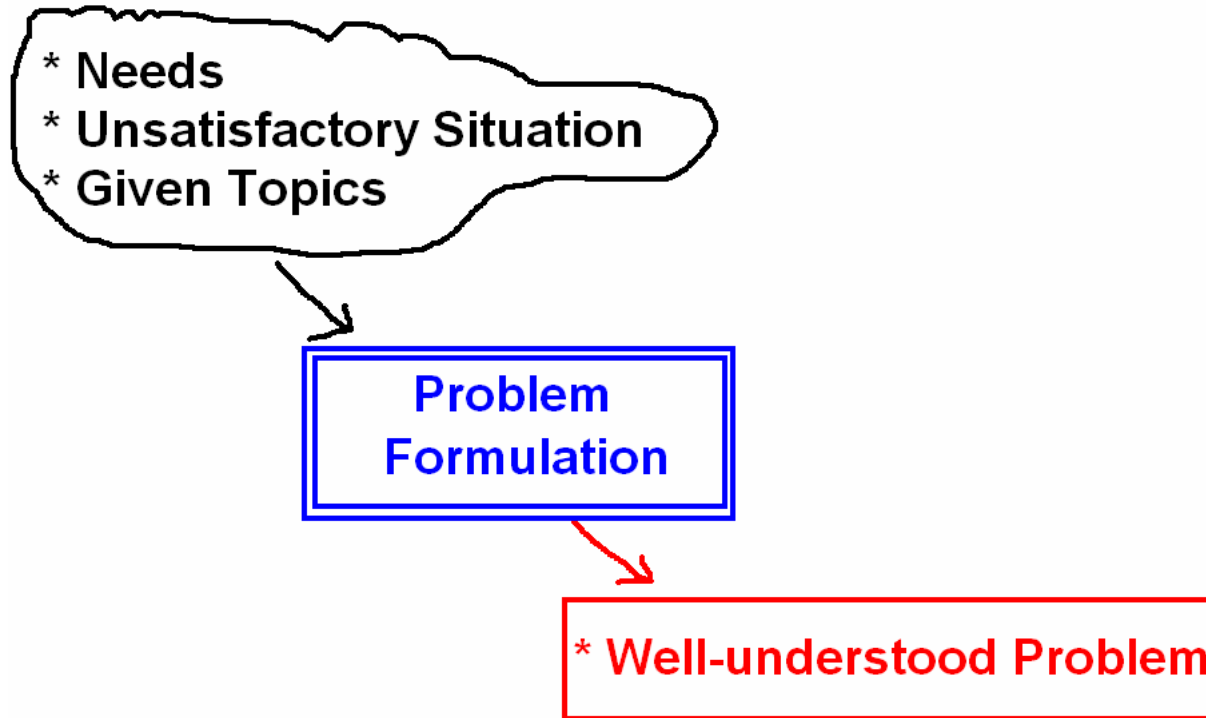


Problem Formulation Process

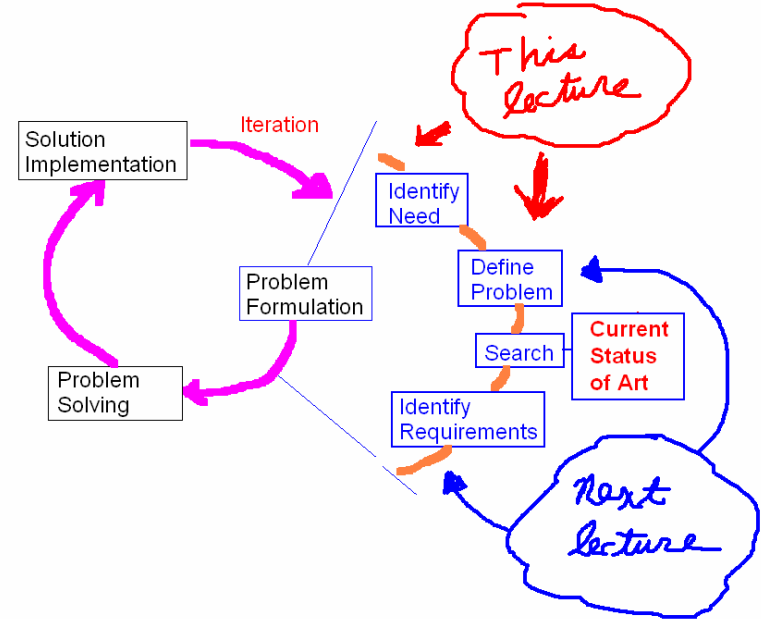


The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science. - Albert Einstein

Problem Formulation and Design Requirement

- **Contents**

- Identify Needs
- Define Problems
- Current Status of Art
- Identify Requirements



- **Goals**

- Why need identification and problem definition are important
- Strategies for gathering information about a problem
- Develop a set of requirements for a problem

Problem Formulation

- “The process of converting a dissatisfied situation into a well-understood problem”
 - **Understanding** the problem **Not finding solution** to the problem
 - Confusing Process relied upon intuition and hard (*essential*) “soft” skills.
 - It’s result?
 - **Need Identification** and **Problem Definition**
 - Clear set of **Requirements** that can guide the design process through to its completion



Identifying Needs and Defining Problem

- **Identify Needs**
 - Dissatisfied situation
 - Need exists
 - Accept responsibility for corrective actions
 - “Attitude”?
 - Pioneer Mentality
 - Identifying a need and accepting responsibility for meeting it
 - Commit time, energy, other resources
 - Take risks
 - Willingness to adapt to situation and use available resources
 - Agent of change
- **No Rush to get a solution** after Needs Identified:
 - A wrong problem may be solved!
 - A symptom may be solved!
 - A part of the problem may be solved!
 - Or a partial solution is obtained

Problem Definition (Answer to “what is THE problem?”)

- Process of Defining Problem
 - Outline why the present situation is so dissatisfying
 - Asking questions about it
 - Comparing it to other situations that are familiar or where experience already exists
 - Gaining and understanding what caused it.
 - Then “*one sentence problem statement*” which includes every element
- Example
 - Needs from customer: “Actually, we need help figuring out how to fit everything in our room.. it’s way too small for all of our stuff,”
 - Problem Definition: “We need to rearrange the contents of the room in such a way as to increase the efficiency of space usage and the convenience of item location”

Gathering Information

- Search for Current Status of Art
 - Patent Search
 - Web Search
 - Market
- Customer Interview
 - Customer Interview
 - Focus group interview
 - Objective is to define needs not to wring out a solution
- Gathering Information from Within the Design Team
 - Draw insight from previous experiences
 - Focus on customers needs NOT their own needs
 - Use Creativity

Creativity

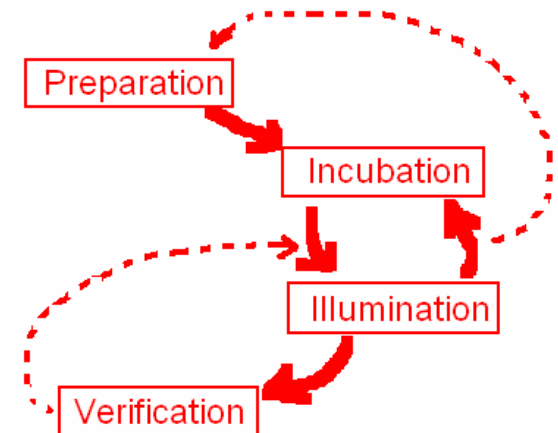
- Unleashing Your Creativity- “How can one gain better access to his or her creative energy?”

Fill in the missing number.

5	6	7	8	9
52	63	94		18

- Creativity as Process

- **Preparation:** Ground work. Background of the situation
- **Incubation:** Taking time out. A rest period.
- **Illumination:** Getting the answer (Aha!). The light bulb is on! Generate Ideas.
- **Verification:** Does the idea work? Confronting and solving the practical problems.



Attributes of Creative People



- Discipline and Self-Confidence
- Adaptability and Resilience
- Conceptualization and Recall
- Flexibility and Fluency
- Visualization Ability
- Curiosity
- Comfort with Complexity
- Mental Agility, detachment, and p
- Skeptical of Accepted Ideas
- Persistence and Capacity
- Informality
- Originality

Approaches for Creative Solution

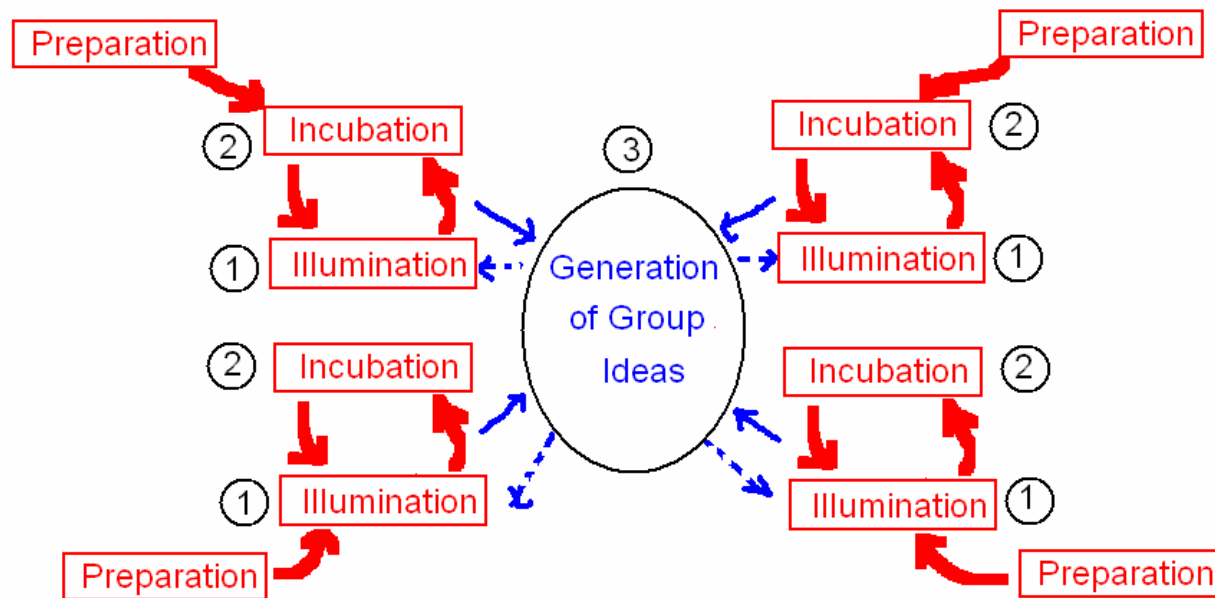
- Powerful approaches
 - Brainstorming
 - Creation of Affinity Diagram
 - Creation of Cause-and-Effect Diagram
 - Synectics
 - “joining together different and seemingly irrelevant elements”
 - Analogy (Personal, Direct, Symbolic, Fantasy)
 - TRIZ
 - The Theory of Inventive Problem Solving
 - Systematic method based on the hypothesis that creative innovations follow universal principles which can be followed.

Brainstorming

- A group process
- Popularized but misunderstood –
 - Not just “sitting down and thinking of it
- A process with guiding principles
- Primary Goal
 - Generation of a large quantity of ideas
- Core Elements
 - No judgment of other people’s ideas is
 - No judgment of your own ideas is allowed
 - Build onto the ideas of others
 - Welcome wild ideas
- People Involvement
 - Gather a diverse team of people
 - Designate a facilitator
 - Keep everyone involved

Team Idea Generation

- Team Idea-generation Strategy
 - Illuminate the first time individually: “generate ideas”
 - Incubate: “set the problem aside”
 - Presentation of individual ideas and build on them in group brainstorming
 - Incubate
 - Generate ideas as a team, and cycles of incubation-illumination- until....



Attention-Directing Tools

- Affinity Chart

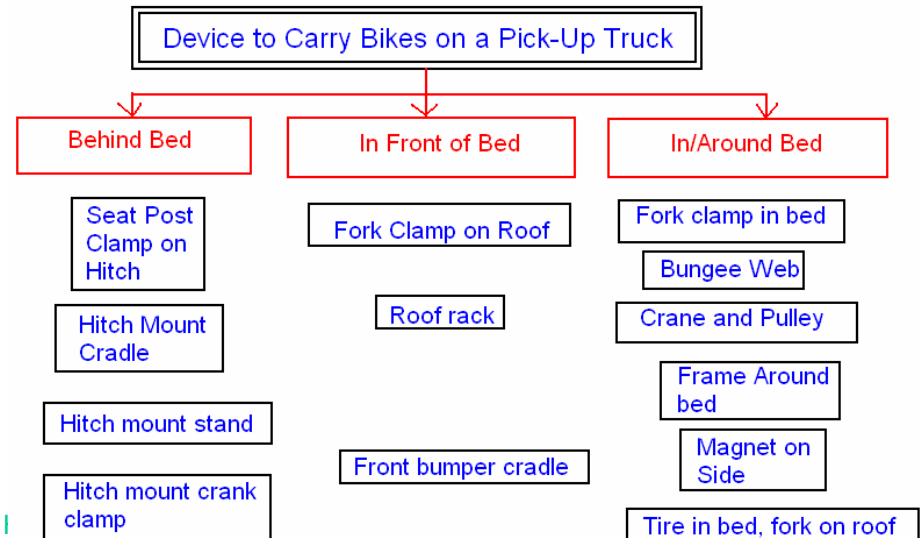
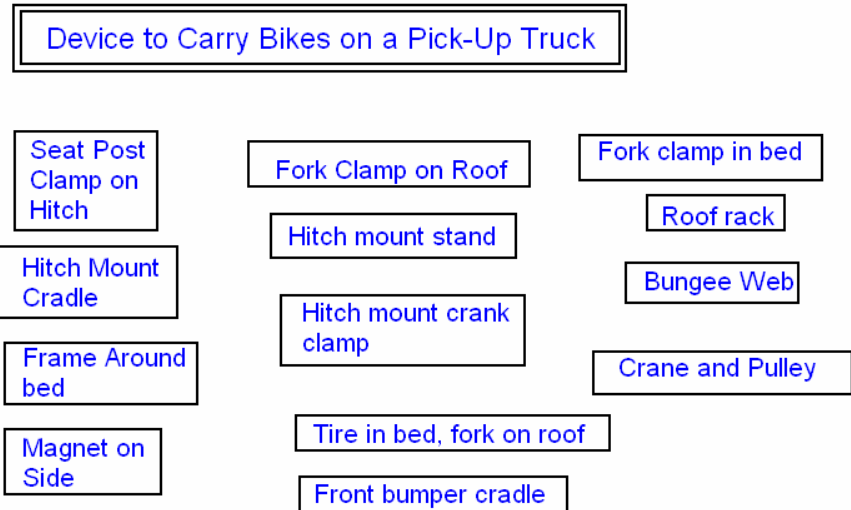
- Team has a big list of ideas (after brainstorming) and is not sure what to do with it
- Grouping similar ideas into **categories**

- Fishbone Diagram

- Team wants to identify **causes** for a problem
 - Examples:
 - What are all possible safety issues with the design?
 - Why are meetings always so unproductive?

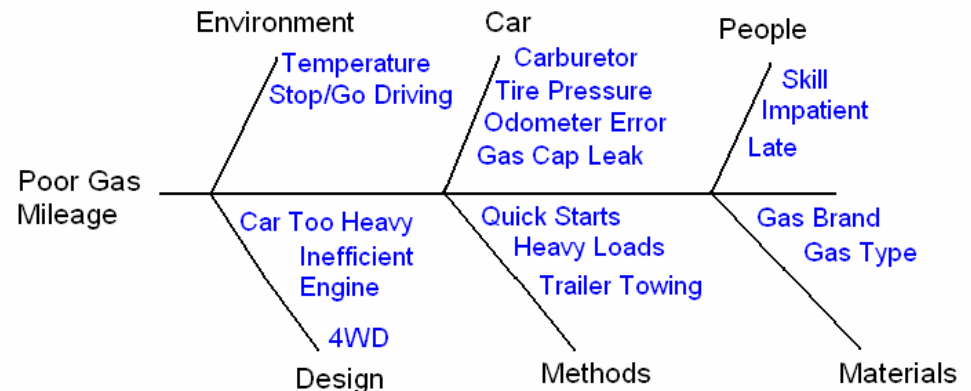
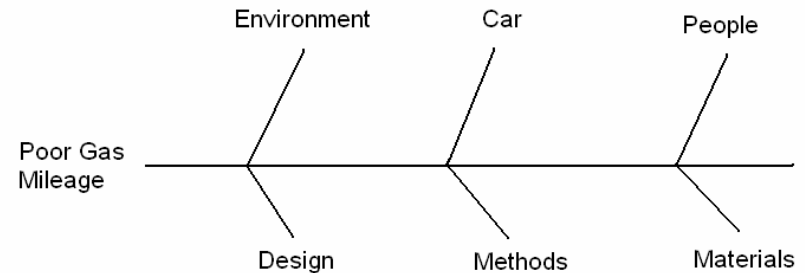
Affinity Chart

- Groping Ideas into Categories
 - Generate Ideas
 - Sort the ideas
 - Create Headings
 - Draw an Affinity Diagram



Fishbone (Cause-and-Effect) Diagram

- The opposite of Affinity Chart
- Start from Categories and Ideas are found to fit within each category
 - Develop a problem statement
 - Construct an empty fishbone diagram with major cause categories identified
 - Generate ideas for each category
 - Identify most likely causes



Charles

Class Activity

- Form a Group (temporary)
- Define the needs and Identify the problem of “Method of E-Waste Reduction” by
 - Individual Idea Generation (10 minutes)
 - Internet Search Allowed
 - Brainstorming (10 minutes)
 - Affinity Chart OR Fishbone Diagram (10 min)
- Submission (10 min)
 - Description of (summarizing the chart or diagram)
 - Problem Definition --- 1 sentence

E-Waste Problem

- E-waste:
 - consumer and business electronic equipment that is near or at the end of its useful life
 - Certain components contain hazardous materials
 - The mantra of "**Reduce, Reuse, Recycle**"
- Fundamentally better way of solving the E-waste problem?

Homework

- Customer Needs:
 - “I am a disabled man and I have difficulties when I am reading to turn page of book.”
- Homework:
 - Identify the problem and
 - Gather information, and
 - Define the problem with 1 sentence.
- Due: Next Wednesday (before class starts)
- Submission:
 - Materials (notes, descriptions, drawing, etc)
 - One sentence problem definition (hardcopy)