Integrating Engineering Design and Thinking Skills into PreK-5th grade interdisciplinary learning environment

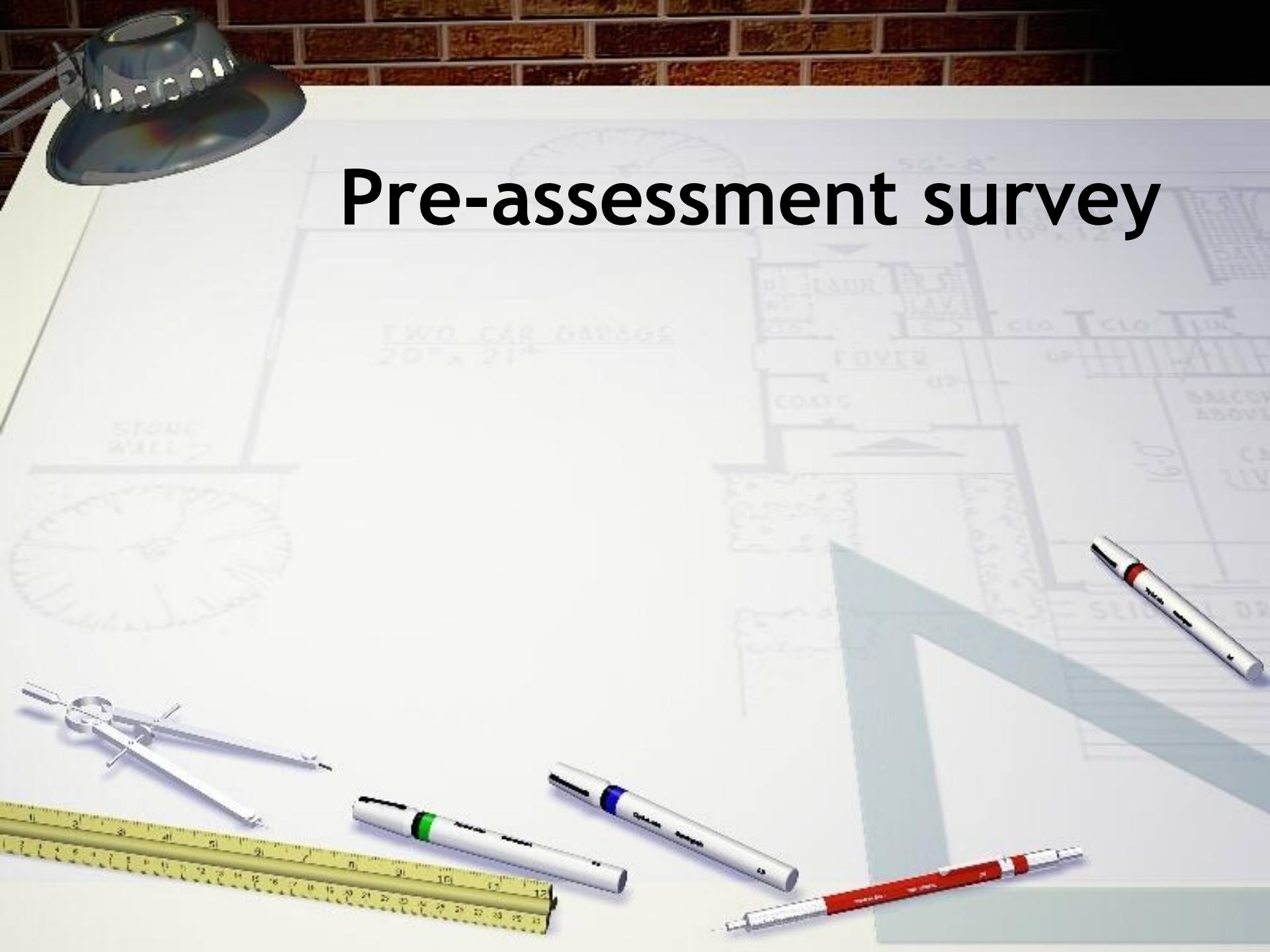
Day 1 08/2/2010

Book of the Day:
A Whole new mind by Daniel Pink

Music

- Bill Wolfson
- Karen DeRusha
- Stacy Newman

Pre-assessment survey



Class set-up

- Introductions
- Class Objectives
- Agenda

Teaching is an intellectual effort

Tell me and I'll forget.
Show me and I'll remember.
Involve me and I'll understand
- Confucius

Introductions

- Name
- Grade level/role
- What are you hoping to gain from this course? …Why did you sign up?

Why are *we* doing this?

- We need to move from a culture of memorization to a culture of thinking, creating and understanding.
- Our students will change careers many times and need to learn how to be life-long learners and questioners.
- The students should see the fun/excitement of learning which includes engineering design, mathematics and science.
- The Massachusetts science framework includes engineering in strand 4.
- Design thinking provides a connector for interdisciplinary learning to support your engagement of the students.

Objectives for this P.D. class

- Describe what engineers, mathematicians, and scientists do and explain why it's important to focus behavior of students to use those skills.
- Demonstrate how to connect literacy with engineering, math, and science instruction.
- Describe what is included in Strand Four of the MA Frameworks (Engineering/Technology).
- Give examples of how to utilize design thinking processes in several areas of the curriculum (across disciplines)
- Model & provide strategies for fostering the development of 21st century skills (i.e. Creativity & Innovation, Critical Thinking & Problem-Solving, Communication & Collaboration) in your students (instead of "Model and involve students in the use of productive questioning, meta-cognitive reflection, creative and critical thinking skills in the learning process.")
- Generate ideas for how to involve students in assessing their own learning.
- [Develop unit/lesson plans that allow students to develop "design thinking" skills]

Agenda

- Intro to Engineering
  - Draw an engineer
  - Compare/contrast engineers with scientists, mathematicians, artists & entrepeneurs
  - Evaluate engineered products
- The 3 Little Pigs: example of “design challenges”

Week's schedule

Mon	Tues	Wed	Thurs	Fri
Teachers as students Intro to Engineering 6 Hats Exercise * Using artifacts to show engineering is everywhere The 3 Little Pigs using the design process *Need to add	***Teachers as learners*** Continuation of The 3 Little Pigs Building Mockup Reflection MA Frameworks (Science/ Engineering) Connecting to literature Connecting Math & Science: Charlotte's Web	***Teachers as learners*** Owl Moon Shaping Requirements Morphological analysis Measuring Success, assessment strategy Developing thinking skills: • Bloom 21st Century Skills	***Teachers as teachers*** What makes a good book? Elements of a lesson plan Choosing a book • Priming • Generative • Convergent Development of lesson plans Create sketch models Assessment/Feedback	***Teachers as teachers*** Build models Review/ reflection Presentations What tools have we learned? Other activities using Design Thinking Planning Celebration/ reflection

Engineering …

- Why do I need to know about engineering as an educator?
- Draw a picture of an engineer and describe what the engineer is doing in the picture.

Draw a picture of an engineer

What are the stereotypes about engineers?

Definitions:

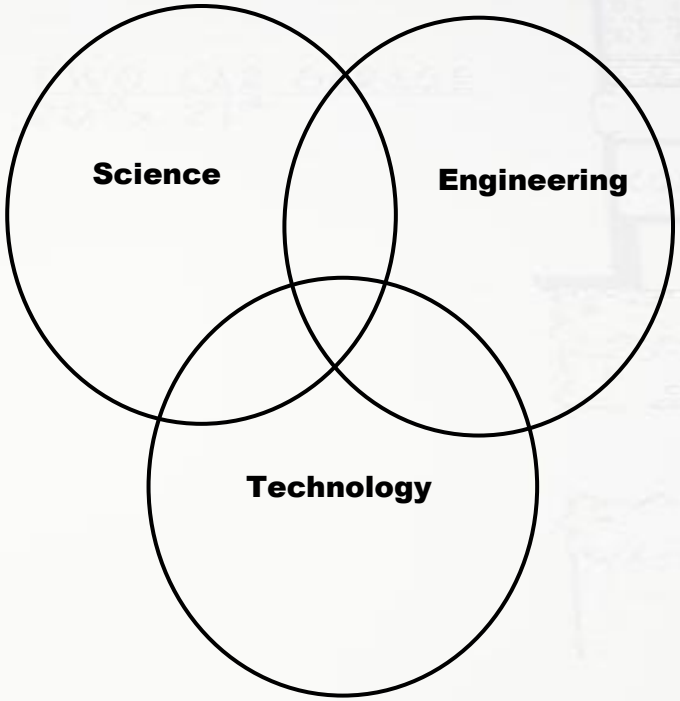
1. Engineers
2. Scientists
3. Mathematicians
4. Artists
5. Entrepreneurs

What are their:

- Definitions
- Similarities
- Differences

The Relationships Among Science, Engineering, and Technology

Science seeks to understand the natural world, and often needs new tools to help discover the answers.



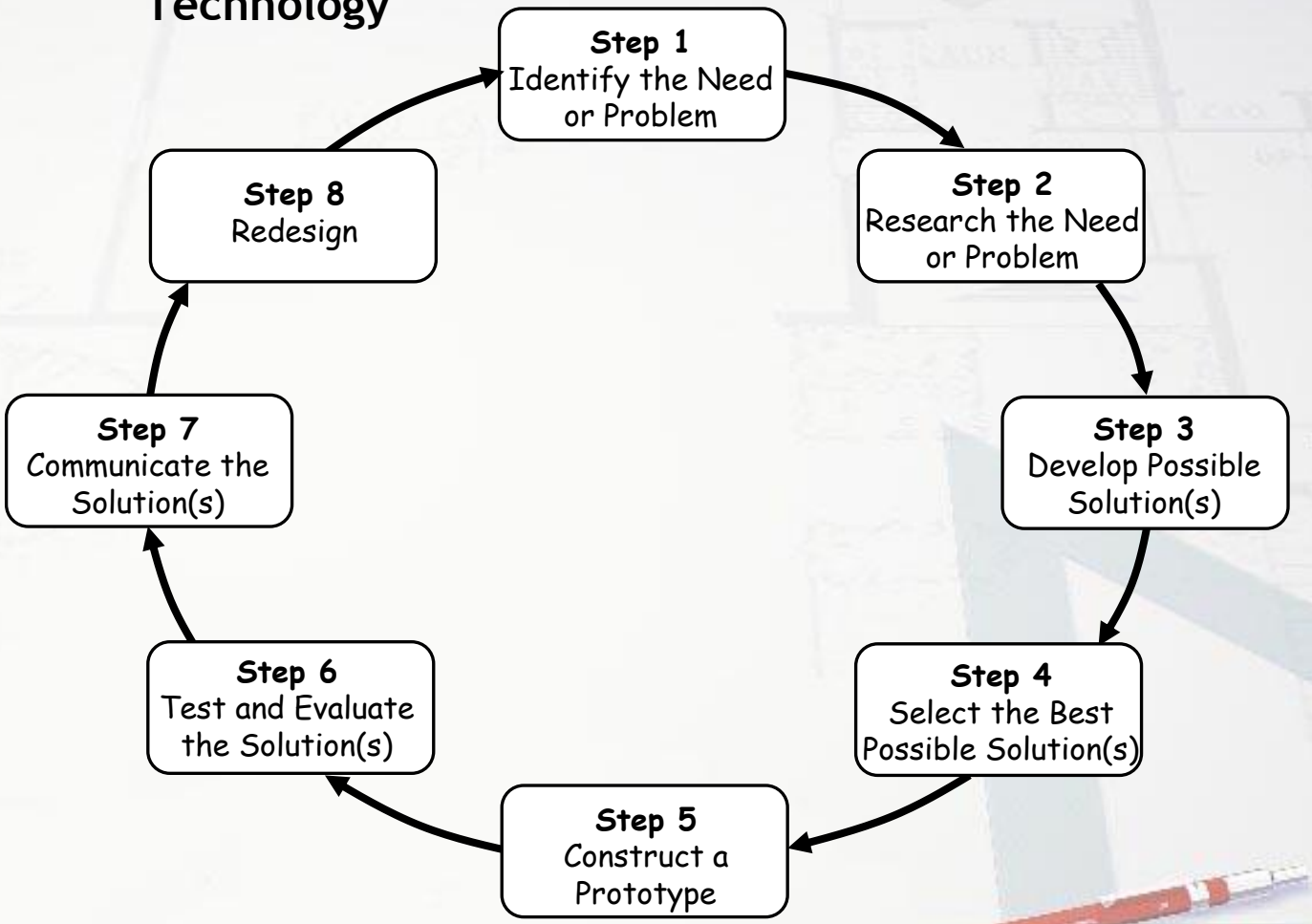
Engineers use scientific discoveries to design products and processes that meet society's needs.

Technologies (products and processes) are the result of engineered designs. They are created by technicians to solve societal needs and wants.

What do engineers do?

- Work around the design process of creating, maintaining products (& systems) and process development.
- They specialize in various science disciplines like civil, electrical, mechanical, aerospace, bio, material.
- They specialize in purchasing, project materials, process, quality, production

MA Framework: Strand 4 Engineering & Technology



Framework Oct. 2006

www.engineeringlens.org

Break

What did you learn about engineering that you did not know?

Activity: Engineered Products

- Look at each item, pass each around and discuss what makes them all the same and different.
- What problems were they trying to solve? How were science and math involved?
- How would you evaluate them? What categories (i.e. Function, Style/ Aesthetics, Cost, Quality, Manufacturability, Safety, etc) would you create to compare and contrast them?
- Discuss in your teams what you like/ don't like about each object.

Report out

1. What problem does your object solve?
2. Criteria you used to evaluate products
3. Science/math included in design
4. Your group's favorite ☺

Class project

Look at each item, pass them around and discuss what makes them the same and different.

Tell the class what you liked and didn't like about each object.
Also consider value and innovation.

Look at the items in your box. How would you evaluate them? What categories would you create to compare and contrast them?

Function, Style, Esthetics (look & feel), Cost, Quality, Manufacturability, Safety, Environment, Features, etc …

See how science and math is used to design them.

Categories	Item 1	Item 2	Item3	

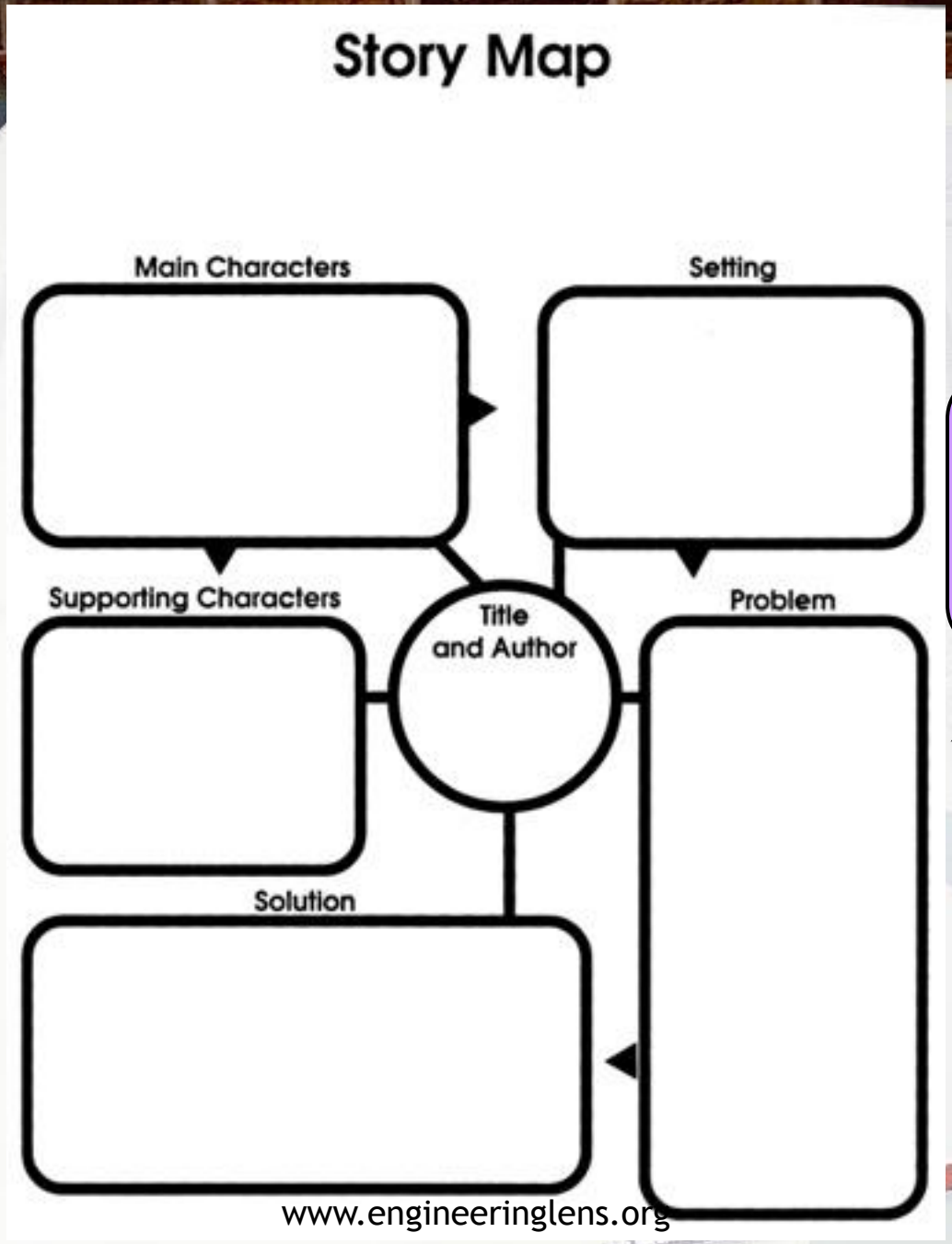
Group Reflection

- What was the purpose of this activity?
- How could you use this with your students?
  - What might you need to adjust/change?
  - What other products/artifacts could you use?

3- Pigs

Team Set-up

- Write on a 3x5 card the answers to the following questions that you will share with your team members:
  - What skills will you bring to the team?
  - What knowledge will you bring to the team?
- Create roles & values for your team



Engineering Design Challenge

Design Process & Thinking Skills

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.

Who are you going to work for?

One idea per card or sticky note!!

Research the problem

- Problem-framing: Do we have the right problem?
  - Example: Large office building (many floors); people believe the elevator takes too long
- What else might you do to research the need/problem?

Example

"It bugs me when my food gets cold."

- Needs

Divergent (**Lots**): Generate raw ideas

Use solar power!

Only drink!

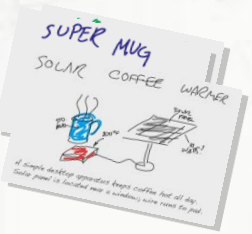
Convergent **(narrow):** Define requirements

Food Warmer
REQUIREMENTS

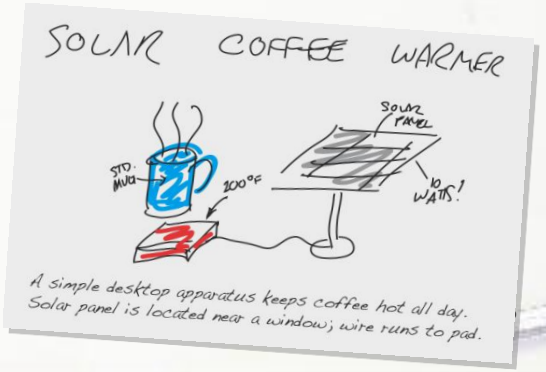
The design should…
Be no larger than…
Cost no more than…
Keep Food at…

- Requirements

Divergent: Generate alternatives



Convergent: Select an approach



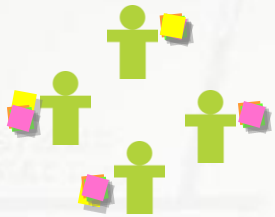
- Specification

Select your “Design Challenge”

- In your teams, select the design challenge that you are most excited about solving

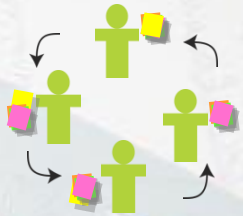
Generate Possible Solutions using Brain-writing

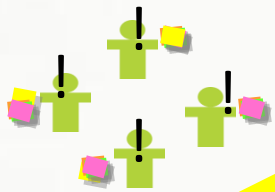
Starting with 4-5 generative framings…



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

Pass ONE of your ideas to your right.





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

One idea per card or sticky note!!

Repeat until time is up.

Now go back & look at your possible solutions – could you incorporate at least 1 or 2 of the following (from the science frameworks) into your design and/or come up with some additional ideas?

- Simple Machines
  - Lever (lift heavy objects)
  - Wheel and Axle (turn objects)
  - Pulley (lift heavy objects)
  - Incline Plane (lift, split, move)
- Evolution & Biodiversity
- Strength of Materials

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.”

Work in pairs to generate 5-10 requirement statements for your table's top idea.

Compare and discuss.

Using the Requirements, pick the two best designs for sketching

Build Sketch Models!

In pairs, make gallery sketches of possible solutions.

Provide an evocative title

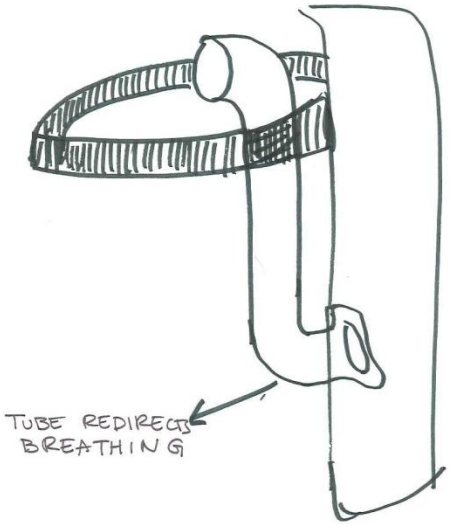
CONNIE YEH ☺ - 2007/02/28

VISOR SNORKEL

Clarify with brief notes

- PROBABLY NO HEAVY WORK
- LOTS OF BR...

Use color functionally



Add labels and arrows

Create a main diagram

NEED: ENCOURAGE WORKERS TO WEAR THEIR PROTECTIVE GEAR

Presentation of Design Solutions

- description of need/problem addressed
- who the intended user(s) of the product would be
- how science constraints are utilized in the solution
- description of other requirements that were identified
- presentation of solution sketch/model and description of how it works
- Additionally each group should comment on how the team worked together to get everything done and any challenges encountered
- *and how they resolved the challenges*

Problems

A problem is nothing more than an opportunity in work clothes. A successful business person pays attention to problems, converting the problems into opportunities and deciding which opportunities are worth pursuing.

Thinkertoys, Michael Michalko p22

'We are continually faced with a series of great opportunities brilliantly disguised as in insoluble problems. John W Gardner

End of day feedback form using the hand outs

End
Thank you