen
"Make Way for Ducklings" by Robert McCloskey	"Snowflake Bentley" by Jacquelin Martin
"Who Sank the Boat?" by Pamela Allen	"The mitten" by Jan Brett
"The North Star" by Peter H. Reynolds	"Rose's Garden" by Peter H. Reynolds
"Where the Wild Things Are" by Maurice Sendak	"A visitor for bear" by Bonny Becker
"One Watermelon Seed" by Celia Barker Lottridge (Math focus)	"Island of the Skog" by Steven Kellogg
"Ibis: A True Whale Story" by John Himmelman	The Enormous Watermelon_example lesson plan...**Kindergarden**
The Tower to the Moon_example lesson plan ... **Grade 2**	Two Bobbies ... by Kirby Larson and Mary Nethery PreK to 2nd grade
A Visitor for Bears... by Bonny Becker Example lesson plans **Grade 1**	Caps For Sale By Esphyr Slobodkina **Grade 1 to 2**
Too Many Toys ... by David Shannon **Grade K-1**	That is Not a Good Idea ... Mo Willems **Grade K-1**

Fiction, chapter book:

"Esperanza Rising" … by Pam Munoz Ryan	"Island of Blue dolphins" by Scott O'Neil
"From the Mixed-up Files of Mrs. Frankweiler" by E.L. Konigsburg	"Dear Mr. Henshaw" by Beverly Cleary

"Number the Stars" by Lois Lowry	Charlottes Web by E.B. White
"The Mouse and the Motorcycle" by Beverly Clearly	"Pictures of Hollis Woods" by Patricia Giff
"Tales of a Fourth Grade Nothing" by Judy Bloom	"Brave Irene" by William Steig
"Cricket in Times Square" by George Sheldon **Example Lesson plan**	"On the Far Side of the Mountain" by Jean Craighead George
"By the Shores of Silver Lake" Laura Ingalls Wilder	"Blizzard" by Jim Murphy; part of a fifth grade Houghton Mifflin Series , historical fiction
"Snow Treasure" by Marie McSwigan	"Bridge to Terabithia" by Katherine Patterson
"Owls in the Family" by Farley Mowat	"Sir Cumference and the First Round Table" by Cindy Neuschwander

Historical Fiction

The Watsons Go to Birmingham by Christopher Curtis	Letting Swift River Go by Jane Yolen ... **Example lesson plan Grade 3**
BLIZZARD! By Jim Murphy – Historical Fiction ... **Example lesson plan Grade 4-5**	

Our Goals for creating this story was to demonstrate the fun of learning that becomes **life long learning**

Add – Kids decide that if they are solving their bugs but what about problems that we sometimes have with each other - Build a list of Life Skills from the team operation

Add- Me Lu talks about how in his village, people would **blow a horn** to gather together to discuss issues in the village and work together to solve them,
ADD : Learn how to create processes that connect action items together

