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Concept Mapping as a Meaningful Learning Tool to Promote Conceptual Understanding and Clinical Reasoning for Resident and Distance Learning Students

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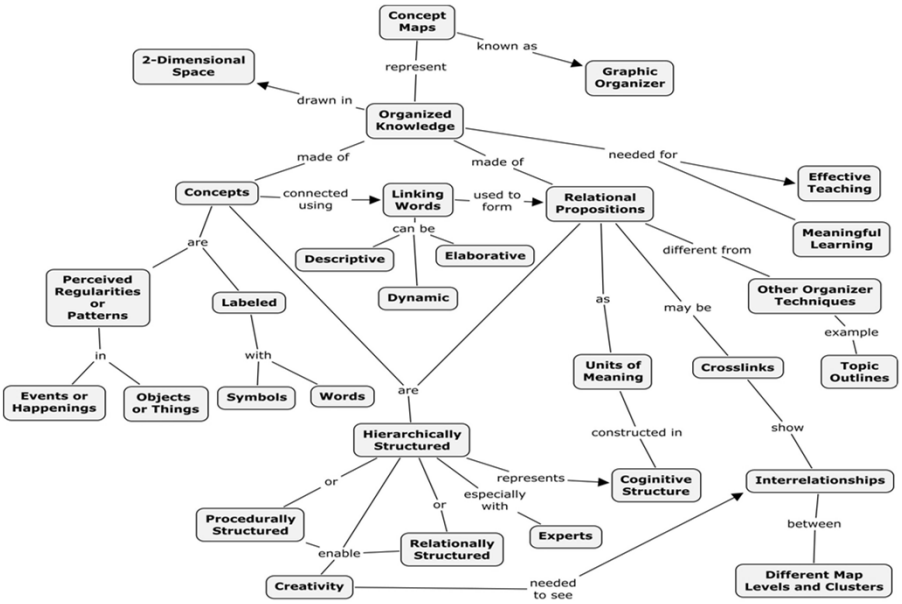
WORKSHOP ACTIVITIES

- Introduction
- Exploration
  - How to make and use C maps
- Explanation
  - Learning Theory, Research, and C maps
- Application
  - Practice making and using C maps

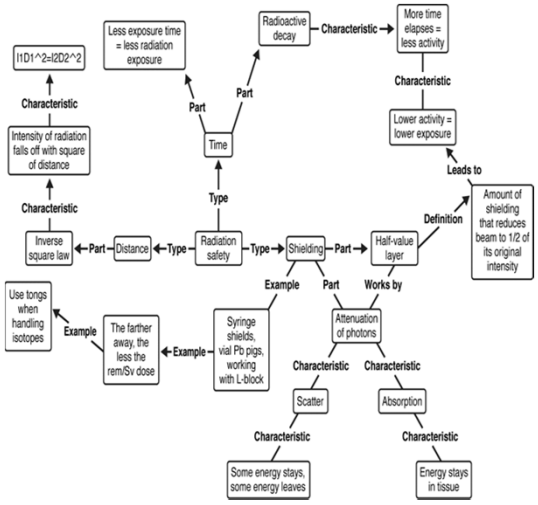
INTRODUCTION: CONCEPT MAPPING



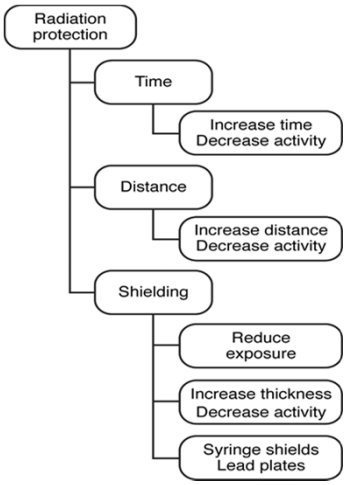
Novak & Canas. 2008. The Theory Underlying Concept Maps.

Introduction: Student Radiation Protection Concept Maps

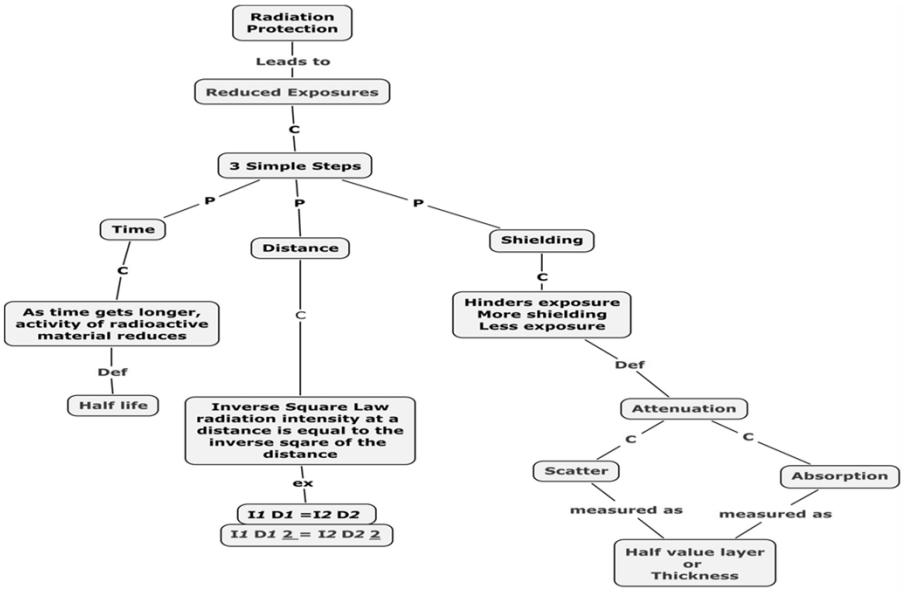
Map with relationships and interconnectivity



Map as "flow diagram": no relationships



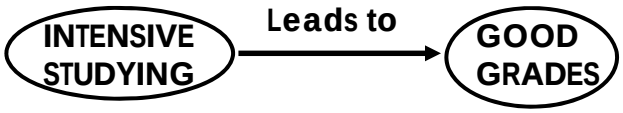
INTRODUCTION: CONCEPT MAP WITH REMEDIATION COMMENTS/CORRECTIONS



EXPLORATION: CONCEPT MAPPING

HOW DO YOU MAKE CONCEPT MAPS?

- **Simplest Unit is a Concept Dumbbell**
  - two concepts and their relationships in the form of two nodes and the link between them



EXPLORATION: CONCEPT MAPPING

HOW DO YOU MAKE SIMPLE CONCEPT MAPS?

- **Linking Relationships**

DESCRIPTIVE	DYNAMIC	ELABORATIVE
Type (T)	Leads to (L)	Example (EX)
Part (P)	Next (N)	Analogy (A)
Characteristic (C)	Influences (I)	Comment (CO)

(Dansereau & Cross, Knowledge Mapping. 1990)

EXPLORATION: CONCEPT MAPPING

HOW DO YOU MAKE CONCEPT MAPS?

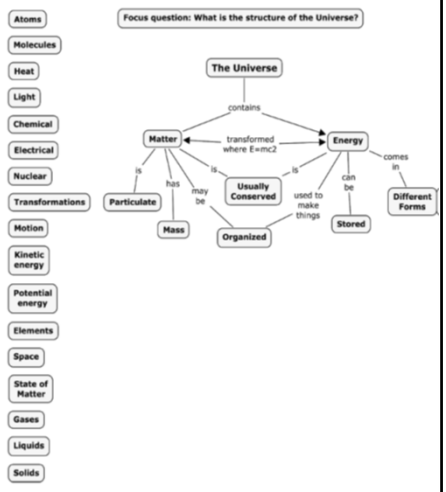
- **Novak (1984) :Ausubel/Hierarchical**
  - **Deductive**
  - **Good grasp of knowledge domain**
  - **Top to Bottom Approach most Efficient**
    - **Most Inclusive or General Concepts at Top**
    - **Narrow and Specific Concepts Underneath**
    - **Important to Identify Linking Relationships**

Novak and Gowin (1984). Learning How to Learn. NY, NY. Cambridge University Press

EXPLORATION: Focus Question Mapping

Concept List Parking Lot with Focus Question

Focus Question, Concept List, and Hierarchical Skeleton



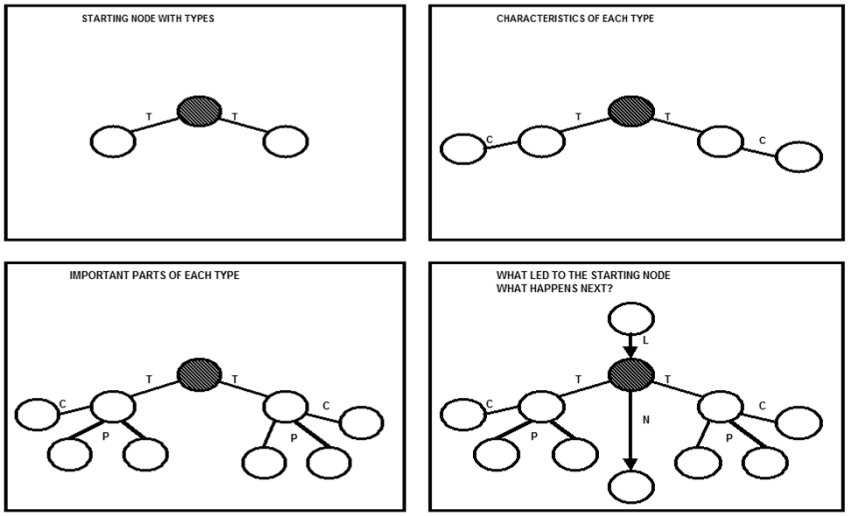
Novak & Canas. 2006. The Theory Underlying Concept Maps. http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf

EXPLORATION: RELATIONSHIP-GUIDED SEARCH - RGS

- **Start with a central concept and ask the following:**
  - **Can this concept be broken down into different types?**
  - **What are the characteristics of each type?**
  - **What are the important parts of each type?**
  - **What led to the starting concept? Or where does it lead to?**
  - **What influences the starting concept? Or what does it influence?**
  - **What happens next? Can I elaborate with an analogy or example?**

(Dansereau & Cross, Knowledge Mapping. 1990)

EXPLORATION: RELATIONSHIP-GUIDED SEARCH - RGS



EXPLORATION: CONCEPT MAPPING - RGS

- **YOUR TURN:**
- **Using the RGS questions and linking relationships listed in your handout, develop a simple concept map for the concept of COMMON COLD.**

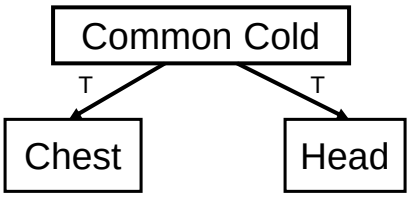
EXPLORATION: RGS – COMMON COLD

What are some types of colds?

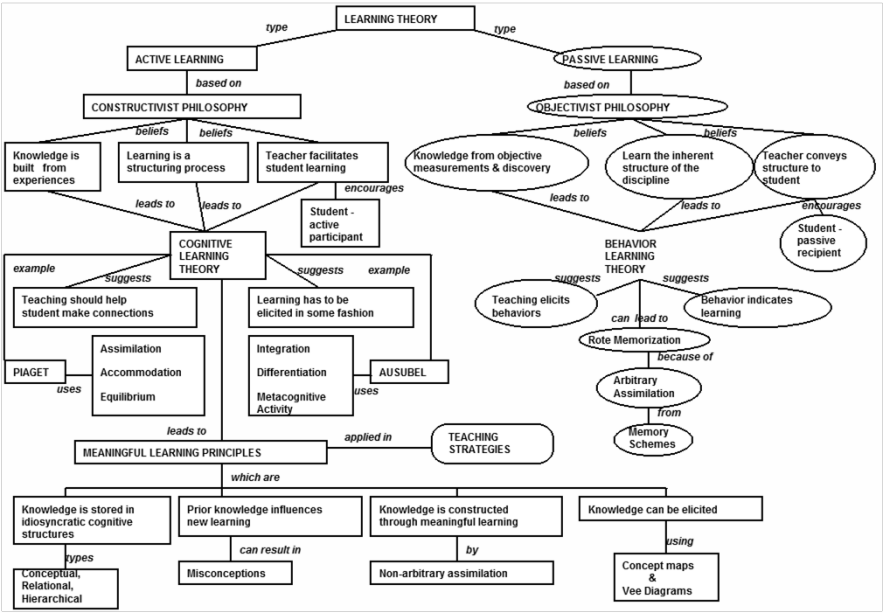
What are some characteristics?

What leads to a cold?

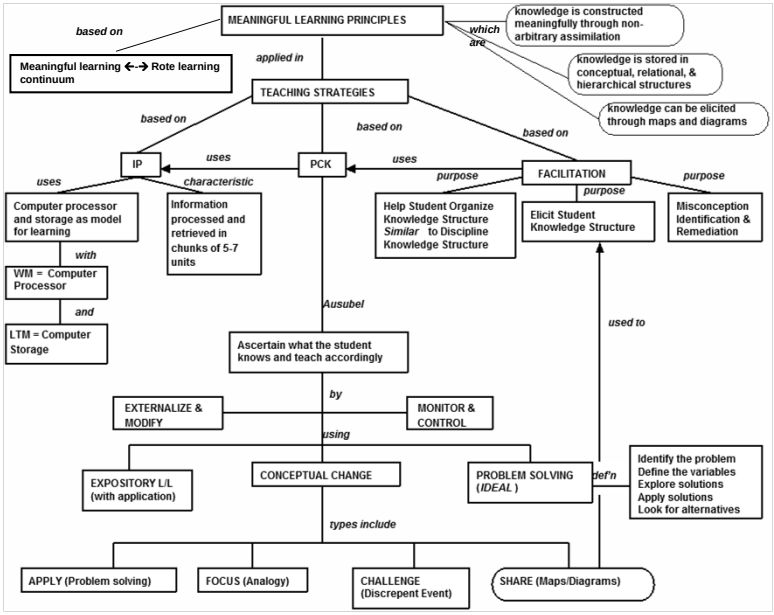
What happens next?



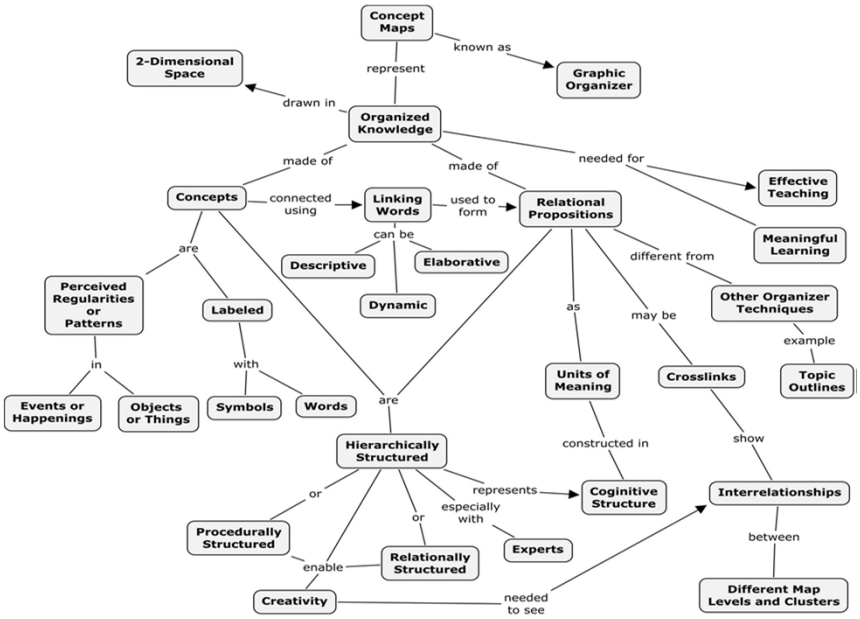
EXPLANATION: LEARNING & TEACHING



EXPLANATION: LEARNING & TEACHING



Explanation: Concept Mapping

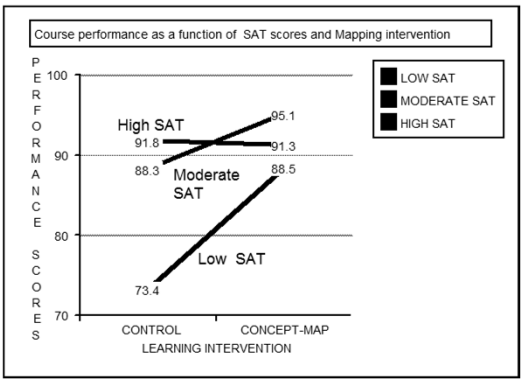


Explanation: Research Objective

- **Advances and complexities in the field of Nuclear Medicine require that NMT students move away from dependency on memorization and learn with a meaningful understanding of the discipline's principles.**
- **Metacognitive learning strategies are based on instructional learning theory which promote deep, meaningful learning.**
- **Test both resident and distance learning NMT students to determine if students perform better when traditional instruction is supplemented with the non-traditional metacognitive learning strategy commonly known as concept mapping.**

EXPLANATION: CONCEPT MAPPING EMPIRICAL EVIDENCE - RESIDENT STUDENT COMPARISONS

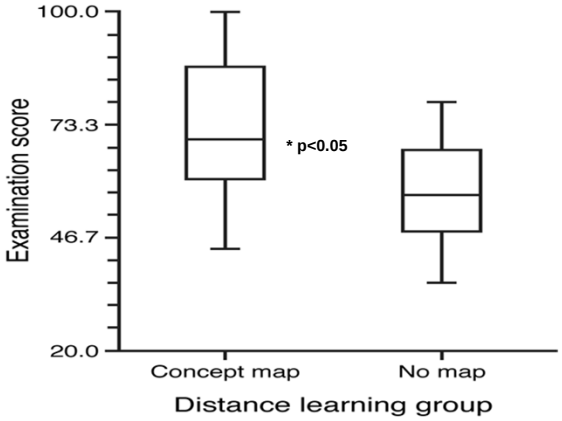
Note: results of applying
Concept Map intervention
to Radiation Physics w/Laboratory Course.
Significant performance gains noted. Some interaction.



ANCOVA F=5.123; p=0.0340; N=24

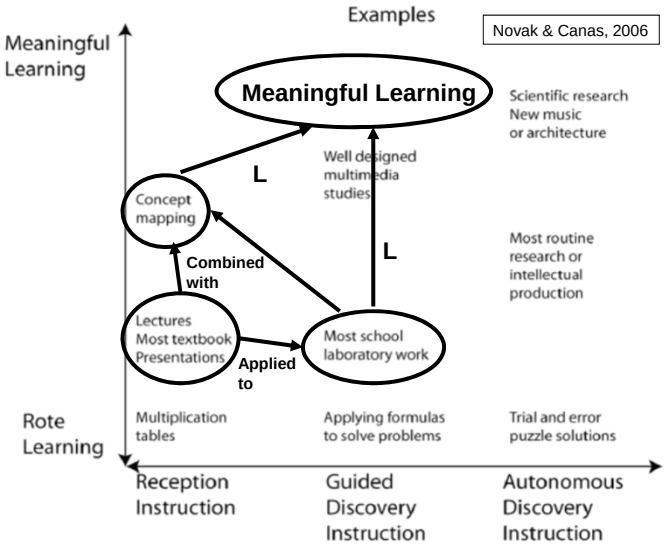
EXPLANATION: CONCEPT MAPPING EMPIRICAL EVIDENCE – DISTANCE STUDENT COMPARISONS

Note: comparison between mapping and non-mapping groups in Radiation Physics And Protection Course w/Laboratory



***Mann Whitney U Test:**
Z = -2.0381, p = 0.0415, n = 25

Explanation: Learning – Instruction Continuum Meaningful Learning from Concept Mapping



EXPLANATION: MEANINGFUL LEARNING FROM LABORATORY

From the Theory/Continua: A student who learns by….

- Rote Learning + Reception Instruction
  - Memorize clinical protocol
  - Unable to work with new protocol/change/modification/variation
- Meaningful Learning + Guided Discovery (Problems w limits)
  - Know protocol and Understand protocol
  - Able to work with new protocol/change/modification/variation
- Meaningful Learning + Autonomous Discovery (Problems w/o limits)
  - Understand protocol
  - Creates new protocol for each application
  - Process not suitable for clinical education/application

EXPLANATION: LEARNING AND LABORATORY

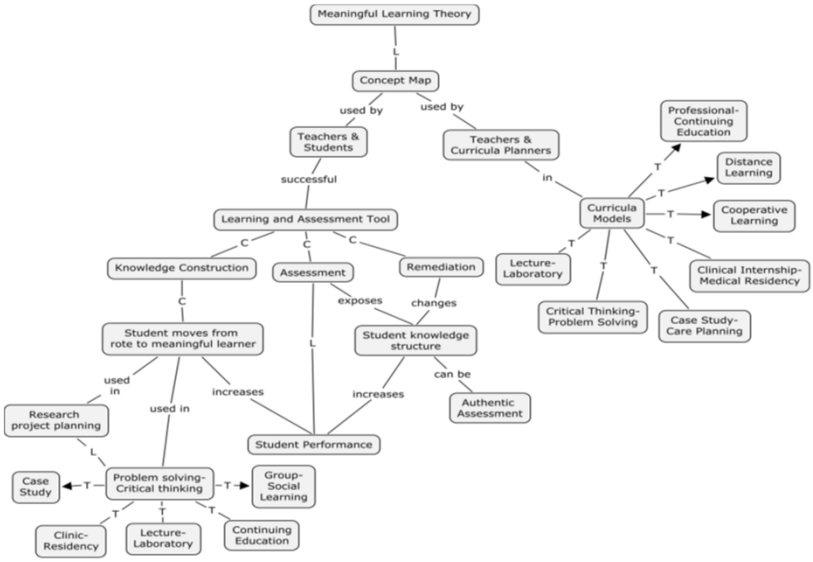
- Students need to be helped to recognize
  - What concepts they already know that relate to the observed events or objects
  - What events or objects they are observing
  - What records are worth making
- Bridge the gap: the “doing” or procedural part of the laboratory needs to be related to the conceptual or “thinking” part of the laboratory for meaningful learning to come from a laboratory activity
- “Knowledge is not discovered like gold or oil, but rather is constructed like cars or pyramids” -Novak & Gowin (1984)

EXPLANATION: CONCEPT MAPPING LEARNING AND ASSESSMENT TOOL

- **Used as a comprehension/misconception check**
- **Can be assessed using a scoring rubric according to accuracy, depth, and degree of integration or synthesis of knowledge**
  - **1 point each valid relationship**
  - **5 points each valid level of hierarchy**
  - **10 points each valid and significant cross link between different segments in the map as evidence of synthesis of knowledge**

Novak & Gowin, Learning How to Learn. 1984

EXPLANATION: LEARNING AND LABORATORY



Passmore, G. "Chapter 26 Concept Mapping: A Meaningful Learning Tool to Promote Conceptual Understanding and Clinical Reasoning" In Innovative Teaching Strategies in Nursing and Related Health Professions, 6Ed. Bradshaw, MJ and Lowenstein AJ, Eds. Jones & Bartlett Pub, Sudbury MA, May 2013

APPLICATION: CONCEPT MAP

YOUR TURN!

- **Construct a concept map from the paragraphs on memory that follow**

THE INFORMATION PROCESSING MODEL OF MEMORY

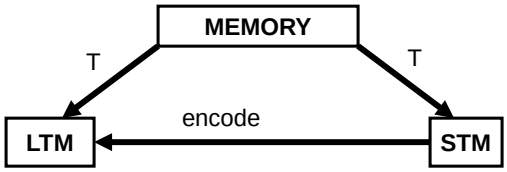
- **Information processing begins with the stimulus from the external environment. If we do not pay attention to the new information coming in, it's forgotten; if we do pay attention to it, it moves to the short-term memory (STM) storage system. Short term memory is conscious/working memory - all that we are aware of at one time. The capacity of this store is limited to about 7 +/- 2 chunks of information. Information in STM can be bumped out by new information (forgotten).**
- **Information in STM, if rehearsed or encoded, remains the focus of attention and is passed along to the long-term memory (LTM). Information that is encoded without attention to prior knowledge is rotely learned. Information that is encoded with attention to prior knowledge is meaningfully learned. This is accomplished via concept assimilation: integration or differentiation.**
- **The capacity of LTM is probably unlimited. The information stored in LTM is rarely forgotten, although we may have difficulty in retrieving it because of the way we search for it.**

HOW DO WE REMEMBER ACCORDING TO THE INFORMATION PROCESSING MODEL OF MEMORY?

- **Information processing**
- **stimulus**
- **attention**
- **forgotten**
- **short-term memory (STM) conscious/working memory**
- **STM capacity limited**
- **7 +/- 2 chunks**
- **bumped out (forgotten).**
- **rehearsed**
- **encoded**
- **focus of attention**
- **long-term memory (LTM)**
- **prior knowledge**
- **meaningful learning**
- **Assimilation**
- **Concept integration**
- **Concept differentiation**
- **rote learning.**
- **LTM capacity unlimited**
- **rarely forgotten**
- **difficulty retrieving**

MAP SKELETON: INFORMATION PROCESSING MODEL

FOCUS QUESTION: How do we remember according to the IPM of memory?



APPLICATION: IPM MEMORY LEARNING TASKS

- What follows is an application/test of the IPM of memory, specifically “chunking”. Your map on memory will serve as the conceptual understanding for what you will experience next.
- To participate, you will need a clean area in which to write.
- You will be exposed to items to memorize for 30 seconds, you will then have 30 seconds to write them down.
- You will then be able to review how many items you could put in STM and score yourself
- A show of hands will tell us if chunking is being used
- Ready… Set… Go!

CONCLUSIONS/DISCUSSION

- **Concept maps allow the teacher to**
  - **Expose/change learner’s knowledge structure**
  - **Identify and remediate misconceptions**
  - **Help student move from rote learner to meaningful learner**
  - **Help student move from algorithm memorization to problem solving**
- **The quantitative analyses support the use of concept mapping as a metacognitive learning strategy suitable for use by both resident and distance learning students in the Nuclear Medicine Technology program.**
- **Meaningful learners are more adept problem solvers/critical thinkers and should be more adaptive technologists**