

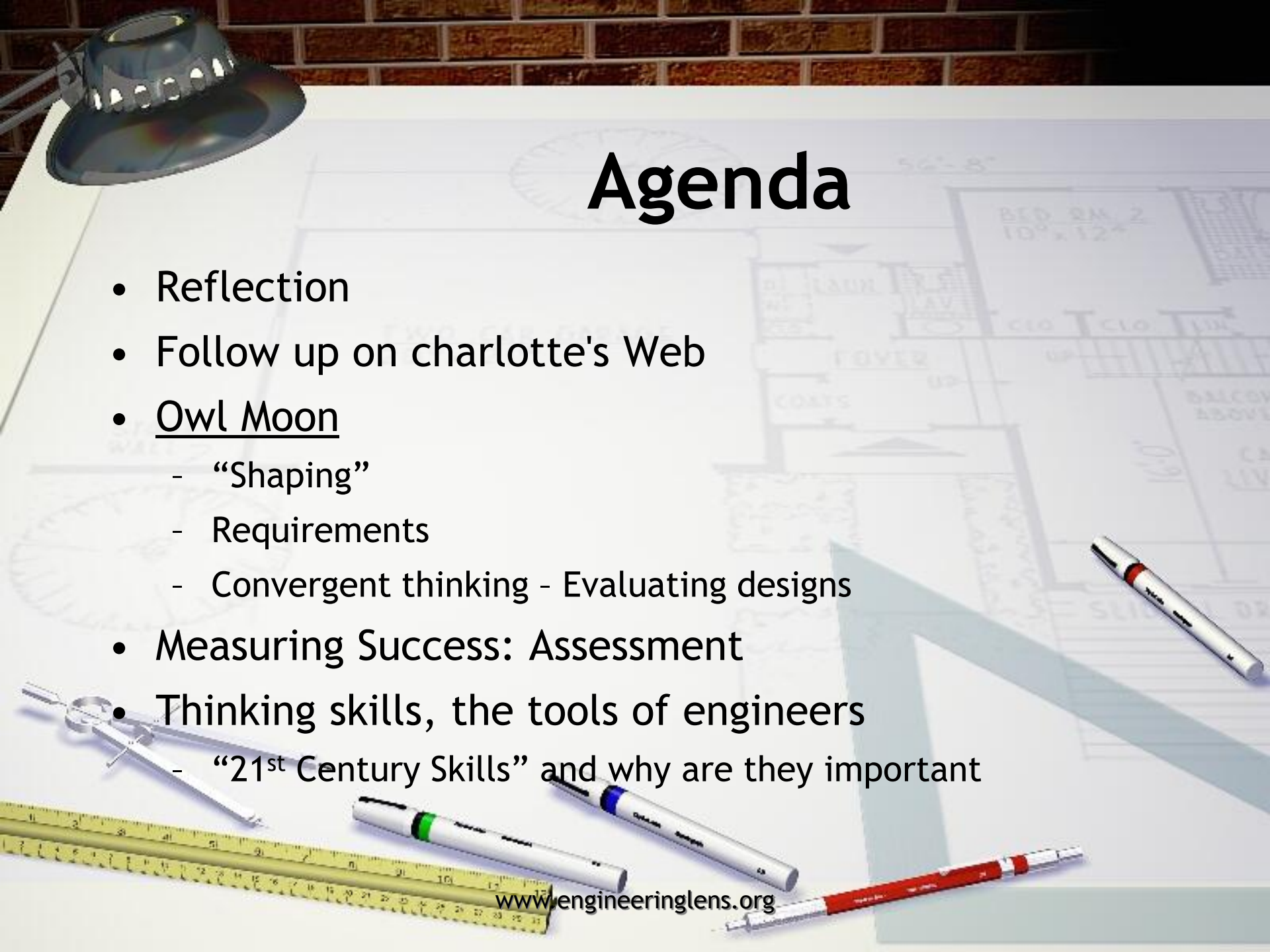
Insanity is doing the same things over and over again and expecting the different results' Albert Einstein

# Integrating Engineering Design and Thinking Skills into PreK-5 grade interdisciplinary education

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- Bill Wolfson
- Karen DeRusha
- Stacy Newman

**'Insanity is doing the same things over and over again and expecting different results' Albert Einstein.**



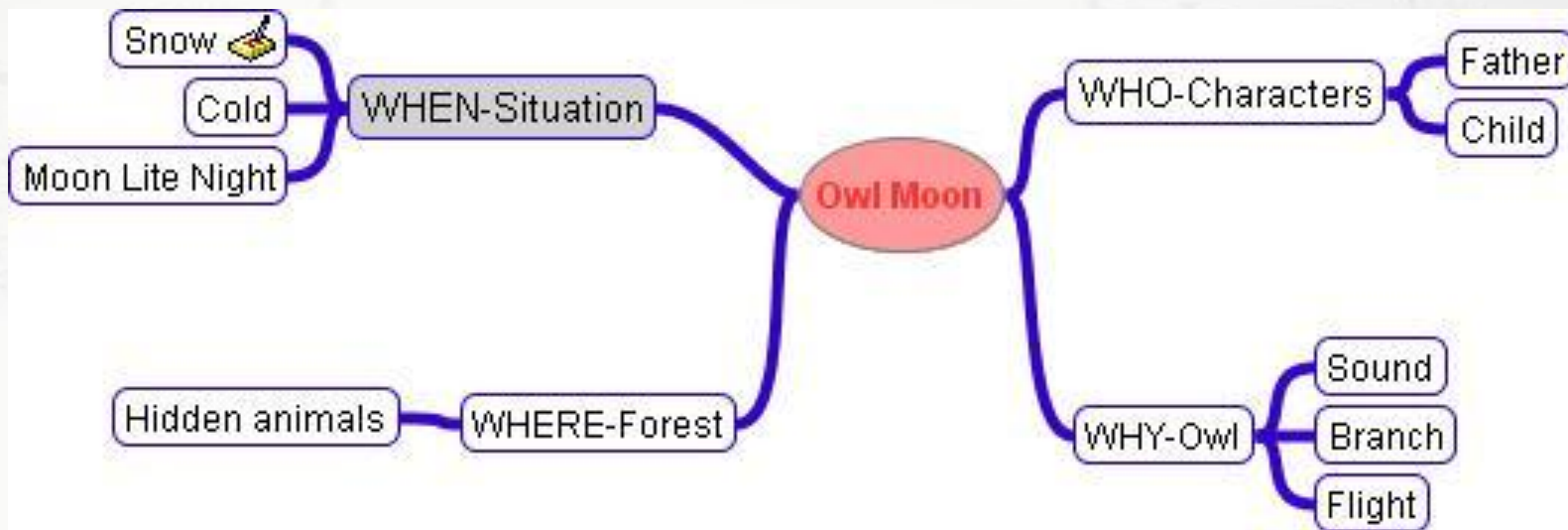
# Agenda

- Reflection
- Follow up on charlotte's Web
- Owl Moon
  - “Shaping”
  - Requirements
  - Convergent thinking - Evaluating designs
- Measuring Success: Assessment
- Thinking skills, the tools of engineers
  - “21<sup>st</sup> Century Skills” and why are they important

A desk setup featuring a desk lamp in the top left corner, a large architectural blueprint spread across the surface, a red pen, and a blue L-shaped ruler. The blueprint contains various technical drawings and text, including 'TWO CAR GARAGE', 'KITCHEN', 'LIVING', 'COATS', 'BED ROOM 2', and '10' x 12''.

# Movie

# Owl Moon







## Identify Needs/Problems in the Story (“Design Challenges”)

**Activity:** In your teams, take 10-15 minutes to generate a list of needs/challenges in the story. These are problems that the characters in the story are having, opportunities to make things better, etc.

# 5 Why's

Bright Moon in the Forest, Makes the forest lighter with the bright moon

1 Why do I want to make it lighter?

So we can see better

2 Why do I want to see better

So I can see the animals

3 Why do I want to see the animals?

So I can learn more about them

4 Why do I want to learn more about them

So I can understand their life

5. Why do I want to understand their life

So I can document their lives... create a light that allows seeing the animals without disturbing them

# Provide a light that won't disturb the animals

Science	Math	Light	Animals	Provide
Life Science	Number sense	visible	Small	Hand held
Physical/chemistry	Algebra	Inferred	Birds	Strapped on the head
Earth/Space	Geometry	Strobe	Large	Located in the forest trees
Simple machines	Data	flash	Insects	Walking stick



# Research the problem

- Understanding the values of the characters

Characters	Values
Child	
Father	
Owl	



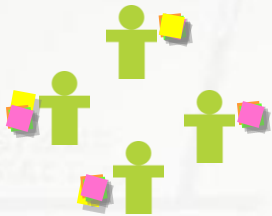
## Use at least one science constraint when generating your design solutions

Design challenges	Sciences	Filters	Results
	Earth & Space	Energy in the Earth System Materials and Energy Resources Earth process and Cycles Structure of the Earth Earth in the Solar System	→
	Life science	Characteristics of Living Things Systems in living Things Heredity Evolution and Biodiversity Living things and their environment	→
	Physic & Chemistry	State of Matter Position and motion of objects	→
	Engineering	Tools Materials Engineering Design	→



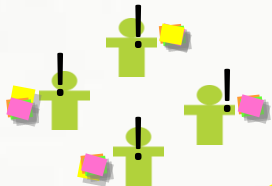
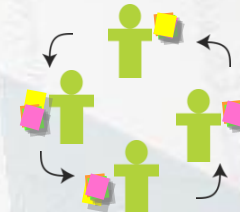
## Generate Possible Solutions using Brain-writing

*Starting with 4-5 generative framings...*



Each team member generates 3-4 ideas on their own.

Pass ONE of your ideas to your right.



One idea per  
card or sticky  
note!!

Read your neighbor's idea, and generate an idea that is somehow inspired by it.

Repeat until time is up.

# Shaping Ideas

Why generate crazy ideas?

So you can shape the into innovative ideas!

Leaves falling on the lawn...

Use a leaf blower



Trees that pick up



magic

|

!?

!!!??



1

## Share and plot your ideas



Trees that  
pick up

Sell the  
leaves

Fanciful Horizon

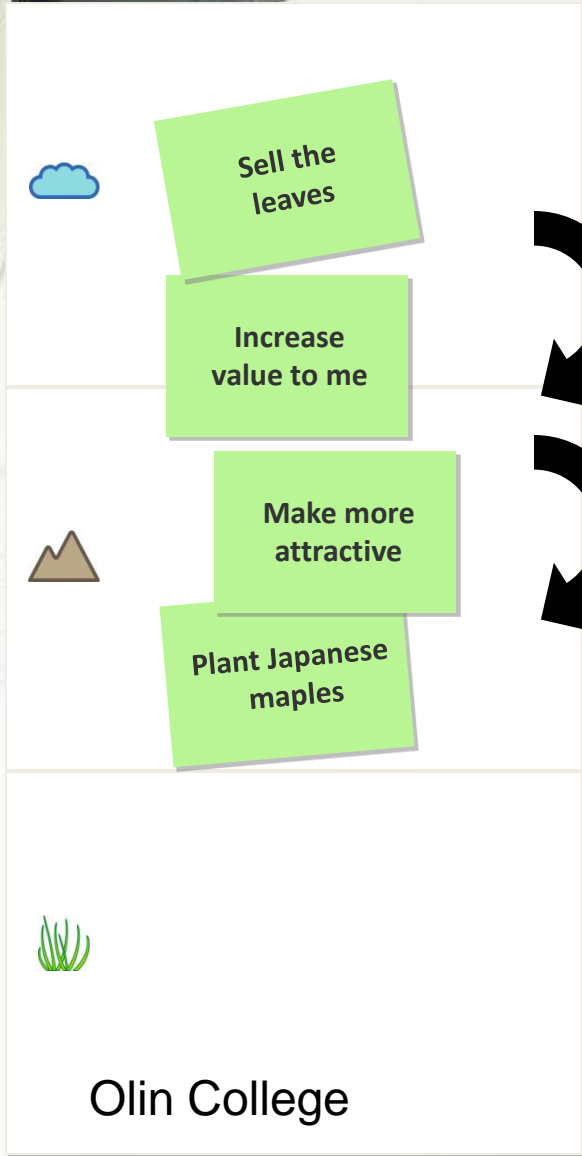


Use a leaf  
blower

[www.engineeringlens.org](http://www.engineeringlens.org)



## 2 Shape ideas



Initial brainstorming ideas for Olin College:

- Sell the leaves
- Increase value to me
- Make more attractive
- Plant Japanese maples

Olin College

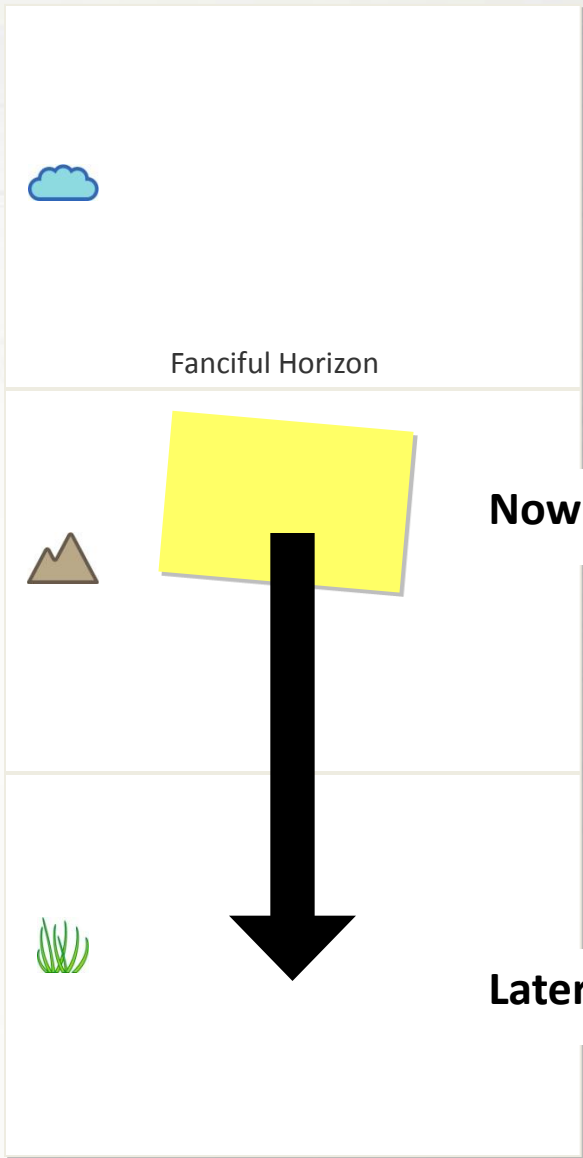
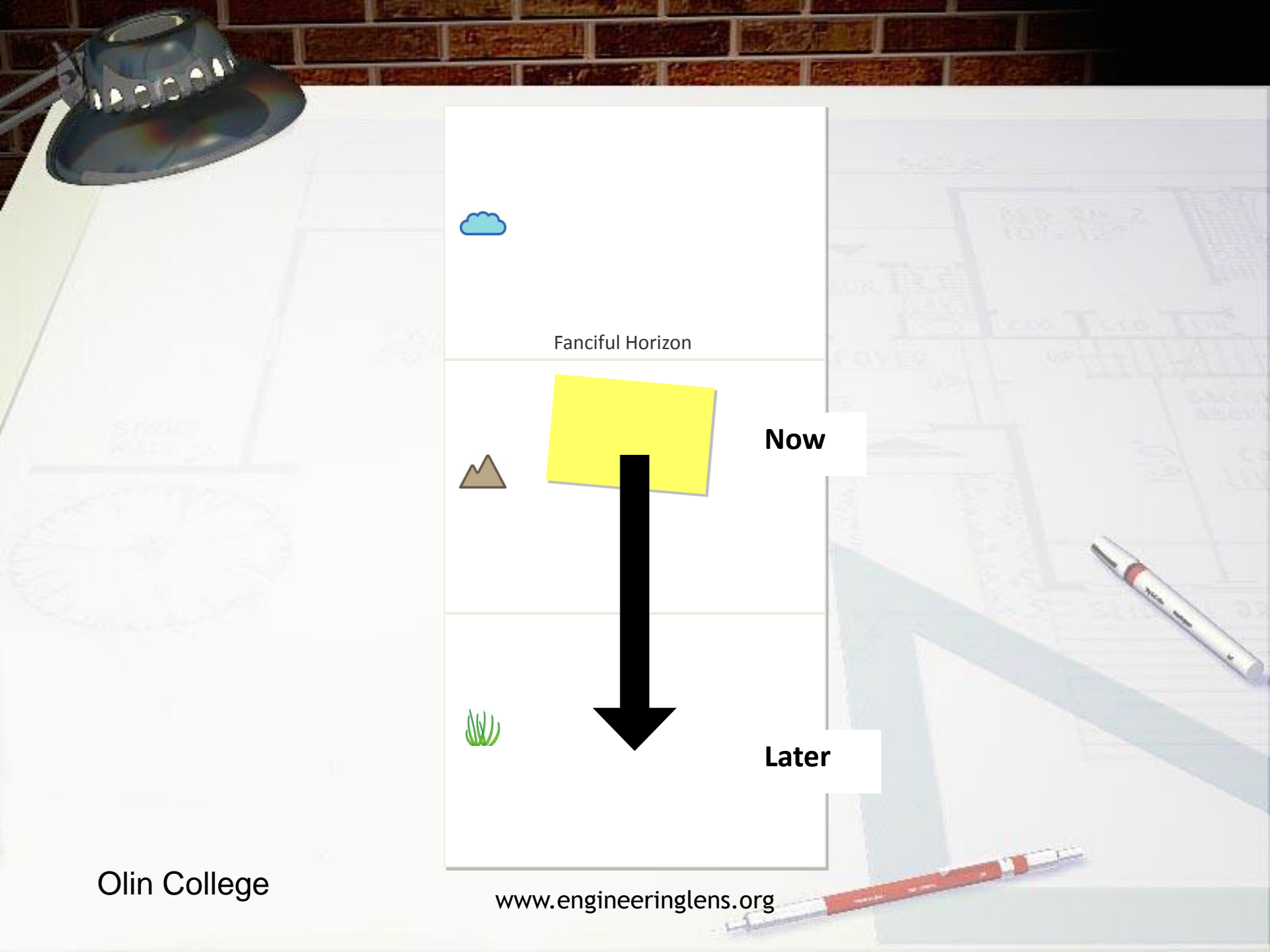


Refined ideas for Olin College:

- Wind blows leaves away
- Fanciful Horizon
- Keep animals that eat leaves
- Use a leaf blower

[www.engineeringlens.org](http://www.engineeringlens.org)

## 3 Share



Olin College

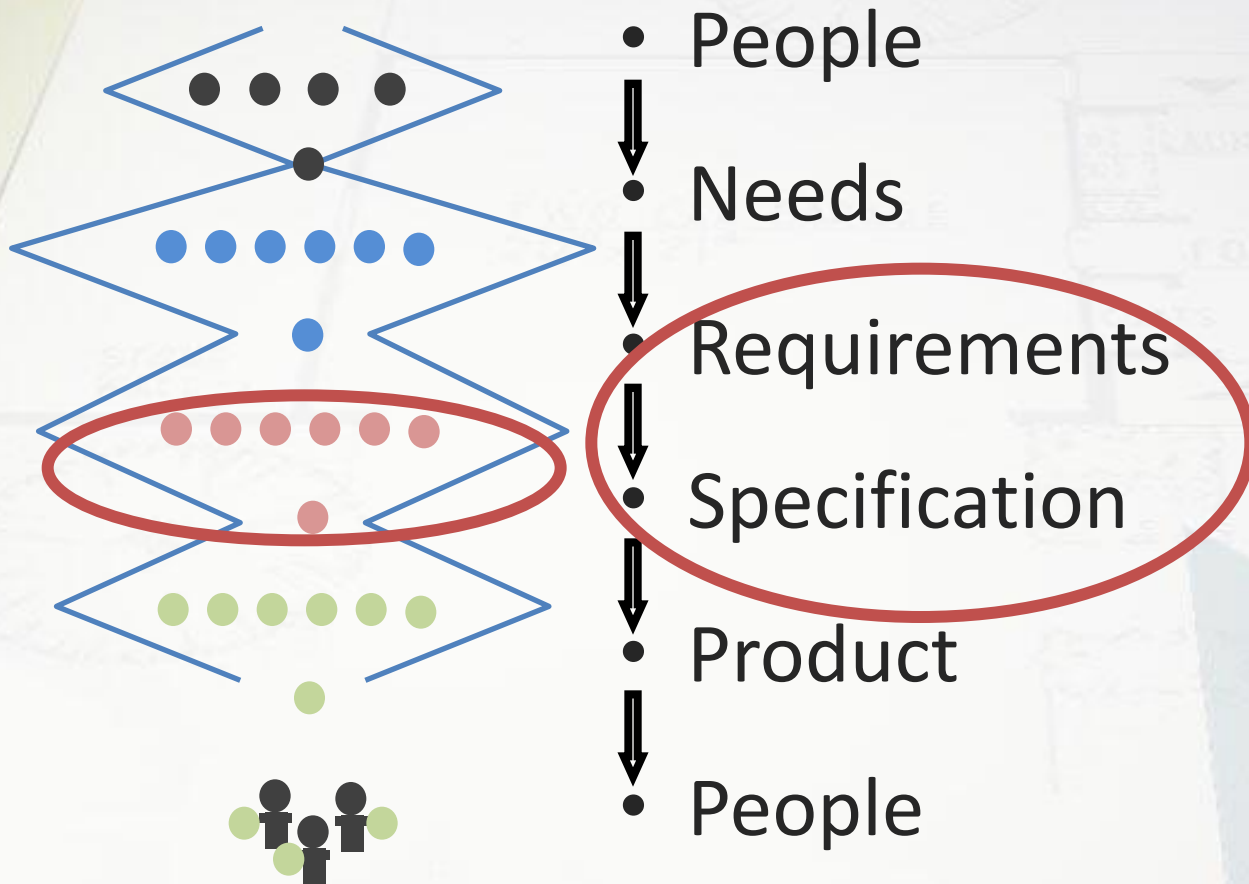
[www.engineeringlens.org](http://www.engineeringlens.org)

# Now Shape your ideas!



- Map (i.e. mundane, magical) and shape your ideas from brain-writing.
- Remember that you can shape ideas to meet constraints and values
- Choose 2-3 “favorites”, taking values and constraints into account.
- Be bold!
- Be prepared to share!

# Convergent Thinking: Selecting from alternatives







# Requirements

- Formalize what the design has to accomplish
- Safety, function, interaction, character
- “The design should...”
- Specify the need, not the solution:
  - Good: “provide space for a family of six to eat together”
  - Bad: “include a dining table in the middle of the room.”
- Science Constraints are requirements you impose on your students

A desk setup for engineering work. In the top left, a desk lamp with a perforated metal shade is illuminated. The desk surface is covered with a large sheet of paper featuring a faint architectural drawing of a building with various rooms and labels like 'EXHIBIT GARAGE', 'LABORATORY', and 'RESEARCH'. A large blue L-shaped ruler is positioned on the right side of the desk. Two pens, one red and one silver, are also visible on the desk. The background is a brick wall.

**Work in pairs to generate 5+ requirement statements for your table's top idea.**

**Compare and discuss.**

As a team, make three gallery sketches of possible solutions.

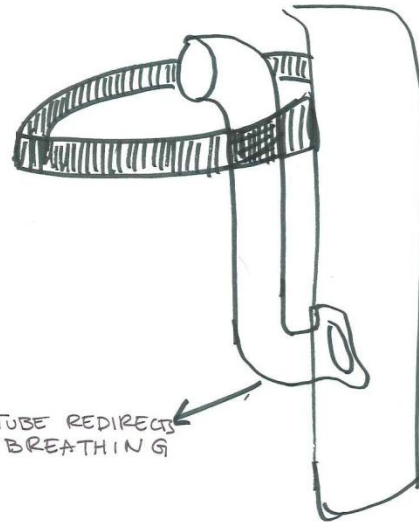
**Generate 2+ gallery sketches per team that would meet your requirements**

CONNIE YEH ☺ - 2009/02/28

# VISOR SNORKEL

**Clarify with brief notes**

**Use color functionally**

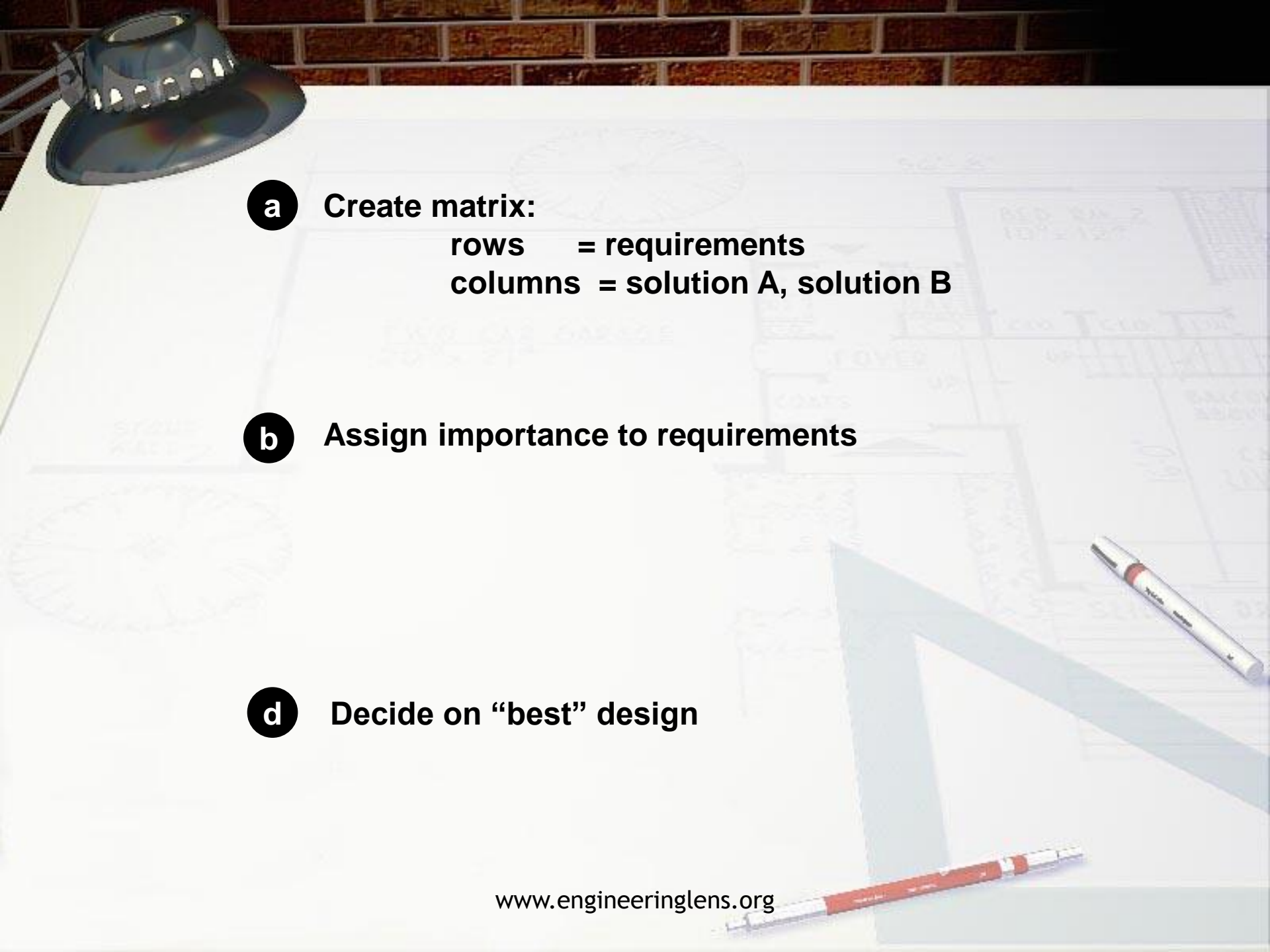


- PROBABLY NOT GOOD FOR HEAVY WORK REQUIRING LOTS OF BREATHING...

**Add labels and arrows**

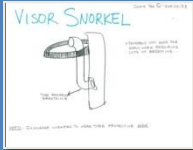
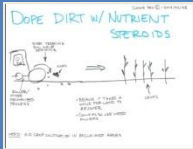
**Create a main diagram**

NEED: ENCOURAGE WORKERS TO WEAR THEIR PROTECTIVE GEAR

- 
- a** Create matrix:  
rows = requirements  
columns = solution A, solution B
- b** Assign importance to requirements
- d** Decide on “best” design



# Decision matrix

Requirements	Weight		
<b>Total=</b>			

# Measuring Success



✓	_____
✓	_____
✓	_____
✓	_____
✓	_____
✓	_____
✓	_____
✓	_____
✓	_____



# Teaching through Assessment

- Gives teachers a number of thinking-centered lenses through which to examine students' thinking and understanding performances.
- Teaching thinking through assessment helps provide teachers and students with a common set of tools they can use to communicate and articulate their ideas about what's good and not so good about their thinking.
- Assessment can be a powerful approach for teaching thinking as well.

*Project Zero ... Harvard Graduate School of Education*

The background of the slide is a detailed architectural blueprint or technical drawing spread across a desk. In the top left corner, a desk lamp with a perforated metal shade is visible. The blueprint features various lines, circles, and text, including the words 'STONE WALLS', 'UP', 'COATS', 'SLICE', and 'DILATED ABOVE'. In the foreground, several drafting tools are scattered: a yellow ruler with black markings, a silver compass, and four white markers with colored caps (green, blue, red, and black).

# Involve students in assessing their learning

Students create assessments for their teams

- What to assess?
- How to assess?





# What to assess?

- Steps in the design process
- Inclusion of science and/or math skills
- How team members worked together
- Presentation to classmates
- Other



# How to assess?

- Whole class designs assessment with teacher
- Teams work independently using criteria established by teacher or class with teacher
- Series of questions
- Rubric
- Song or rap with learning lyrics
- Other



# Measurement and standards

- From the Objectives we get the goals for assessing.
- Students should be involved and at least know what they will be judged on.
- This is a form of learning and growth for the student and you.
- Need to provide a mirror for thinking skills improvement.

The background of the slide is a photograph of a desk. In the top left corner, there is a desk lamp with a white shade. The desk surface is covered with a white sheet of paper that has faint, light blue engineering drawings or blueprints on it. A large, light blue ruler is positioned vertically on the right side of the desk. A red and white pen lies horizontally at the bottom right of the desk. The background wall is made of red bricks.

# Tools of the Engineer

How are Thinking Skills the tools of engineering ?



**What do you do when you don't  
know the answer?**

*This is what engineers face all the time.*

Dismiss it! Panic?

OR

That's a great question. I need to think about it  
or How can we find the answer to that  
question!

Its O.K. not to know all the answers at first.

# Thinking Skills

- Questioning
- Creative and Critical thinking
- Meta-cognitive reflection
- Strategies

Learning environment

Can someone give examples of these?



# Bloom's Taxonomy Higher Order thinking

## Elements

### **Creating**

Generating new ideas, products, or ways of viewing things

### **Evaluating**

Justifying a decision or course of action

### **Analysing**

Breaking information into parts to explore understandings and relationships

### **Applying**

Using information in another familiar situation

### **Understanding**

Explaining ideas or concepts

### **Remembering**

Recalling information

## Complete the table:

Elements	Verbs	Questions
<b>Creating</b> Generating new ideas, products, or ways of viewing things		
<b>Evaluating</b> Justifying a decision or course of action		
<b>Analysing</b> Breaking information into parts to explore understandings and relationships		
<b>Applying</b> Using information in another familiar situation	Implementing, carrying out, using, executing	<i>What would you have done? Could we design something to change or solve the problem?</i>

What questions would you use to stimulate dialogue with your students when discussing Design Challenges in a story?





# 21st- Century Skills

## 1. Core Subjects and 21st Century Themes

## 2. Learning and Innovation Skills; The four C's

- Creativity and Innovation
- Critical Thinking and Problem Solving
- Communication and Collaboration

## 3. Information, Media and Technology Skills

- ICT Literacy
- Media Literacy
- Information Literacy

## 4. Life and Career Skills



# Reflection

How does our methodology fit into the  
21<sup>st</sup> Century needs?



# Failure is a dress rehearsal for success.

I am always struck by James Dyson's claim that he built 5,127 prototypes before he got it right. This reminds me of [IDEO](#)'s philosophy of "fail early and often to succeed at the end". Dyson argues that there is more we can [learn from failures](#) than from successes.

**End  
Thank you**

