Def: Acquiring new skills, attitudes or knowledge.

WHY IMPORTANT?
1. Survive formal education.
2. Develop lifetime learning skills.
3. Provide knowledge in a form needed for problem solving.
4. Learn with and from others.
5. Prepare for small group, self-directed, self-assessed, interdependent problem-based learning.

Pretest: Use an "x" to rate your Awareness & Skill

Time 10 s Finish by ______

Objectives...
Read over...

Time ______ Finish by ______

Where it fits in....

Where it fits in....

Pretest, objectives

Route ahead

Address issues based on Research about learning:

- Attitude: motivated & expect success
- Time on task: be organized
- Be active
- Cooperate
- Quality of interaction
- [Prompt feedback]
- Exploit personal style
- Exploit teacher's learning environment
- Improve retention
- Knowledge: structure, elaborate, cues
MPS 12: Learning. Research says:
Learning improves if students (learners) are:
1. Motivated.
2. In an environment that expects Success.
3. Clear for time and task
4. Actively engaged in the learning (not passively listening/reading).
5. Working cooperatively together (not competitively).
6. Experiencing quality interaction with instructor inside & outside of class. High social environment.
7. Receive prompt feedback.
8. In an environment that caters to the learner’s personal learning style.

MPS 12: Learning 1. Be motivated & 2. Expect success. Research says... expect success
Visualize yourself in control:
who is in charge of your learning?
You? the Prof? the University?
Set your learning goals
Reward yourself

Activity: Be proactive
as an individual list opportunities for motivation & to show that you expect success.
TIME __ min.

MPS 12: Learning 3. Clear time on task
Research says... have clear time on task
Related to motivation &
to time management MPS 17:

Have clear idea of what task you are going to do, the resources you will use and then do it!

Write reflections ________
3. Be Active
Research says... Dale's Cone of learning
We tend to remember

10%
Reading

20%
Hearing

30%
Looking at picture

PASSIVE

50%
watching a movie
looking at exhibit
watch demonstration
see it done on location

70%
discuss
give talk

ACTIVE

90% of said & do
do drama
simulate real
do real thing

What does "be active mean" for your learning?

Activity
Form groups of _______ or individual
share ideas about how you can be active.

TIME _______
MPS 12: Learning High Quality & numerous interactions with professors & students outside of class

What can you control?

Activity as _______ individual _______ group of _______
Brainstorm ideas on this

TIME ________

Share

Reflections ____________

MPS 12: Learning Get Prompt feedback

Teacher owns this one... or does he/she?

How might you get prompt feedback on your learning task?

Activity: as group of _________ Brainstorm ideas

TIME ________

Reflections ____________
Exploit teacher’s learning environment.

You don’t have control over what environment the teacher elects to use:
lecture
cooperative groups
teams
Discussion
Presentations
Laboratories

Problem-based learning
But... you can understand and exploit the uniqueness of each.
Often, professor uses the lecture
This is passive, you sit, make notes....

10 to 50% from Dale’s cone for learning

Is the lecture for Learning?

Activity: as groups of 3 to 4 what is the purpose of the lecture? Why go? What can you gain from a lecture that you cannot gain from reading the required text?

TIME ___ 5 min___

Report Ideas

Write reflections ________
MPS 12: Learning Lecture notes
Bring your lecture notes from day ________ for course ________.

In a set of information; there is usually
- the subject knowledge eg. Fundamentals of Chemical Engineering
- examples values, applications
- suggestions for problem solving

Activity As ______________ For the first ___ 15 min__, classify the information into these categories and then identify for the Subject knowledge:
1. The most important information for you to learn
2. The most important concept introduced
3. The fundamental law behind that concept

TIME __________

Option 20

MPS 12: Learning Lecture notes
With the lecture notes in hand, Form a line based on Jungian typology

S N

Number off, # 1 (dominant S) get together with number middle of line, #2 with ______ with next; and so on until middle is together with dominant N.

In pairs, compare lecture notes.

TIME __________

Reflections __________

Option 22

MPS 12: Learning Lecture notes
You receive of copy of the lecture notes taken by the instructor who has a Jungian SN indicator of ________

In groups of __________ Compare your notes with those of instructor.

Report:
Similarities Differences

Reflections TIME ________

Option 23
MPS 12: Learning Lectures.

Your professor uses the lecture format. Your professor is SN.....

Activity: Form small groups of 3 or 4 that have similar SN Jungian typology.

In the context of the lecture, what might you request of the instructor to improve your learning.

TIME ________________

Share ideas

MPS 12: Learning Lecture: Ideas to request of professor to improve your learning

- summarize key ideas
- present major ideas visually, verbally & symbolically
- use ombudspersons
- give us 2 minutes every 20 minutes to write reflections about what we have learned so far
- help us to see the main points
- give us his/her version of concept maps for sections
- tell us what to read ahead of time before class
- let us complete the Course Perceptions Questionnaire after midway through the course.
- tell us his/her Jungian SN and TF dimensions
- tell us his/her view of the purpose of the lectures.
- ask the Chair of the Department to ask professor to do the above

MPS 12: Learning Your personal learning style

From MPS 11, p. 1112 Consider the results of inventories and reflect.... does this represent me?
Implications for studying and learning.

Visual symbolic verbal
diagrams? Equations? Word
Show me Write equns Explain it

Symbolizer; \(dT/dx = \text{constant}\)

Verbalizer Visualizer
Temperature increases with distance
MPS 12: Learning Learning style
Example: how do you think about this problem?

A tolquot is equal to 4 quamquats. Vessel A has a base of 1 tolquot by 1 tolquot with a height of 1 quamquat. Vessel B has a base of 1 quamquat by 1 quamquat with a height of 1 tolquot. Which vessel holds more water?

Draw a sketch?

Use symbols 1 T = 4 Q
Vessel A is T x T x Q = volume = 4Q x 4Q x Q
Vessel B is Q x Q x T = volume = Q x Q x 4Q

MPS 12: Learning Your learning style
In clusters with similar learning styles based on Visualizers, verbalizers, symbolizers and on Jungian SN

S Visualize  S Verbalize  S symbol
Visualize  Verbalize  Symbol
N Visualize  N verbalize  N symbol

Activity
Discuss:
lectures, Lecture note taking
selection of textbooks
selection of study partners.

TIME ____________

MPS 12: Learning Improving retention
Research says.....

- write it
- review systematically To maintain need
  first review for 10 min after 10 after
  2nd review 2 min after 24 h
  3rd 10 min after 1 week
  4th 10 min after 1 month
  5 th 10 min after 6 months

MPS 12: Learning Research says:

1. New Knowledge is understood in the context of old

2. Knowledge has structure

3. Knowledge is used for a purpose
1. New knowledge is understood in the context of old knowledge

not an empty vessel to be filled

Where does new fit in?

my head is full

MPS 12: Learning New into old, So What?
Possible misconceptions.

Examples in Physics.

- Misconception: Mass cannot discriminate from weight
- Friction cannot establish a causal relationship between normal force & retarding force
- Acceleration is dependent on mass of object due to gravity

Electric power & current describe same physical quantity

- Electrons get used up as a battery wears down
- Concept Possible misconception

MPS 12: Learning New into old. So what?

- Identify new concept carefully; think about past experience. Do you think of it this way?
- Force, work energy, power, heat
- Many examples in Physics
- Note differences between precise definitions used in science & engineering and the everyday use.

- Elaborate on new ideas in context of old. What is this related to? Similar to? Different from? Easy to confuse with?

Activity: for the concept of ________
list 10 everyday experiences that might be related

TIME ________
MPS 12: Learning Knowledge has structure & vital interconnects and conditions

- hierarchical
- with fundamental laws on top, - surface structure, approximations, simplifications, special cases are at the lower levels.
- encoded with the fundamentals are chunks that encode the fundamentals to identify the conditions, constraints when the knowledge is applicable.
- "concepts" are defined to allow us to apply the fundamentals easily.
- encoded with subject knowledge should be experience or tacit knowledge that allow us to work qualitatively with the knowledge.
- knowledge is organized in chunks for convenient processing.

MPS 12: Learning Knowledge Structure, eg.

a. Unsuccessful problem-solver's script for a circuit problem

MPS 12: Learning So what? Take time to be complete when make connections:

- Surface rote learning: memorize stuff; recall bits & pieces with no idea of main theme
- Semi-deep: recalls conclusions but no idea of reason, evidence, basis fundamentals underlying it.
- Deep: conclusion, equations, main theme, context, evidence, conditions

Use Approaches to Studying LASQ to provide idea of current emphasis.

MPS 12: Learning Fundamentals in Science & Engineering. Fundamental law is a universally applicable explanation of how things behave. We have about 8 laws.
1. Conservation of mass (& of elements) except for nuclear reactions or E = mc²
2. Conservation of momentum
3. Conservation of charge
4. Conservation of energy except for nuclear reactions or E = mc²
5. Second law of thermodynamics: criteria for stable equilibrium: Systems at constant pressure and temperature adjust to try to minimize the total Gibbs free energy in the system.
6. Reactions occur in stoichiometric proportions. Think moles!
7. At equilibrium, to every action there is an equal and opposite reaction.
8. F = ma
9. You can't push on a rope.

Most of the so-called "laws" are wishes. Ideal gas wish. Raoult's wish. Henry's wish. Einstein's wish for viscosity, Newton's wish for viscosity, Fourier's wish for thermal conductivity; Fick's wish for diffusion.

MPS 12: Learning Examples from Physics

force
force... acts on < > on <particle> by <other particles>

acceleration
acceleration of < particle> at <time> relative to <reference plane>,

Model correlation law

correlation that applies for <condition>, <condition> and <condition> to < ± accuracy > and that needs <input data>.

MPS 12: Learning
1. Law always simplified definition, use of a law
2. (Wish/ constrained law)
3. Theory relates dependent and independent variables & mostly based on laws or wishes
4. Model representation to explain behavior
5. Balance equation applied to a conserved entity
6. Empirical correlation no model used. Curve fit and "constants" determined from experiments.
7. Semi-empirical correlation model where the "constants needed to match reality are determined from experiments. Identify conditions.
8. Concept
general term for idea
9. Convention agreed-upon set of rules
10. Postulate simplified set of agreed-upon conditions
MPS 12: Learning vapor-liquid equilibrium

At equilibrium, & constant T and P the Gibbs free energy in one phase for the species (chemical potential) = Gibbs free energy for that species in the other phase.

\[ \sum x_i \Delta G_i = 0 \]

\[ x_i = \frac{q_i}{q_i^0} = \frac{\mu_i^0}{\mu_i} \quad \mu_i^0 = \mu_i + RT \ln x_i \]  
\[ \mu_i = \mu_i^0 - RT \ln x_i \]

**Example Concept Map**

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MPS 12: Learning

For the concepts, “laws” and wishes you are learning, identify which of the 10 pertains (TR 39).

With the help of the professor or the TA find the connection.

Jill Larkin created a checklist to be used to remind us of the types of information we need to determine (and internalize) for equations, “laws”, concepts.

Larkin found that concepts and equations that are most difficult are...

Those that use symbols or concepts that have multiple meanings:

x mole fraction? Mass fraction?

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MPS 12: Learning Larkin's research

**Physics**

\[ F = ma \quad x = v_o t + \frac{1}{2} a t^2 \]
\[ F = \sum F \quad v = v_o + a t \]
\[ f = \mu N \quad v^2 = v_o^2 + 2a \Delta x \]
\[ N = mg \cos \theta \quad v = (v_o + v)/2 \]
\[ F'g = mg \sin \theta \quad x = v t \]

\[ \Delta K = \frac{1}{2} m v^2 - \frac{1}{2} m v_o^2 \]
\[ W = \Delta K \]
\[ W = Fx \]
MPS 12: Learning
Which symbols have different meanings depending on the context?

Do you experience similar challenges in the subject you are studying?

Activity: Complete a Larkin checklist for

TIME ___________

MPS 12: Learning Knowledge has a purpose
.... to solve problems Problem solving
MPS 12: Learning: Knowledge has a purpose:
... to solve problems: exercise solving

MPS 12: Learning: Knowledge & problem solving
So what? Research says....

Unsuccessful
immediately translate into symbols and focus on
symbol manipulation without understanding
what is really going on."I
know, this is the equation
that applies"

Successful
Focus on the
observations; describe in
words what's going on.
Tend to start with
concrete events in Kolb's
cycle.

Tend to start on the
abstract end of Kolb's
learning cycle or recalling
worked examples

Use a strategy of cooking
past sample solutions to
match the current
situation.

Use "surface wording" of
the problem statement to
incorrectly identify what
they think is going on.

MPS 12: Learning Clement's research

Figure 14.1 Clement's model of internal knowledge

MPS 12: Learning Schoenfeld's research

Figure 4.2 The results of pattern recognition of novices versus experts

Unsuccessful looks at words
Successful considers principles
MPS 12: Learning

MEMORIZE pointers and cues that identify fundamental law that applies and conditions.

MPS 12: Learning

When creating the internal representation we need to be able to estimate, approximate, play around with ideas. We need Experience knowledge: Memorized, values to allow us to use the knowledge.

Velocity: how fast does a car travel 2000 km/h? 1 km/h?

What is a reasonable value for Henry's law constant?

For the density of water

for the density of benzene?

For the molar mass of carbon dioxide?

Activity: create a list of memorized values... with units... for the course so far.

TIME __________

MPS 12: Learning

SUMMARY:

Use an "O" to summarize your current awareness and skill

TIME ____ FINISH BY ____

OBJECTIVES.....

MPS 12: Learning

SYSTEMS

Discovered Application

Option-54

Option-55

Option-56

Option-57