Analysis of Trends and Patterns

- The goal is to identify the trend or pattern precisely
  - Don't stop at simply identifying the "next step".
  - Explicitly state what the pattern is that defined the next element in the series.

Sample   Problems

- A B A C A D A E __ __ __

- 3 4 6 7 9 10 12 13 15 16 __ __ __

- 2 7 4 9 6 11 8 13 __ __ __

- 1 z 3 w 9 t 27 q 81 __ __ __

- JKLMNO JKLMON JKLOMN JKOLMN __ __

Jars Problem

You have 3 jars, of sizes 11 quarts, 9 quarts, and 4 quarts. You would like to use these jars to collect 6 quarts of water in one jar. How?

A	B	C	Goal	
11	9	4	6	A – B + C
21	127	4	98	
15	90	4	67	
14	163	25	99	
18	43	10	5	
9	43	6	22	
20	59	4	31	
14	36	8	6	
28	76	3	25	

Don't be Blind

- For most problems, people use a relevant strategy from habit.
  - There's an excellent reason for this: It usually works!!
- Sometimes, the habit strategy is a bad match for the problem.
- In this case, people can act like they are "blind" to the solution.
- Example: Water jar problem.

Einstellung

- "Einstellung" is the state of being "blind" or "tuned-in" to something.
- "Functional Fixedness": People often fail to see alternate uses to an object once they assign it a role.
- People are fairly predictable in their susceptibility to functional blindness.
- Awareness of the problem helps to avoid it.
- This is real issue for students and in "real life"
  - Example: Debugging, algorithm design

Lateral Thinking

- "Vertical thinking" is sticking with the current approach, being rigid.

- "Lateral thinking" is coming at a problem from a different (perhaps nonstandard) direction.

- Often, just realizing that this should be done is enough to find a good solution (getting out of the old approach).

- Of course, it can be hard to tell when you are in the trap! It helps to have a "flexible" mindset.

Examples of Lateral Thinking

- Unsticking a car lock on a cold night
  - Approach 1: Heat the key
  - Approach 2: Unfreeze the lock (with alcohol)
- Need to iron a shirt, but no iron
  - Iron with something else (a frying pan)
- Sheep in front of the truck
  - Approach 1: Beep horn, try to push or scare sheep
  - Approach 2: Lead the sheep behind the truck

How to Facilitate Flexibility?

- Brainstorming (Chapter 6 in Fogler/LeBlanc)
  - Generate ideas
  - Usually done in groups
  - Don't judge – respect crude ideas
  - Quantity is important
- Brainstorming is a skill that can be developed
  - Skills are developed by practice

✧✧A contrary view: D. Boyd and J. Goldenberg, "Inside the Box: A Proven System of Creativity for Breakthrough Results," Simon & Schuster, 2013.

The Intermediate Impossible

- For really hard problems
- Generate an impossible solution
- "Play with" that solution
  - Expand on it, modify it
- Thus, the "impossible" solution is an intermediate step to a feasible solution

Example Problems

- Unloading cargo ships takes a long time.

  - Unload at sea?

- New (taller) cargo ships cannot enter a port city due to a bridge.

  - Lower river?

- A factory dumps pollution into a river.

  - If the factory had to suffer from the pollution, they would be motivated to clean it up. So, put factory intake downstream from factory discharge?

Random Associations

- Pick an (interesting) word out of the dictionary.
- Let it stimulate your mind.
- Problem: Noise pollution
- Word: Anthracite
  - Comes from under ground
    - Put noise underground?
    - Put quiet places underground?
  - Black
    - Eyelids cover eyes… cover ears?

Analogies and Metaphors

- Many inventors take analogies from nature
  - Tunnels underwater: worms tunneling in wood
  - Microphone (for telephone) from the ear
  - Infection cause deduced from observing fermentation of wine
  - Spider nets lead to fishing nets

Sleep On It

- Passage of time can unstick many problems.
- The mind "incubates" the problem.
  - Perhaps works on problem unconsciously.
- Each of us has circumstances in which we are most creative:
  - lying in bed, taking a shower, waiting for an appointment.
  - Take advantage of this.
- Must give yourself time to solve the problem.
- Example: debugging a computer program.

Sleep On It (cont)

- It gives you a chance to come at the problem with another approach
  - Does the solution occur to you?
  - Perhaps a new approach that immediately leads to the solution?
- Promotes (allows) lateral thinking