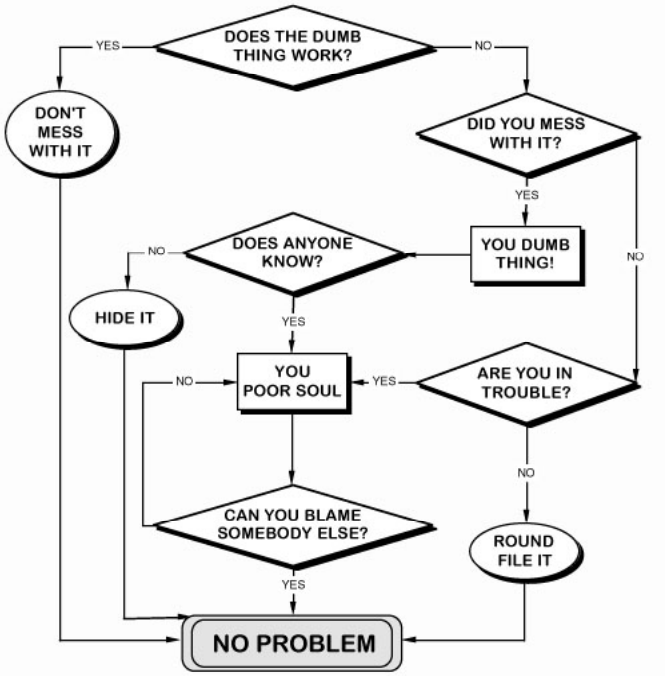


Solving Problems with Methods Questions

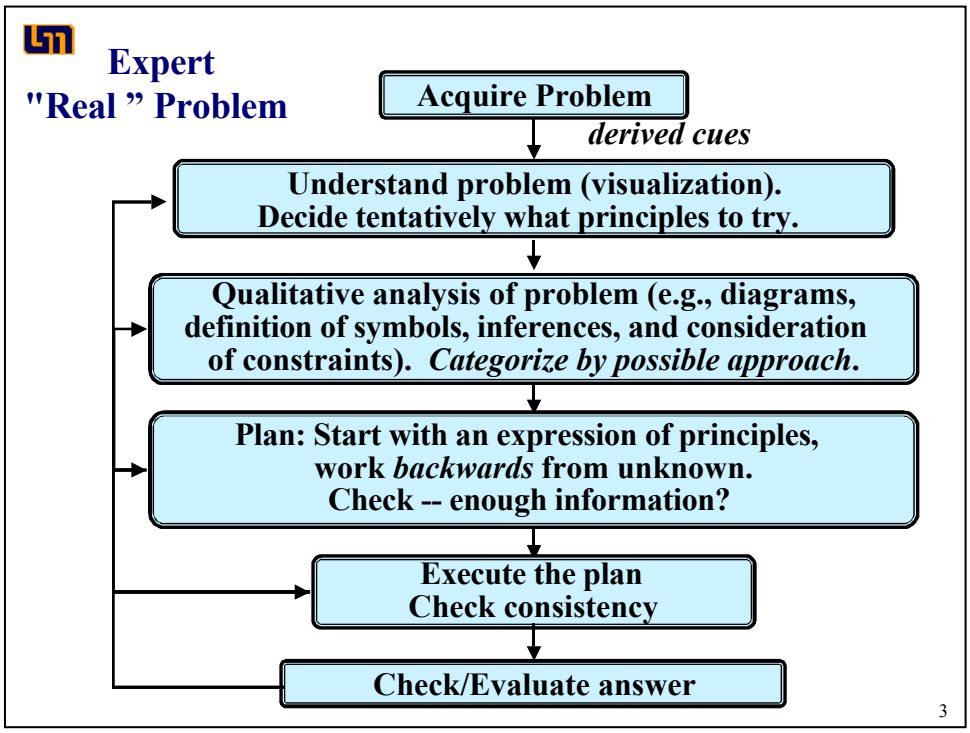
1

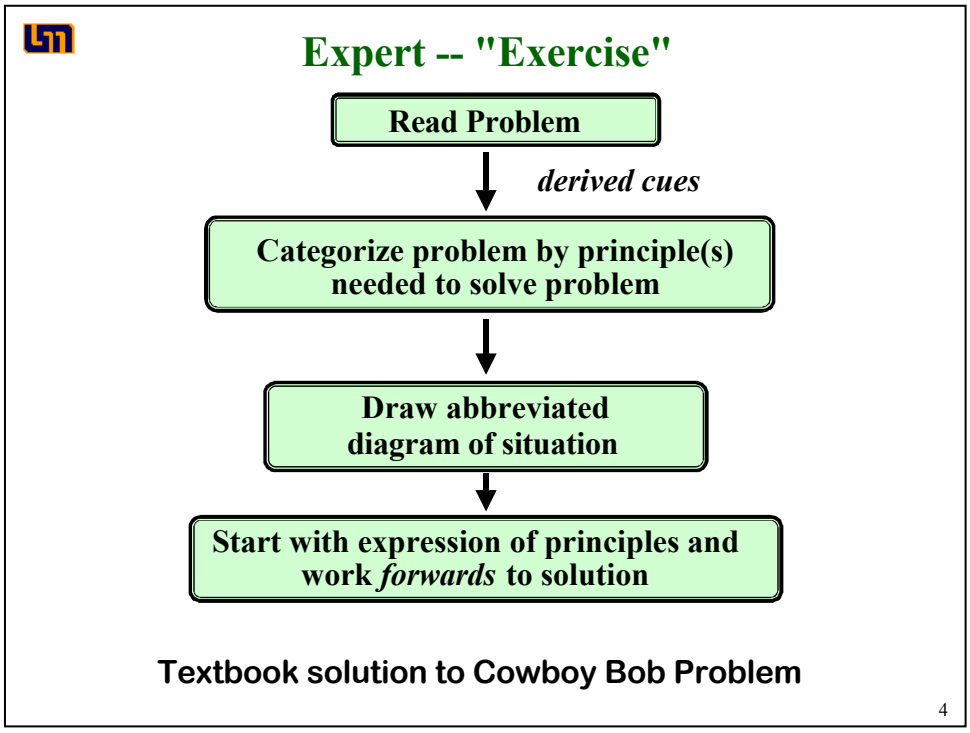
Problem solving is a process similar to working your way through a maze.

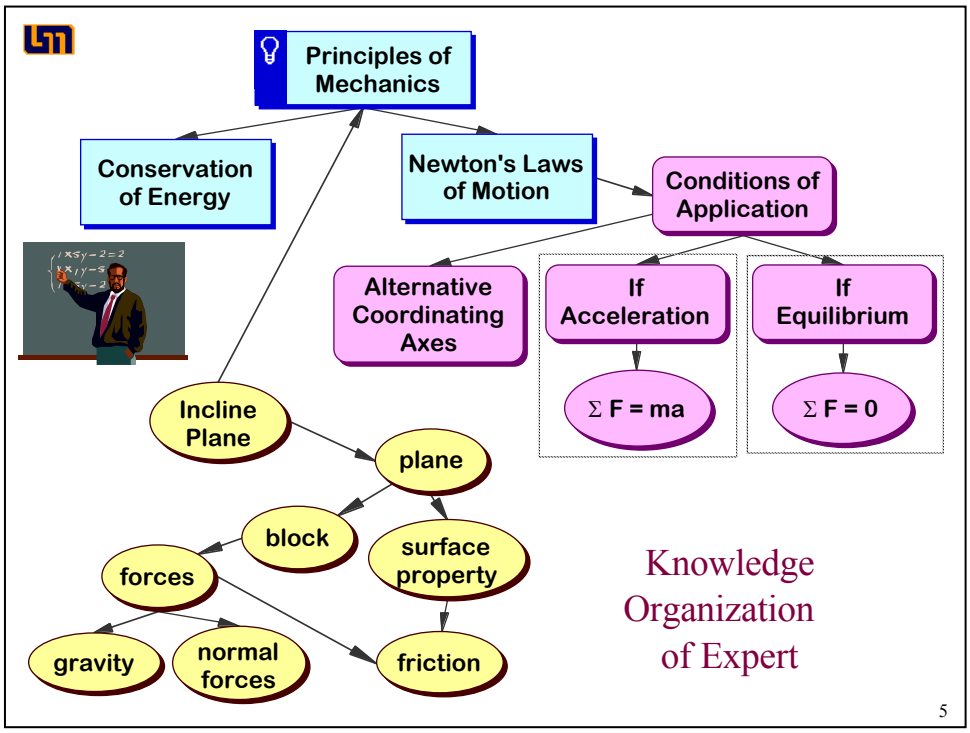
You navigate your way through a maze toward your goal (solution) *step by step*, making some false moves but gradually moving closer toward the goal.

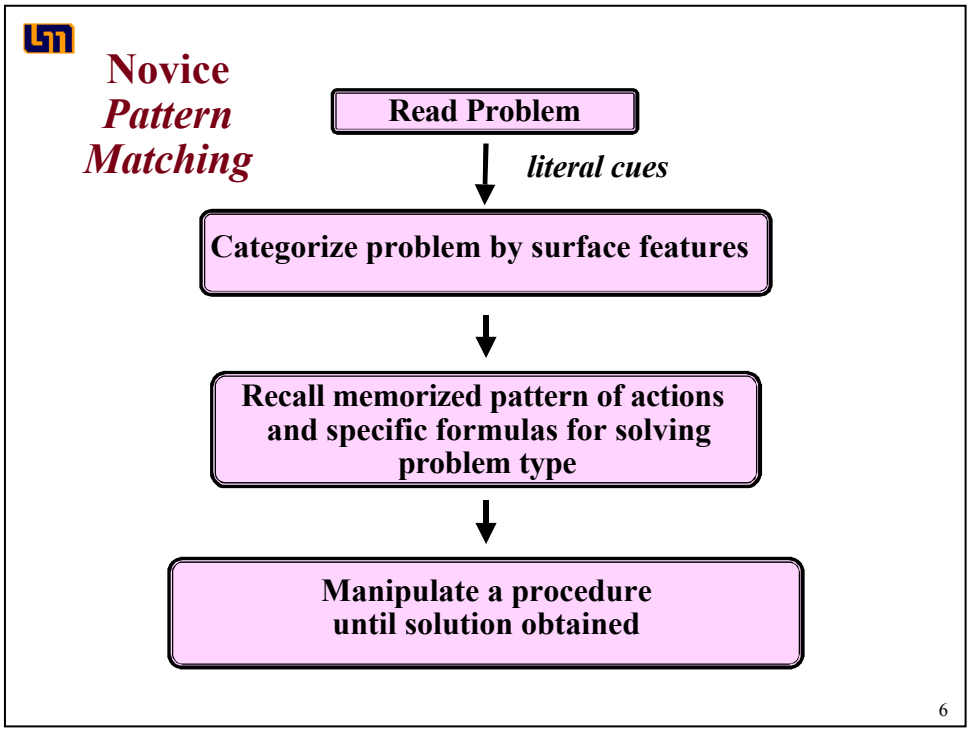
But what are these "steps" and what guides your decisions?

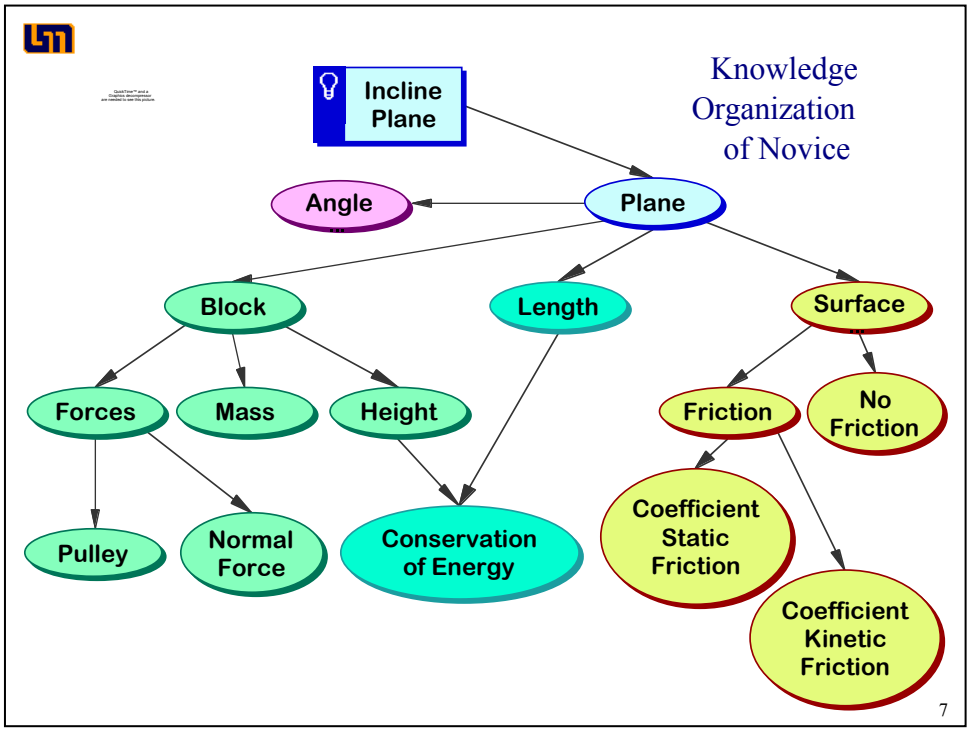
2


Expert
"Real " Problem
Acquire Problem
derived cues
Understand problem (visualization).
Decide tentatively what principles to try.
Qualitative analysis of problem (e.g., diagrams, definition of symbols, inferences, and consideration of constraints). Categorize by possible approach.
Plan: Start with an expression of principles, work backwards from unknown.
Check -- enough information?
Execute the plan
Check consistency
Check/Evaluate answer
3


Expert -- "Exercise"
Read Problem
derived cues
Categorize problem by principle(s) needed to solve problem
Draw abbreviated diagram of situation
Start with expression of principles and work forwards to solution
Textbook solution to Cowboy Bob Problem
4


Principles of Mechanics
Conservation of Energy
Newton's Laws of Motion
Conditions of Application
Alternative Coordinating Axes
If Acceleration
If Equilibrium
Σ F = ma
Σ F = 0
Incline Plane
plane
block
surface property
forces
gravity
normal forces
friction
Knowledge Organization of Expert
5


Novice Pattern Matching
Read Problem
literal cues
Categorize problem by surface features
Recall memorized pattern of actions and specific formulas for solving problem type
Manipulate a procedure until solution obtained
6



For freshmen, many physics problems are real problems, not exercises.

So how can students be coached in using a logical, organized process for solving real problems?

1. **Discussion Section:** Focus of final discussion is on the *qualitative analysis of the problem*, not on the mathematics.

2. **Laboratory Section:**

(a) Students answer *Methods Questions* (before lab) that provide a guide or framework for how to solve each laboratory problem in a logical, organized fashion.

(b) Focus of discussion is on Methods Questions that are part of the qualitative analysis of the problem.

8

Using Methods Questions for Coaching

INDIVIDUAL AND GROUP TASKS:

1. **Individually** read the passage below. Participate in a class discussion about this passage

> The procedure is actually quite simple. First, you arrange them into different groups. Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities that is the next step; otherwise, you are pretty well set.
>
> It is important not to overdo things. That is, it is better to do too few things than too many. In the short run, this may not seem important, but complications can easily arise. A mistake can be expensive as well. At first, the whole procedure will seem complicated. Soon, however, it will become just another fact of life. It is difficult to foresee any end of the necessity of the task in the immediate future, but then, one can never tell.
>
> After the procedure is completed, one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more and the whole cycle will then have to be repeated. However, that is a part of life.

2. You will be given directions for a group discussion with specific questions about using Methods Questions for coaching.

COOPERATIVE GROUP ROLES:

Skeptic: Ask what other possibilities there are, keep the group from superficial analysis by not allowing the group to agree too quickly; ask questions that lead to a deeper analysis; agree when satisfied that the group has explored all possibilities.

Manager: Suggest a plan for answering the questions; make sure everyone participates and stays on task; watch the time.

Checker/Recorder: Ask others to explain their reasoning process so it is clear to all that their suggestions can be discussed; paraphrase, write down, and edit your group's answers to the questions.

TIME: 20 minutes.

One member from your group will be randomly selected to present your group's answers.

PRODUCT:

Overhead of group answers. One member from your group will be randomly selected to present your group's answers.