腦海地圖（Mind Map）

（學習地圖、思維導圖、心智(繪)圖法、大腦圖像、大腦彩圖）

http://www.pooikei.edu.hk/mainpage/subpages/mind/course_1.html

引言

由 Tony Buzan 托尼‧布贊所發明的一種學習方法。是將資訊記錄在一個放射形的樹狀結構圖上，每一分支均附上代表不同概念的關鍵字、圖像或短句，分支之下可以再有分支，從而將各種資訊有層次地表達出來。

「思考地圖」的學習方式以圖像表達繁複的資料，藉此協助腦部組織及記憶，爲學生在傳統學習以外提供一個捷徑，有別於過往「一行一點」的記憶法，「思考地圖」的學習方法以一個主題爲中心，學生可在中心出發表達各項資料間的關係。

優點：

1. 大多數人慣用左腦直線思維（point form 列出資訊），腦圖可幫助人們左右腦並用思考，產生更多聯想。
2. 放射式的結構可發展擴散性思維，這種形式很接近人類腦神經運作的思考式。
3. 刺激大腦進行多種思維，例如：綜合、分析、聯想、比較等。
4. 幫助人們吸收新知識及增強對知識的記憶。例：讓學生在一張紙上記錄許多訊息及各種訊息間的關係，有助學生以整體的方式來思考問題，並增加學生思考的靈活度。讓學生清楚看出一個主題的內容結構，同時可看出不同主題間的關係。
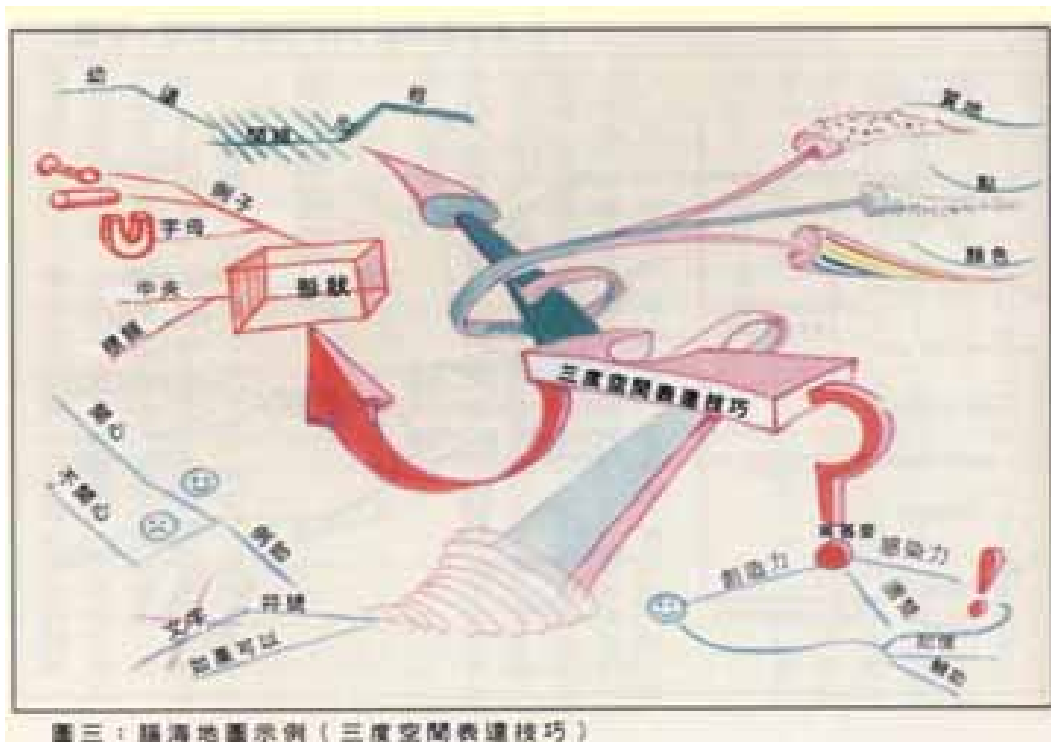5. 使用圖像、符號、箭咀、顏色等顯示，更「好玩」、易記。
6. 間線亦可以加強人腦對事物連繫的印象。

用途

1. 做筆記
2. 會議記錄
3. 記憶
4. 溫習
5. 講解
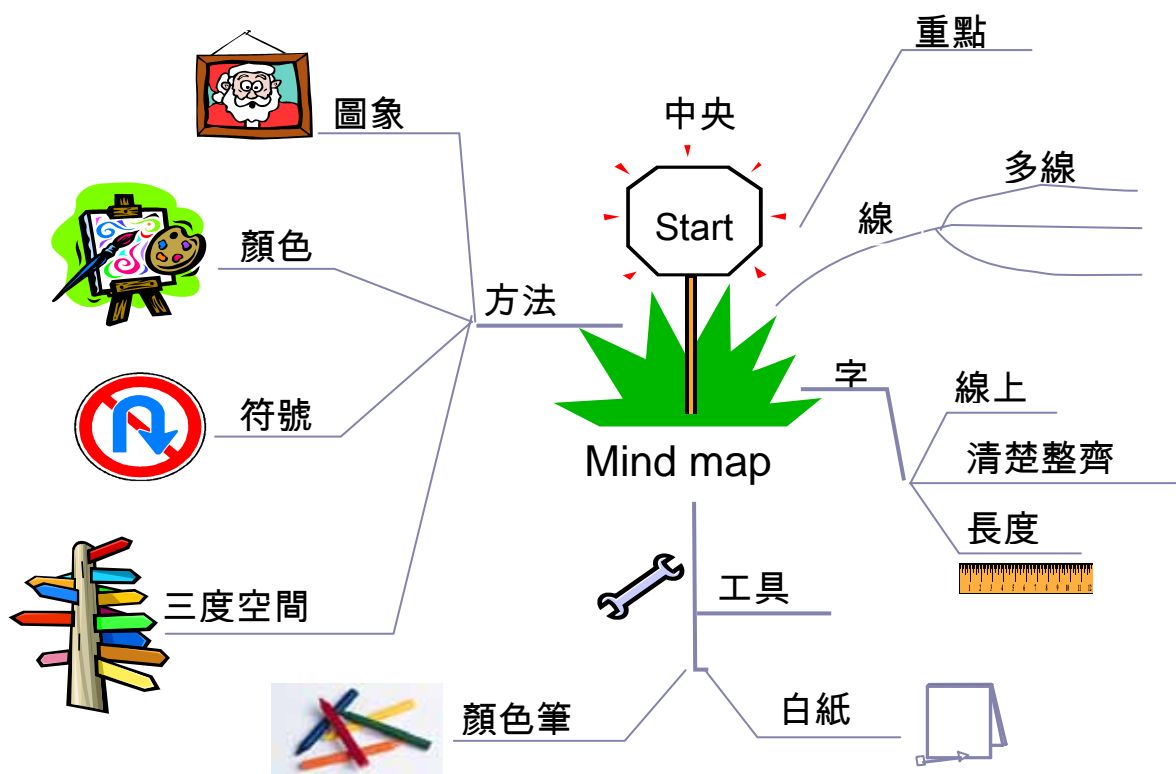6. 推銷
7. 分析
8. 解決問題
9. 作文
10. 創作
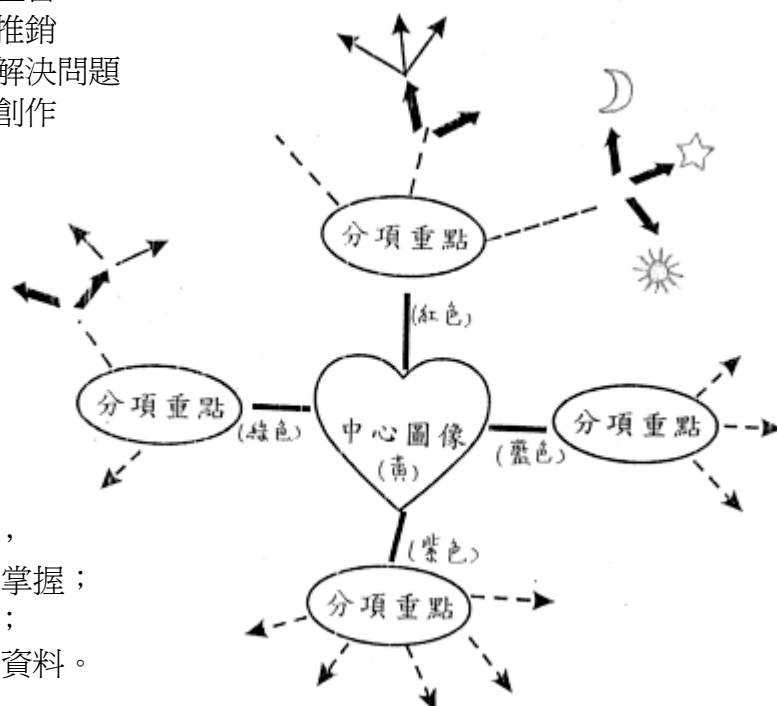
效果

1. 有效程度：因人而異，善於畫圖的同學較易掌握；
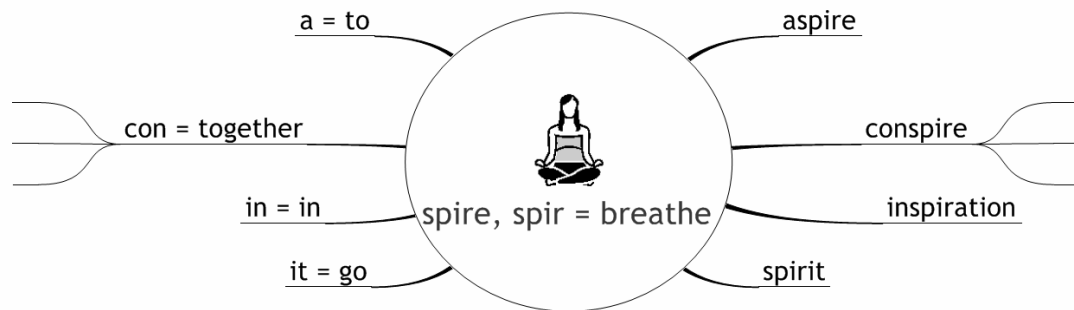2. 喜歡程度：因人而異；
3. 合用於處理本科學習資料。
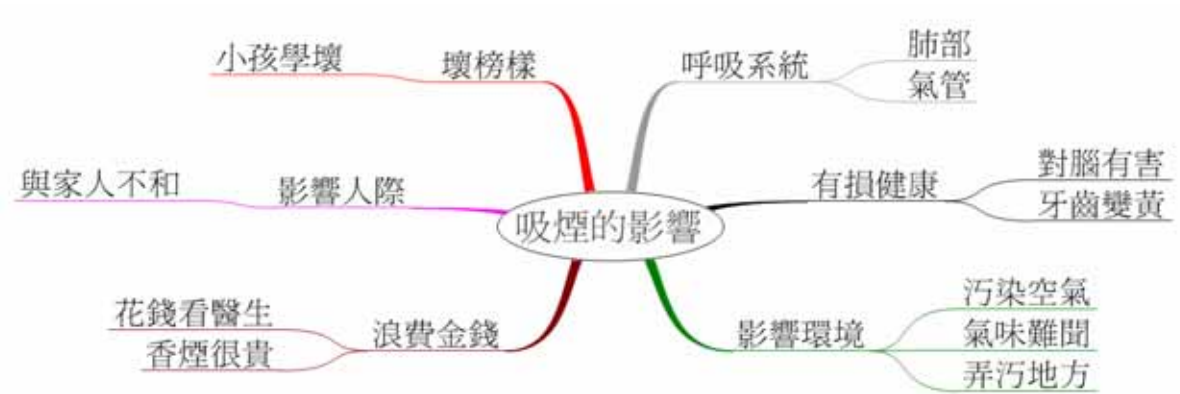
圖三：腦海地圖示例（三度空間表達技巧）

製作規則

1. 主題放在中央
2. 由中央開始，分支向外擴張張
3. 分支最好維持在 5 至 7 個
4. 一線一個重點字
5. 多用想象
6. 用顏色把資料作分類
7. 用圖畫/圖形附加近文字旁或代替文字
8. 用線條、箭咀、符號等表達連系

「腦海地圖」例子

「六何法」（5W1H）在思考地圖中的應用
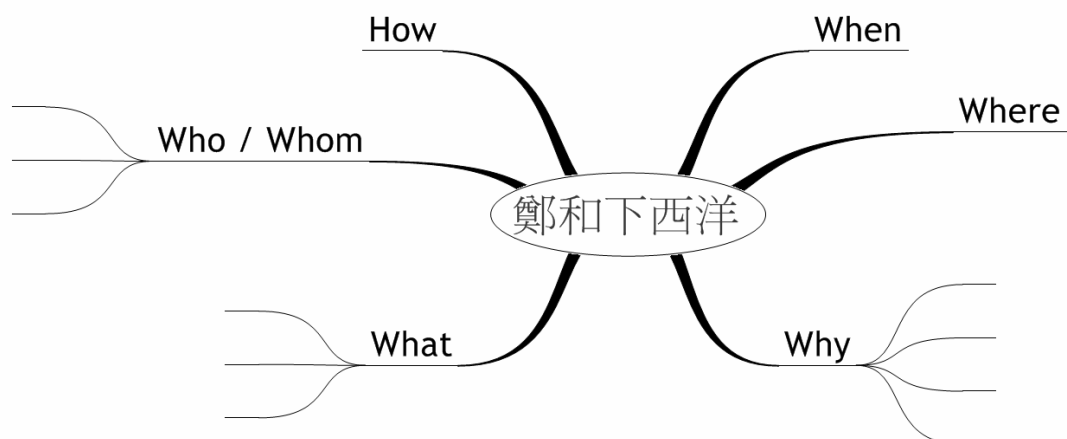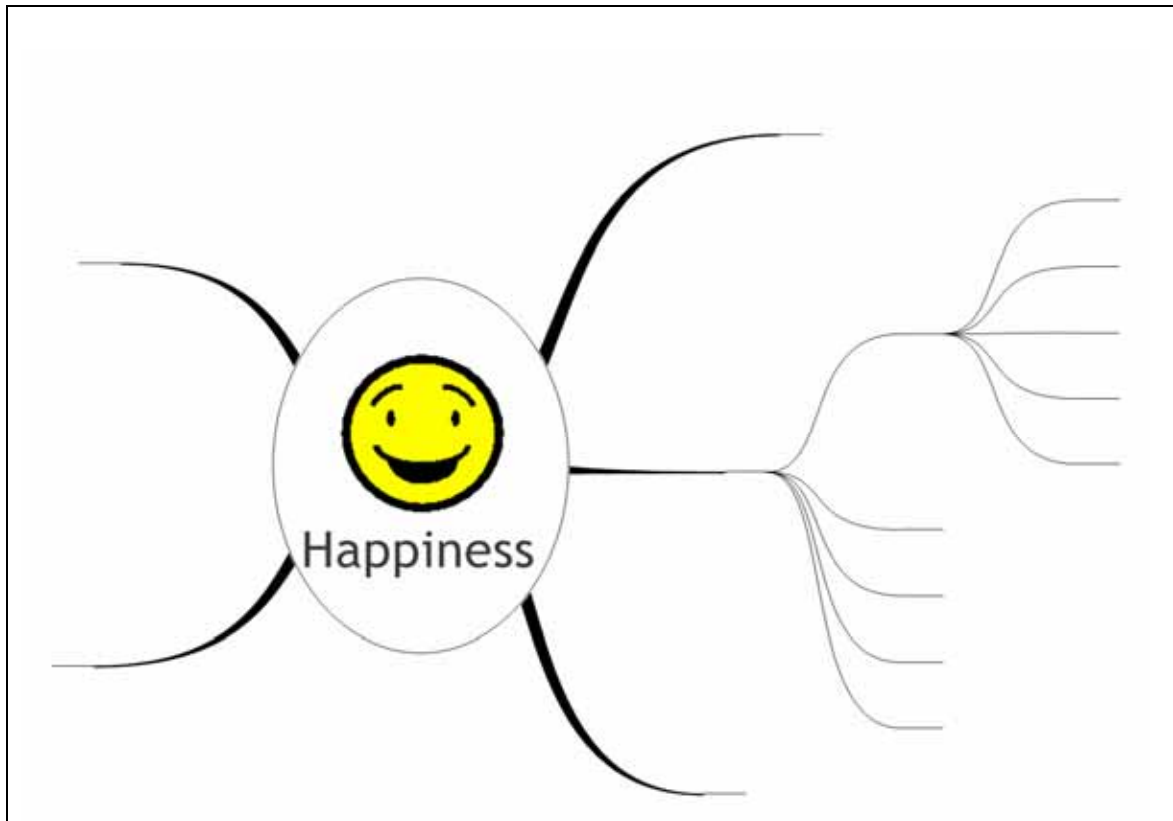
「六何法」是訓練人們從多方面的角度去考慮、分析事物的一種思考方式，它以某事物或問題為中心，以六個角度去探討事物的合理性，從而提升學生多角度思維及強化他們的找難力及解難力。雖然有六種問題：（Where 何地、When 何時、Who 何人、What 甚麼、Why 為何、How 如何），但並不是每次都非討論六種不可，而是依情形而定，每一類問題又可列出各種不同的問題。

例子：

Mind Map Exercises

唐太宗德政

唐太宗的德政大致可分成三方面:

(1) 注重官吏－唐太宗把屬下官吏的名字和政績記錄在屏風上,每
當要有處理升遷事宜或調兵遣將時,便可從名冊上
挑選,任用賢能。

(2)建立良好制度－唐太宗期間實行貢雨制和府兵制。

(3) 社會安寧－唐太宗統治期間,治安良好,百姓夜不閉戶、人民
無需 帶武器外出,以保安全,市場上貨幣流通。

需求改變

1. 「需求量改變」是由貨品本身的價格改變所導致的 (假設其他因素不變)，其改變是由一價格下的需求量轉到另一價格下的需求量；「需求改變」是由貨品本身價格外的其他因素因變動所導致的，其改變是全套購買計劃的改變。

2. 貨品的需求受很多因素影響：

因素		導致貨品甲的需求增加	導致貨品甲的需求減少
相關貨品的價格	聯合需求	代替品的價格↑	代替品的價格↓
	競爭需求	輔助品的價格↓	輔助品的價格↑
消費者的收入 ➢ 對「優等物品」而言 ➢ 對「次選物品」而言		消費者收入↑ 消費者收入↓	消費者收入↓ 消費者收入↑
消費者對價格的預期		消費者預期未來的價格↑	消費者預期未來的價格↓
消費者的喜好		喜愛貨品	不喜愛貨品
➢ 引申需求 ➢ 複合需求		以貨品甲生產的另一貨品的需求和價格↑ 貨品甲的其中一種或多種用途的需求和價格↑	以貨品甲生產的另一貨品的需求和價格↓ 貨品甲的其中一種或多種用途的需求和價格↓
人口的轉變		人口↑	人口↓

整理歷史科內容的構圖方法

(一) 時序內容

(二)　因果關係內容

2.1　一個原因，一個／數個結果

原因　　　　　　　結果

| 事件 | → | 事件 |

事件 → 事件
事件 → 事件
事件 → 事件

2.2　數個原因，一個／數個結果

原因　　　　　　　結果

事件
事件　→　事件
事件

事件
事件　→　事件
事件　　　事件
事件

2.3　一連串的因果關係

原因　　　　結果／原因　　　結果／原因　　　結果

事件　→　事件　→　事件　→　事件

2.4　複雜的關係

事件
　　　結果／原因
事件　→　事件　→　事件
　　　　　　　　事件
事件
　　　　　　　　事件
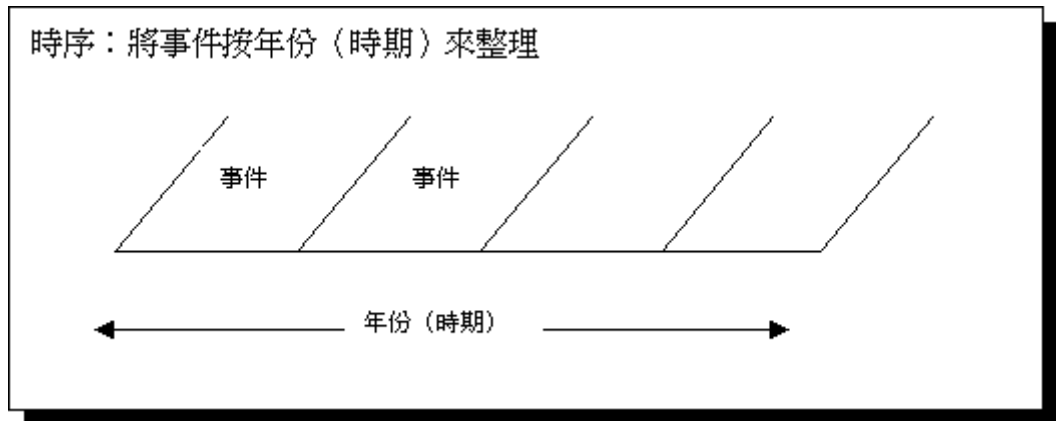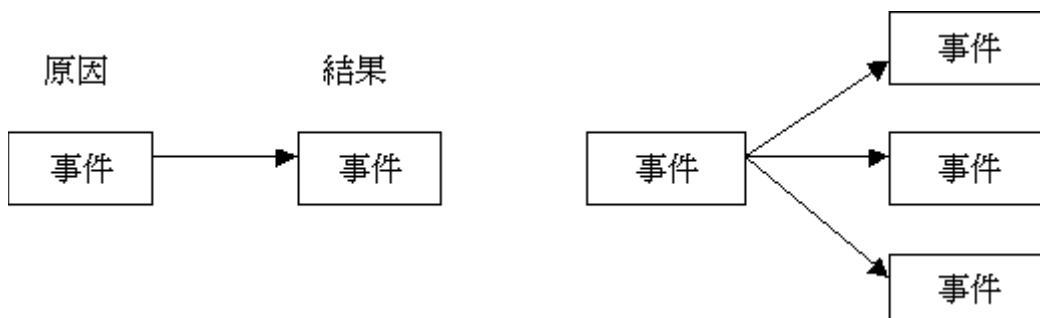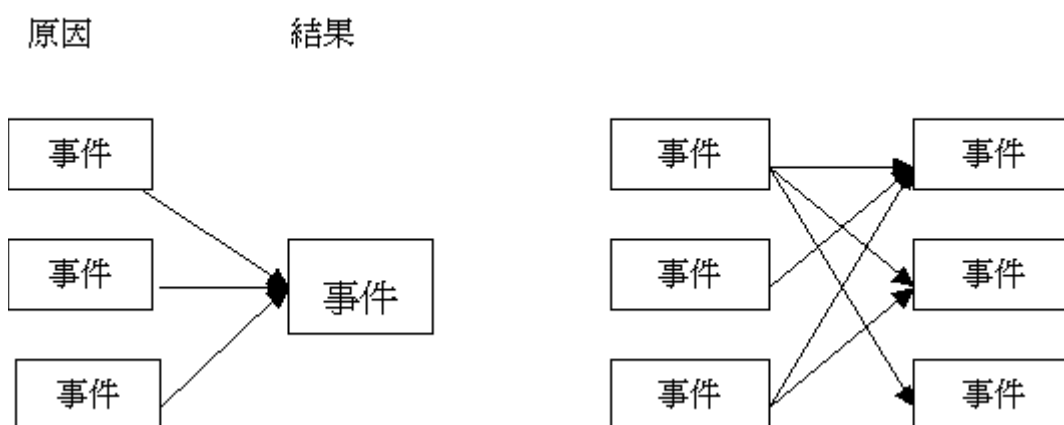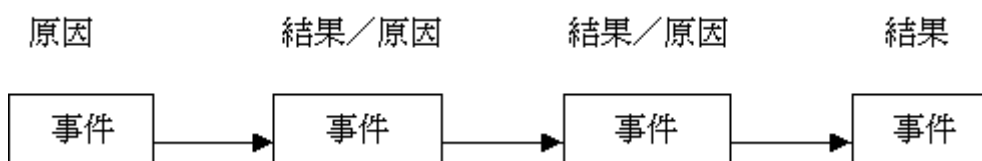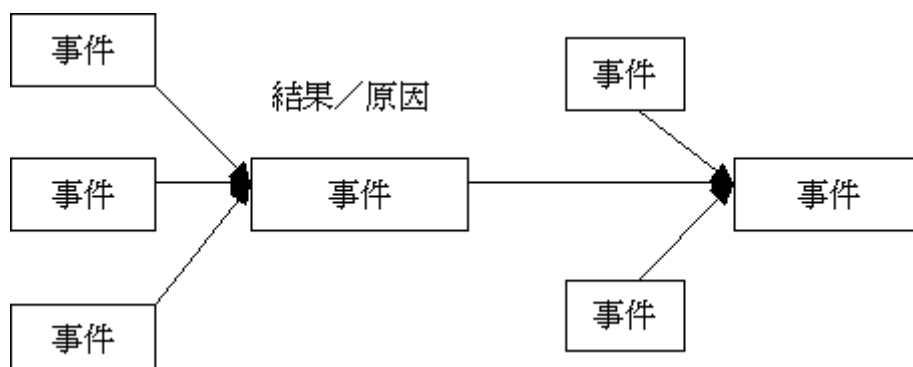
教導學生認識及運用「思考地圖」

目的
1. 讓同學易於掌握學習資料；
2. 增加同學的組織能力；
3. 使同學易於明白資料間的關係。

推行過程
先向同學簡介特點 ——▶ 示範 ——▶ 範例觀摩 ——▶ 實習

教學程序
1. 介紹這一節的目的及如何整理資料的因果關係（相關圖表）。
2. 可用 pair reading 的方法，將學生分為兩小組，每組負責一部份的內容。
3. 兩/三位同學閱讀一部份的文章，整理每一部份的史實/概念。
4. 嘗試在空白紙張中繪畫因果關係。
5. 向另一組同學介紹負責部份的內容，和他們討論，整理全文的因果關係。
6. 學生報告，可要求學生報告另一小組的內容。
7. 全班討論，整理這一篇文章的因果關係。
8. 派發另一篇文章，整理其因果關係。

教學內容
　　使用一些圖型(graphic organizer)的方法，以整理一篇文章的資料。具體方法見以下圖型：

The Theory Underlying Concept Maps and How to Construct Them

Joseph D. Novak

Concept maps are tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts or propositions, indicated by a connecting line between two concepts. Words on the line specify the relationship between the two concepts. We define *concept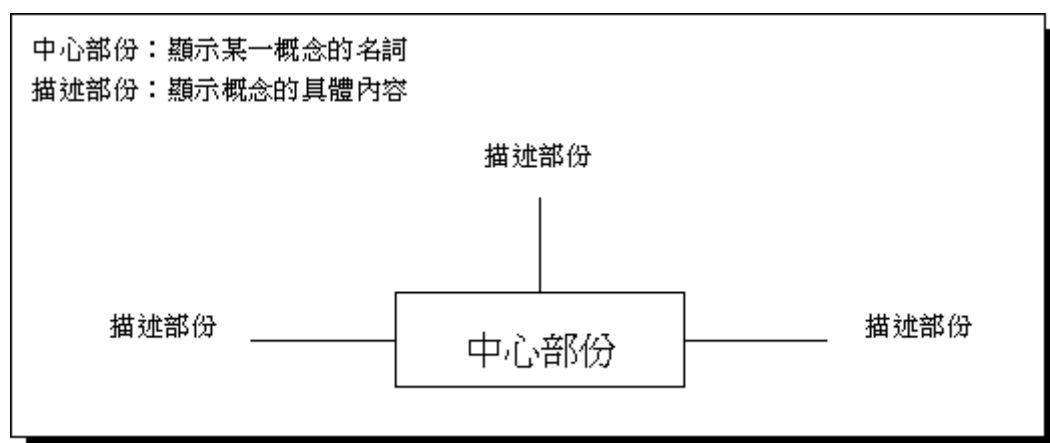 as a perceived regularity in events or objects, or records of events or objects, designated by a label.* The label for most concepts is a word, although sometimes we use symbols such as + or %. *Propositions are statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected with other words to form a meaningful statement.* Sometimes these are called semantic units,or units of meaning. Figure 1 shows an example of a concept map that describes the structure of concept maps and illustrates the above characteristics.

Another characteristic of concept maps is that the concepts are represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below. The hierarchical structure for a particular domain of knowledge also depends on the context in which that knowledge is being applied or considered. Therefore, it is best to construct concept maps with reference to some particular question we seek to answer or some situation or event that we are trying to understand through the organization of knowledge in the form of a concept map.

Figure 1
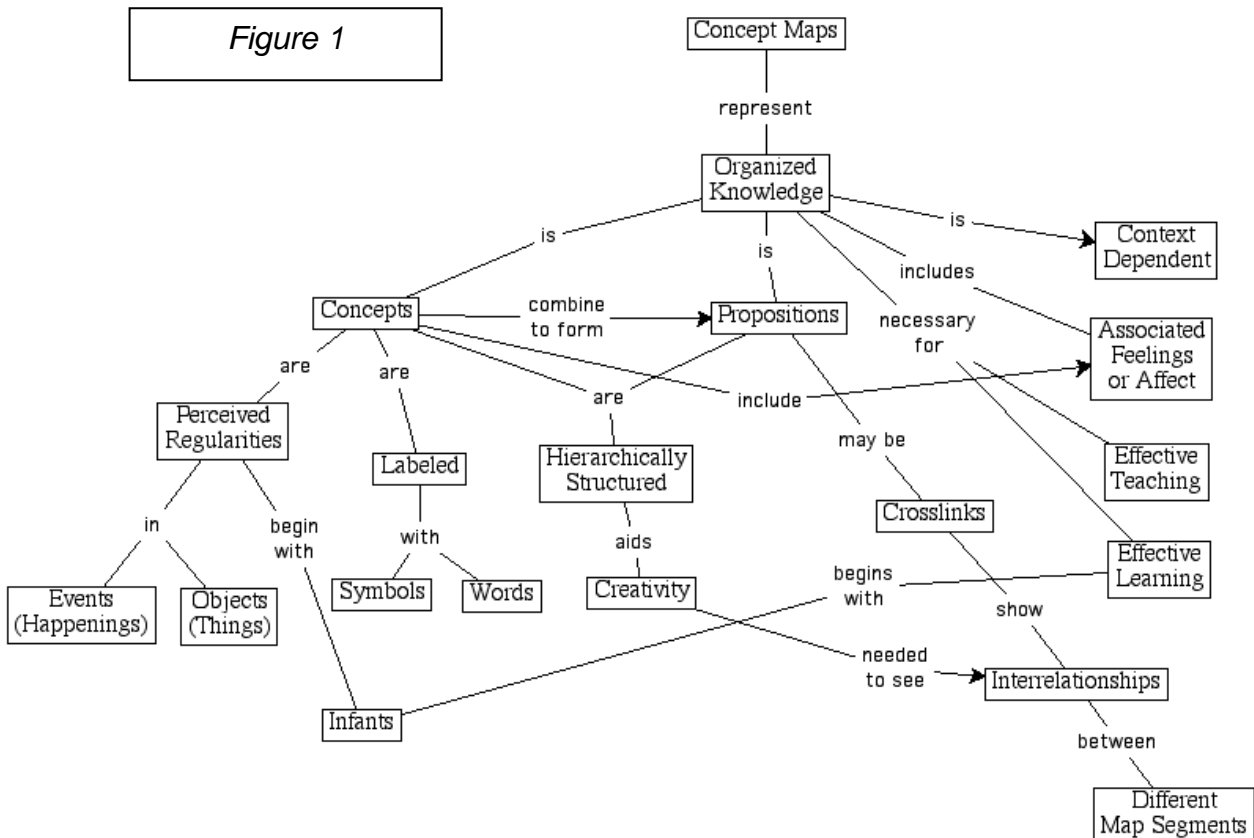
Another important characteristic of concept maps is the inclusion of "cross-links." These are relationships (propositions) between concepts in different domains of the concept map. Cross-links help us to see how some domains of knowledge represented on the map are related to each other. In the creation of new knowledge, cross-links often represent creative leaps on the part of the knowledge producer. There are two features of concept maps that are important in the facilitation of creative thinking: the hierarchical structure that is represented in a good map and the ability to search for and characterize cross-links. A final feature that may be added to concept maps are specific examples of events or objects that help to clarify the meaning of a given concept.

To summarize (http://www.yottkp.edu.hk/hots/concept.htm),

A Concept Map is:

1. A visual representation of an individual's knowledge /cognitive structure
2. It represents how one's organized information in the mind
3. Different people will have different types of concept map, even in the same content
4. Constructivist view of learning

Teachers can use concept maps to:

1. Organize course content
2. Prepare lesson plan
3. Present teaching materials
4. Assess change in the knowledge structure of students: Qualitative assessments
5. Give formative feedback to students

Students can use concept maps to:

1. Make class notes and summary
2. Integrate and construct meaning from existing prior knowledge
3. Extract meaning from textbooks, newspaper
4. Actively construct own knowledge structure
5. Plan a paper or a project

如何建構一幅概念圖

1. 認定中心主題：辨清你希望利用概念圖了解的問題焦點、知識概念。用這個中心主題作導引，找出十至廿個與中心主題相關的概念，並表列出來。有些學員會喜歡將個別概念寫上 Post-its 或卡紙上，可方便嘗試將概念任意放置。每一張卡紙或 Post-its 只適宜寫上一個概念，或代表概念的兩至三字。

2. 將列出來的概念排序：由最籠統、最富涵蓋性和抽象的概念放置在最高位置。學員偶爾會在揀選最高層概念時遇上困難，反思中心主題的引導方向可以幫助為概念排序。這個過程可能會使學員需要重新思考、修正或重改概念圖的中心主題。

3. 將其餘的概念一層一層的排放在列表上。

4. 開始製作概念圖：由最籠統、最富涵蓋性和抽象的概念放置在概念圖的最高位置。在最高層的位置通常只會有兩至三個涵蓋性的概念。

5. 隨後將往下的二、三、四層的「子概念」(sub-concepts)放置在概念圖上。留意不要讓每個概念帶有多於四個子概念。若發現任何概念同時帶有六至八個子概念時，學員可以將這些概念重新排序，找出一些較有涵蓋性和較仔細的概念並建立起上下層的關係來。

6. 將概念用畫線連上。在連線上寫上合適的連結字(linking words)。連結字必須清晰表達兩個概念之間的關係，使可成為簡單、有效的句式(proposition)。由連結製造意義。當學員將大量的概念進行連結並形成層次，可以看到對應某一知識、命題、中心主題的意義架構。

7. 重新整理概念圖的結構。這包括為概念圖進行概念的加減或改變上下層關係等。學員可能需要進行數次的整理，而也是這些整理的過程為學員帶來新的啟示和有意義性的學習。Post-its 在這個過程最能發揮作用，而利用電腦會更加有效。

8. 為配置在不同分支的概念尋找有意義的「橫向連結」(cross-links)並在線上用連結字寫上關係。橫向連結能有效地幫助學員在某知識範疇內看到新的關係和帶來創意的工具。

9. 仔細、具體的例子可以用簡圖或代表符號附在概念上，不需會圖圈來代表。

10. 知識或問題的表達不只一種形式：對應同一系列的概念，可以有不同結構的概念圖出現。

The Effect of Concept Mapping to Enhance Reading Comprehension and Summarization Abilities: A Comparison of the Map-correction, Scaffold-fading, and Self-generation Approaches

Yao-Ting Sung, Ine-Dai Chen, Kuo-En Chang
2000 annual meeting of American Educational Research Association,
Apr. 24-28, New Orleans\

http://cslsrv.ice.ntnu.edu.tw/../../LabNews/Minutes20/000720pearl.html

研究動機：Concept mapping usually excels in science education yet has seldom been applied to language learning.

研究目的：To explore the effectiveness of the concept mapping strategy in enhancing reading comprehension and summarization abilities.

研究方法

參加者：126 位五年級學生(60 位女生，66 位男生)。隨機分成三組實驗組 (correction、scaffolding、self-generation)及一組控制組。四組人數分別為 26，32，34，34 人。每一組學生依據閱讀理解力前測成績，又再分成高能力及低能力。

設計：The study involved 7 weeks of reading and (or) map-construction instruction for the experimental and control groups as well as pre- and posttest in reading and summarization.

教材

Measures:

To evaluate student initial reading comprehension ability, this study adopted the Expository-Text Comprehension test designed by Su & Lin (1991). This test included 5 pieces of expository writings from both scientific and social science domains. Twenty-five items of multiple-choice question were constructed from those articles. 摘要能力利用 Garner 提出的 summarizing efficiency 來衡量。(summarizing efficiency = the number of major idea units/the total word count of the summary)

Instructional materials：

This study used seven pieces of scientific writing. Each article consisted of about 400-820 Chinese character. Students were given a concept mapping training course consisting of seven units that corresponded to these articles. The text presentation and the concept mapping exercise were conducted using the Concept Mapping-based Learning System (Chang, Sung, & Chen, in press; Sung, Chen, Lin, & Chang, 1998).

The correction group was given an expert-generated concept map which was partly revised to contain incorrect concepts and semantic links.

The scaffolding group was arranged into five stages: (1) reading expert concept map (2) fill in the blanks of the expert concept map (3) complete the partial expert concept map (4) construct the concept map using the given concepts and relation-links (5) determine the key concepts and relation-links from the text to construct the concept map.

Only the articles were provided for the self-generation group students.

實施程序：

　　實驗前一週對三組實驗組解說 concept mapping 的概念、方法及相關的電腦操作程序，同時也解釋文章摘要。控制組只說明如何閱讀 WORD 所呈現的文章。指導課程結束後，給予前測。然後進行正式實，實驗完後一週，進行後測。

研究結果：

1. 在加強閱讀理解力方面：各組的成就有顯著差異；閱讀能力的影響不顯著；group 和 ability 之間交互作用不顯著，表示不同的能力在不同的組別中，並未導致不同的績效。(correction > scaffolding = self-generation = control)
2. 在摘要能力方面：四組有顯著差異；閱讀能力對摘要能力無顯著影響；group 和 ability 之間交互作用不顯著。(correction>scaffolding>>self-generation=control)
3. 對於使用 concept mapping 的態度分析：
   ● 依據不同組別，對於建構 concept mapping 的感覺也不同。
   ● 多數人同意對於組織學習內容及抓住文章要點，concept mapping 是有用的工具。
   ● 雖然感覺建構 concept mapping 是困難的，但卻很有趣；在往後學習的日子裏，仍願意使用 concept mapping。

討論：

1. Concept mapping by correction not only preserves the advantages of providing an expert knowledge structure and less teaching time, it also corrected the possible drawbacks of readers' negligence (McCagg & Dansereau, et al, 1991) and passive knowledge acceptance (Barron, et al, 1984) in reading expert maps.

2. This study found that concept mapping training can effectively shift into summarization skills that are closely tied to comprehension. This finding has two important implications. First, the training effect is retained for a certain period of time. Secondly, concept mapping and summarization have a lot in common. The single biggest difference lies in the presentation format.

3. The effect of scaffolding concept mapping conducted through a gradual graphic adjunct removal was not superior to the strategy without gradual removal. There are some possible reasons. First, the operation after scaffolding was removed was still too difficult for elementary school students. Secondly, may be the lack of sufficient time for training.

結論：

1. Concept mapping may be used as a useful strategy for improving text learning.

2. The training effects of spatial learning strategy may not be limited to comprehension, but also may be transferred to different situations and skills.

3. It suggests that the combination of spatial learning strategy with correction method or scaffolding instruction is worthy of further exploration to expand the field of reading strategy research.
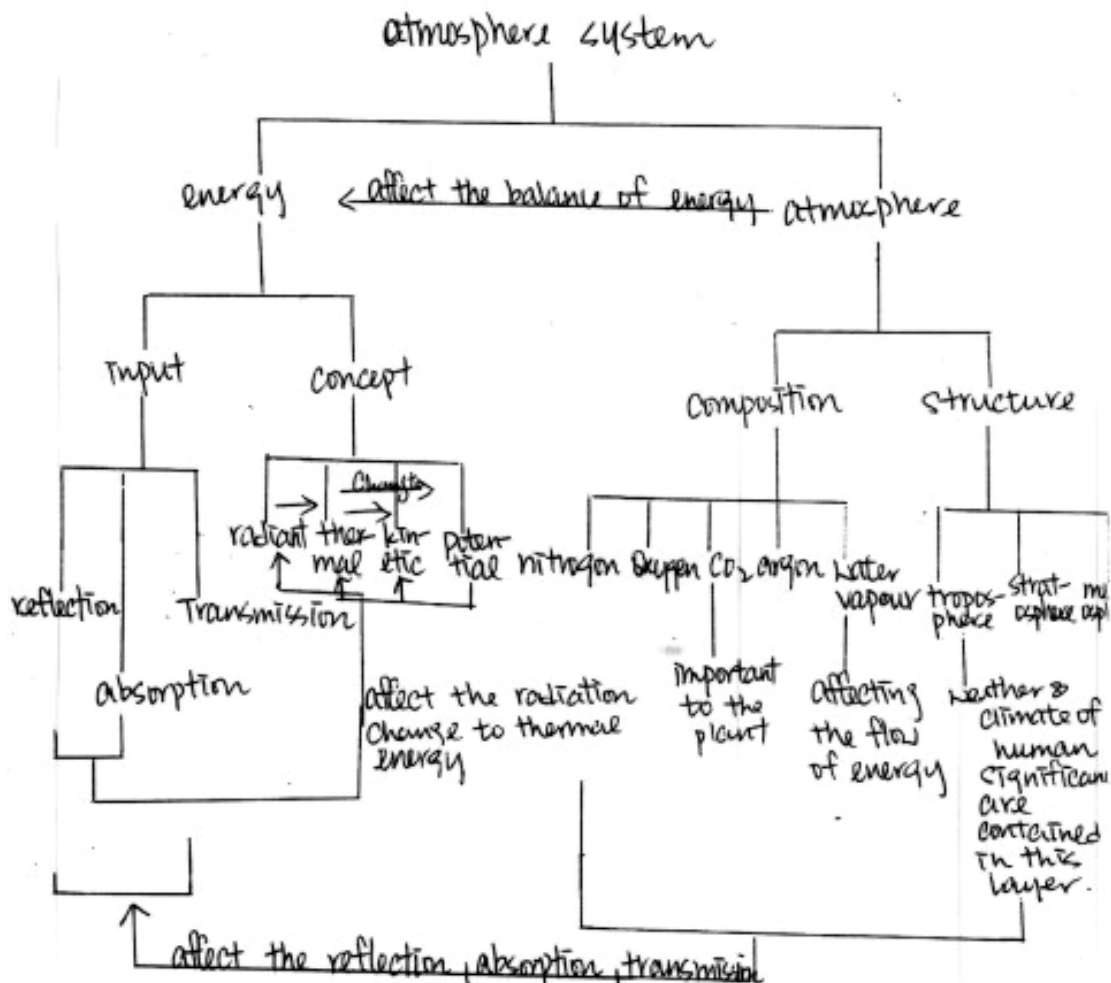
學生的概念圖

中二中文科

中五附加數科

8-10-2000
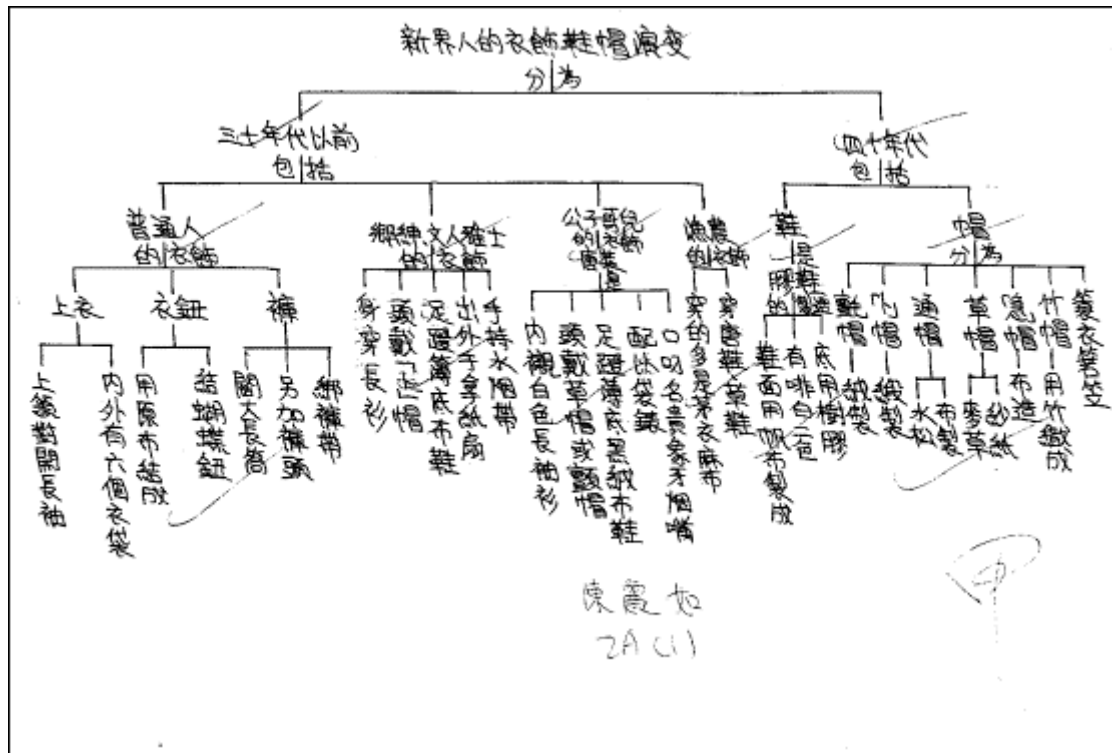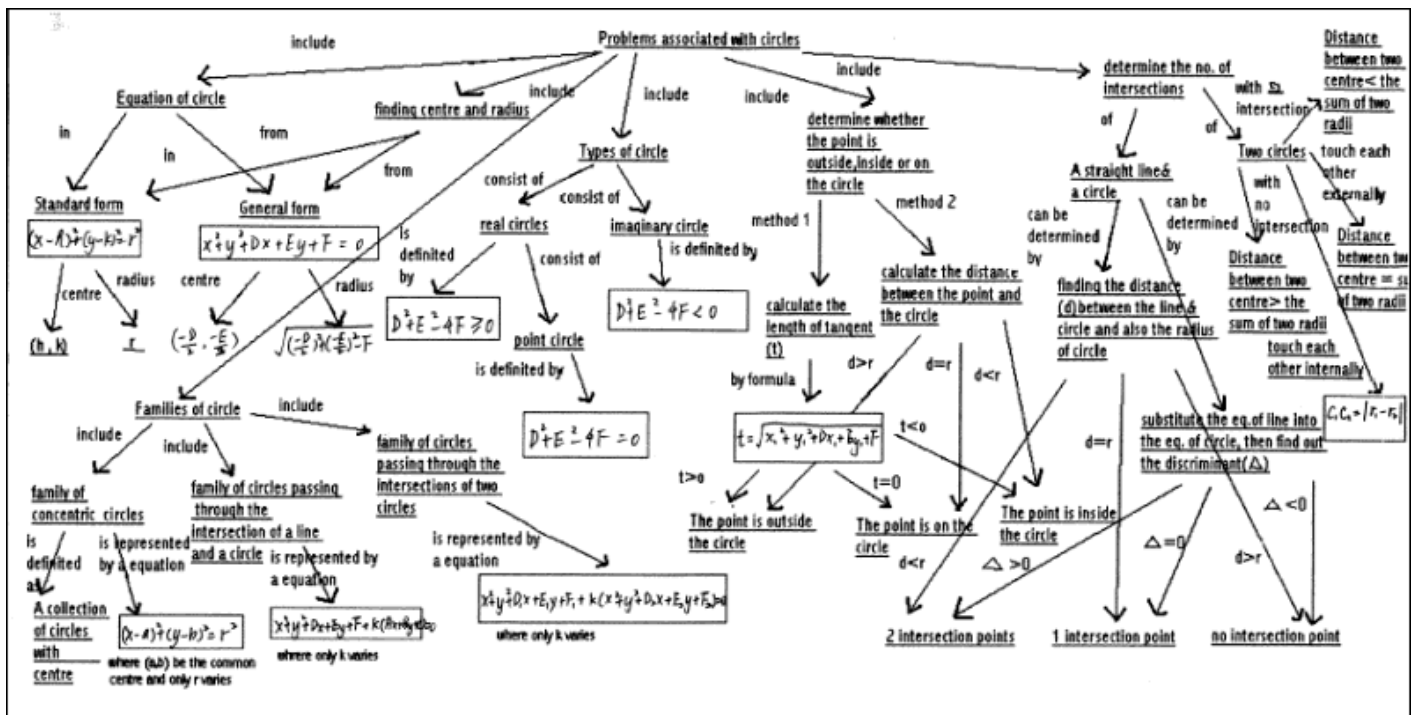
Concept Map exercises

Transform the following paragraphs into networks and discuss them with your neighbours.

Most people don't know whether their present learning strategies are good or bad or whether there are other techniques that would work better for them. This is mainly because they haven't been given the chance to explore alternative techniques.

In fact many people who think of themselves as being only average intellectually may have capabilities that are being stifled or suppressed because they have not learned good techniques for dealing with information.

In some ways this would be like having a powerful, highly tuned sports car without ever having learned to drive it properly.
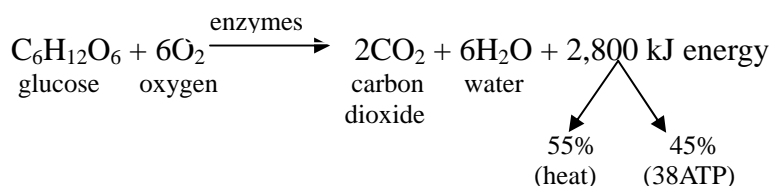
I think most of us are in this situation and that with some training we could substantially increase our intellectual ability.

Types of cellular respiration

There are two types of cellular respiration: aerobic respiration and anaerobic respiration.

A. Aerobic respiration

In the presence of oxygen, one molecule of glucose is oxidized completely to release large amount of energy (38ATP) with carbon dioxide and water as the end products. This process is known as AEROBIC RESPIRATION.

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{enzymes}} 2CO_2 + 6H_2O + 2,800 \text{ kJ energy}$$

glucose   oxygen   carbon   water
                          dioxide
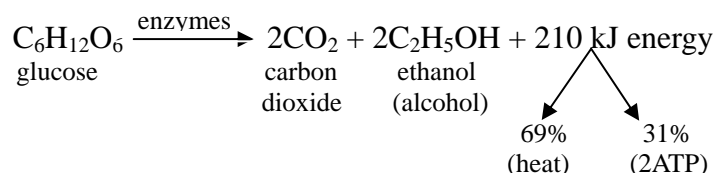
55%   45%
(heat)   (38ATP)

B. Anaerobic respiration

In the absence of oxygen, the glucose molecule is oxidized incompletely to release less energy (2ATP) and give 'energy-rich' end products. This process is known as ANAEROBIC RESPIRATION which gives different end products in plants and animals.
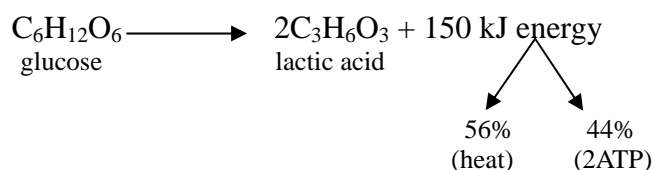
(1) Alcoholic fermentation
It is carried out by yeast cells and some plant cells in the absence of oxygen. Carbon dioxide and ethanol (alcohol) are the end products.

$$C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2CO_2 + 2C_2H_5OH + 210 \text{ kJ energy}$$

glucose   carbon   ethanol
                     dioxide   (alcohol)

69%   31%
(heat)   (2ATP)

Most of the energy in the glucose is still stored in the ethanol. It is proved by burning ethanol which releases large amount of heat and light energy.

(2) Lactic acid fermentation
It is carried out in vertebrate muscles in the absence of oxygen. The waste product is lactic acid.

$$C_6H_{12}O_6 \longrightarrow 2C_3H_6O_3 + 150 \text{ kJ energy}$$

glucose   lactic acid

56%   44%
(heat)   (2ATP)

思考地圖 (Mind Map) 與概念圖 (Concept Map)的異同

	思考地圖	概念圖
始創人	Tony Buzan 在英國 Warwick 大學？	Joseph D. Novak 在 美國 Cornell 大學
始創期	1970 年代	1960 年代
形狀	樹或太陽	網絡
主題	一個	多個
特點	1. 主題在中央，概念/關鍵字向外擴散。 2. 一線一重點，字在線上。 3. 除了聯線外，還以大小、遠近、粗幼線條表達概念間的關係。 4. 較少出現交义線	1. 由上而下的層階表達方式 2. 概念以圓圈或方格包圍 3. 每對概念皆以聯線及線上文字表示其關係 4. 交义線串連兩個或以上的概念
用途/好處	結合「分類記憶法」與「位置記憶法」的原理和優點及充份運用右腦功能，能把資料有系統地儲存，方便日後溫習或回憶。	1. 腦震盪 2. 能激發較深入及複雜性的思考
限制	構圖較為結構性 (分類及位置排列)，進行腦較複雜性的邏輯思考活動時，不及概念圖般靈活。	「畫面」較花，較難溫習及記憶

製造腦海地圖及概念圖的軟件

1. Mind Map : http://www.mindjet.com

2. Concept Map: http://www.inspiration.com/home.cfm

推介網址

1. http://serc.emb.gov.hk/big5/resources/sbrsp/sbrsp_05-2.htm (教署 - 概念圖)
2. http://www.yottkp.edu.hk/hots/concept.htm (仁愛堂田家炳中學 – 概念圖)
3. http://www.pooikei.edu.hk/mainpage/subpages/mind/course_1.html (崇真書院 - 思考地圖)

—— **完** ——