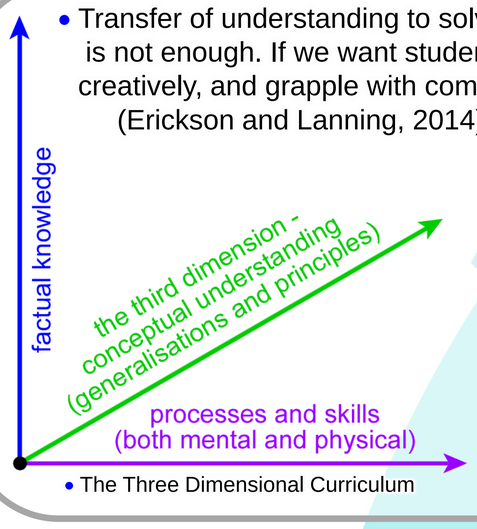
Using Concept-Based Curriculum and Instruction to Deepen Disciplinary Literacy and Build Interdisciplinary Connections in Chemistry*

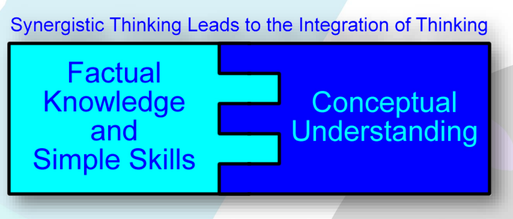
Nanyang Girls' High School and Hwa Chong Institution – Integrated Programme Conference on Education – 9th February 2018

1 Conceptual Understanding



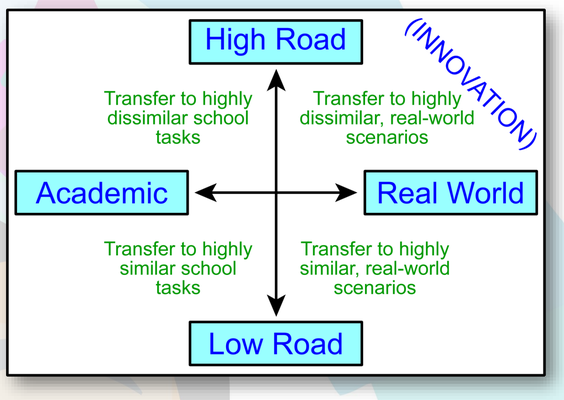
• The Three Dimensional Curriculum

• Transfer of understanding to solve novel problems is essential. Knowing facts is not enough. If we want students to develop intellectually, solve problems creatively, and grapple with complexity, the key is *conceptual understanding* (Erickson and Lanning, 2014).



• Concepts are mental constructs that frame a set of examples sharing common attributes. Concepts are *timeless*, *universal* and *abstract*. Concepts transfer within disciplines, and across disciplines, due to their generalisability.

2 The Concept-Based Curriculum

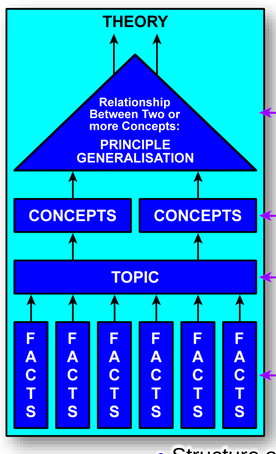


• Facts and topics cannot be applied directly to new situations. Before existing knowledge can be applied to a new situation, it must be *abstracted to the conceptual level*, generalising from specific examples to broader rules. Only then can the new situation be understood and any associated problems solved.

• Concept-based units focus on using content (topics, facts and skills) to investigate the relationships amongst concepts so as to develop *generalisations*.

• *Innovation* requires the creative transfer of the fundamental and powerful concepts of the traditional disciplines.

3 Structures of Knowledge & Process



Subject: Chemistry

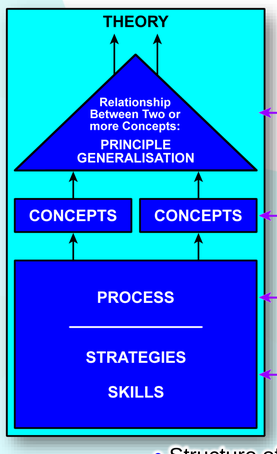
Generalisation #1
(Students will understand that) the reactions of both acids and bases are *systems* in which *changes* take place. *Patterns* emerge from the complexity of the reactions which allow them to be simplified and *modelled* as ionic equations.

Concepts
Change, dissociation, equilibrium, models, neutralisation, patterns, systems

Topic
Acids, Bases and Salts

Factual Knowledge
pH Scale, pH = $-\log_{10}[H^+]$
Equilibrium constants (K_a)
Strength of acids & alkalis
Basicity of acids & alkalis
Solubility rules

• Structure of Knowledge
Lynn Erickson, 1995.



Subject: Chemistry

Generalisation #1
(Students will understand that) making accurate and precise measurements leads to the formulation of theories which allow the natural world to be understood, predicted, controlled and modified.

Concepts
Accuracy, control, persistence, precision, measurement, neutralisation.

Process
Perform an acid-base titration.

Strategies
Obtain results that are accurate and precise.

Skills
Correct manipulation of glassware and solutions.

• Structure of Process
Lois Lanning, 2012.

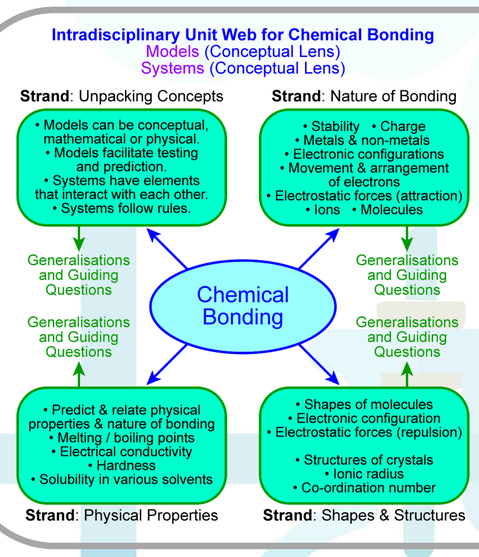
4 Designing Concept-Based Units

Knowledge Dimension	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Metacognitive Knowledge						

• Designing units for Concept-Based Curriculum and Instruction encourages teachers to question and unpack the very nature of their discipline. The process is almost philosophical in nature, leading teachers to understand *the heart of their subject – disciplinarity*. Only when teachers have done this can they hope to guide their students on the same journey.

• Elements of a concept-based unit: **a)** Title **b)** Choose conceptual lenses **c)** Identify unit strands **d)** Visualise the unit's content (unit web) **e)** Write generalisations **f)** Develop guiding questions **g)** Critical content (students must know) **h)** Critical skills (students must do) **i)** Assessment rubric **j)** Students' learning experiences **k)** Write unit overview.

5 Unit Webs

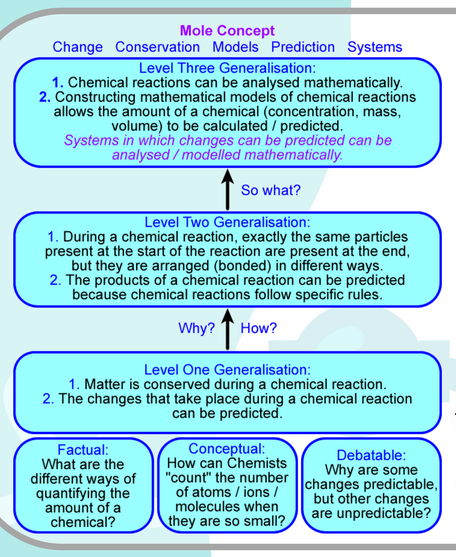


• Learning factual information and simple skills are important in Concept-Based Curriculum and Instruction, but it is only through conceptual understanding that the facts and skills become relevant.

• Designing a *unit web* is a brainstorming activity that results in a visual representation of how the unit's content could be organised, and which concepts in particular could be used to structure it.

• A *conceptual lens* provides focus and depth to the study. It guides students in *synergistic thinking*, allowing them to develop concepts from facts.

6 Generalisations & Guiding Questions



• *Generalisations* are two or more concepts stated as a relationship. Generalisations are conceptual understandings that transfer through time, across cultures, and across situations. They reflect the deeper, *transferable understandings* associated with specific factual content or skills. They are derived by students through *inductive instruction*, guided by a conceptual lens and a specific set of questions.

• Each unit of study should have at least five generalisations, one or two per strand.

• Generalisations: **a)** use strong verbs, **b)** avoid past tense, **c)** avoid passive voice, **d)** avoid proper nouns.

• *Guiding questions* facilitate the students' thinking towards deriving a generalisation. Guiding questions should be *factual*, *conceptual* and *debatable*.

7 Deep Learning

Macroconcepts allow connections to be made between disciplines, giving breadth to the curriculum.

Microconcepts (concepts within individual disciplines) give depth to the discipline.

• With *inductive reasoning*, students first work with examples and attributes of a concept or generalisation and use this information to construct and articulate the conceptual ideas that are represented (generalisations).

• Students move from concrete to abstract ideas.

• Lessons are deliberately designed so that students construct their own understanding through inquiry learning – *visible thinking*.

• Student-centred, thinking classrooms where students are given time to refine and increase the sophistication of their ideas – *iteration*.

8 Assessment

• Student's ATT on bonding.

• What is the objective of assessment?
• Transfer is the ultimate goal.
• Mistakes are important.
• Assessment is about progress and evidence, not right or wrong.
• Provide feedback throughout, not just at the end of the assignment.
• Use novel information and vary the assessment method.
• Use rubrics to measure a range of conceptual understandings.
• Authentic transfer tasks (ATT): **G**oal, **R**ole, **A**udience, **S**ituation, **P**roduct, **S**tandards.

• Erickson, H. L., & Lanning, L. A. (2014). *Transitioning to concept-based curriculum and instruction: how to bring content and process together*. Thousand Oaks, CA: Corwin Press, Inc.
• Erickson, H. L., Lanning, L. A., & French, R. (2017). *Concept-based curriculum and instruction for the thinking classroom*. Thousand Oaks, CA: Corwin Press, Inc.
• Stern, J. H., Mohnkern, J., & Ferraro, K. F. (2017). *Tools for teaching conceptual understanding, secondary: designing lessons and assessments for deep learning*. Thousand Oaks, CA: Corwin Press, Inc.

• Scan the QR code to view this poster and other online resources at:
http://www.scientist.sg/concept_based_teaching/concept_based_teaching.htm

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