



國立臺灣大學 數學發展中心  
Center for Teaching and Learning Development



## 教學實務與技巧

**幫助學生**。 **成就自己**

經營教學心得

教學歷程檔

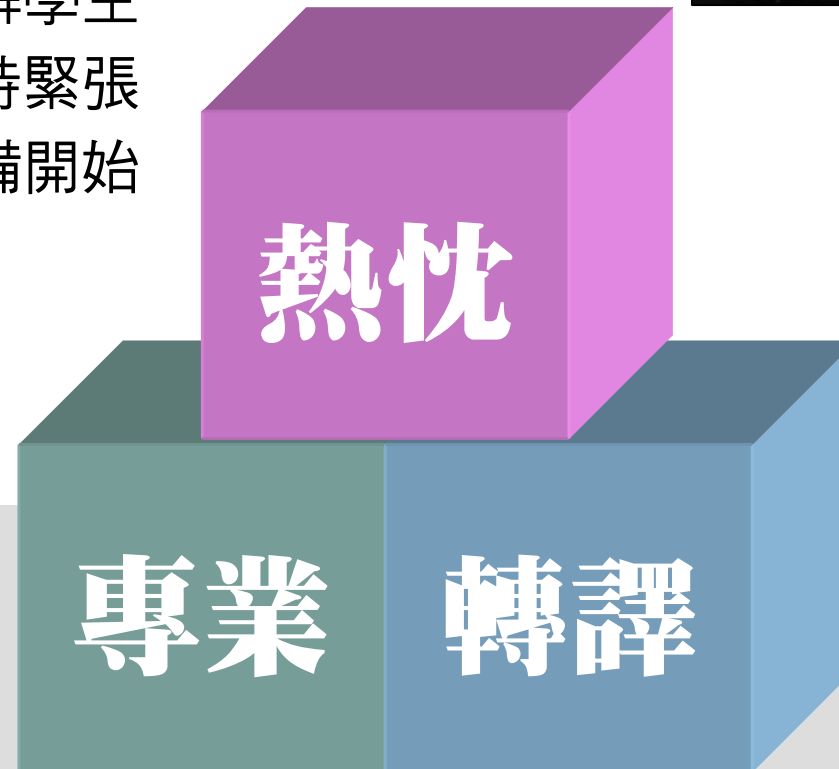
國立臺灣大學  
教學發展中心主任 莊榮輝  
生命科學院 生化科技學系



- (1) 無熱忱易被識破
- (2) 主動去瞭解學生
- (3) 平常心看待緊張
- (4) 以專業準備開始



**Great Mentors**



- (1) 專業素養要深厚
- (2) 自己先累積趣味
- (3) 要配合學生背景
- (4) 啟發知識與見識

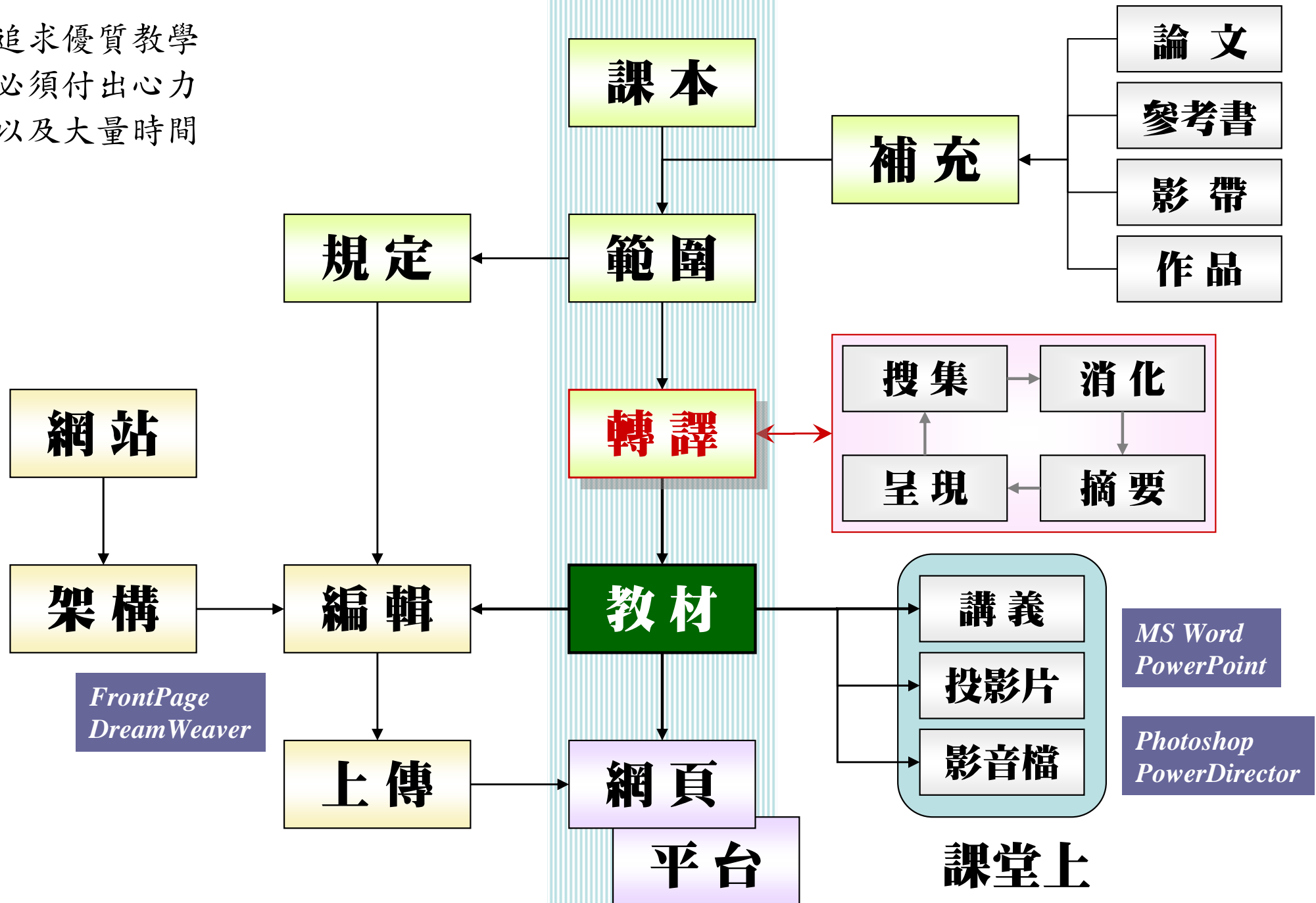
- (1) 學識要經過轉譯
- (2) 以投影片為舞台
- (3) 充分預習與掌握
- (4) 利用問題與個案

**以學生之立場與角度**

# 準備課程之關鍵流程

3

追求優質教學  
必須付出心力  
以及大量時間





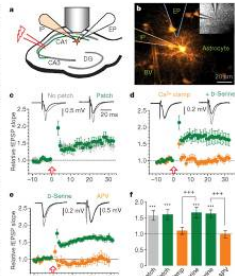
## LETTERS

### Long-term potentiation depends on release of D-serine from astrocytes

Christian Henneberger<sup>1</sup>, Thomas Papouliou<sup>1</sup>, Stéphane H. R. Olié<sup>1,2</sup> & Dmitri A. Rusakov<sup>1</sup>

Long-term potentiation (LTP) of synaptic transmission provides an experimental model for studying mechanisms of memory<sup>1</sup>. The classical form of LTP relies on N-methyl-D-aspartate receptors (NMDARs), and it has been shown that astroglia can regulate their activation through Ca<sup>2+</sup>-dependent release of the NMDAR co-agonist D-serine<sup>2–5</sup>. Release of D-serine from glia enables LTP in cultured<sup>6</sup> and explains a correlation between glial coverage of synapses and LTP in the hippocampus<sup>7</sup>. However, increases in Ca<sup>2+</sup> concentration in astroglia can also release other signalling molecules, most prominently glutamate<sup>8</sup>. ATP and tumour necrosis factor- $\alpha$ <sup>9,10</sup>, whereas neurons themselves can synthesize and supply D-serine<sup>11</sup>. Furthermore, loading an astrocyte with exogenous Ca<sup>2+</sup> buffers does not suppress LTP in hippocampal area CA1 (refs 14–16), and the physiological relevance of experiments in cultured or strong exogenous stimuli applied to astrocytes has been questioned<sup>17</sup>. The involvement of glia in LTP induction therefore remains controversial. Here we show that clamping internal Ca<sup>2+</sup> in individual CA1 astrocytes blocks LTP induction at nearby excitatory synapses by decreasing the occupancy of the NMDAR co-agonist site. This LTP blockade can be reversed by exogenous D-serine or glycine, whereas depletion of D-serine or disruption of exocytosis in an individual astrocyte blocks LTP. We therefore demonstrate that Ca<sup>2+</sup>-dependent release of D-serine from an astrocyte controls NMDAR-dependent plasticity in many thousands of excitatory synapses nearby.

To investigate the role of astrocytes in NMDAR-dependent LTP, we focused on Schaffer collaterals (SC-CA1) pyramidal cell synapses, a classical subject of LTP studies. We patched paired astrocytes in the stratum radiatum and monitored SC-mediated field excitatory post-



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Strikingly, clamping the intracellular Ca<sup>2+</sup> concentration completely suppresses LTP at nearby synapses, and the addition of 10  $\mu$ M D-serine (16  $\pm$  1.2%,  $n = 7$ ; Fig. 2a,b). Ca<sup>2+</sup>-dependent astrocytic

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To boost the Ca<sup>2+</sup> against the exocytosis transiently short-term potentiation of the NMDAR-mediated EPSCs approximately 20% after the train

and did not involve changes in release probability or ability (Supplementary Fig. 10).

How far do individual CA1 astrocytes extend their LTP? Although astrocytes occupy separate domains<sup>18</sup>, innervate through gap junctions<sup>19</sup>, which were left intact in our study. To determine whether these cells could act

monitored LTP simultaneously in two neurons paired with two astrocytes. First, we confirmed that

repeated through an astrocytic patch-pipette reliably (Fig. 9b), with no bias from glutamate transporter or

(Supplementary Fig. 11). We next patched two neurons and monitored SC-evoked astrocytic responses (Fig. 10) at the two respective areas (Fig. 8c). Clamped

astrocytes caused LTP induction by increasing activation of the NMDAR co-agonist site, demonstrating the availability of D-serine (LTP). To replicate the roughly 25% decrease of NMDAR

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and reduced release probability (Fig. 9c, d). This strongly suggests that the availability of D-serine is the limiting factor in LTP.

Nitric oxide (NO) synthase<sup>20,21</sup> provide potential examples of how astrocytes can act as haem-containing cells to very different roles. As in cytochrome P450s, the active site of NO synthase contains a haem bound to a cysteine amino acid (the base, B, in Fig. 1b). But their activity is confined to the amino acid

1-arginine, which converts to NO — a signalling molecule vital to the nervous, immune and cardiovascular systems. The chemistry involves two sequential oxidations, each requiring oxygen and NADPH. Each step proceeds via oxy, and follows into either peroxo<sup>22</sup>

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and did not

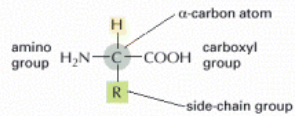


# 二十種基本胺基酸

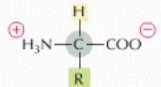
5

## THE AMINO ACID

The general formula of an amino acid is



R is commonly one of 20 different side chains. At pH 7 both the amino and carboxyl groups are ionized.



## FAMILIES OF AMINO ACIDS

The common amino acids are grouped according to whether their side chains are

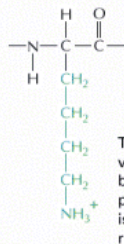
acidic  
basic  
uncharged polar  
nonpolar

These 20 amino acids are given both three-letter and one-letter abbreviations.

Thus: alanine = Ala = A

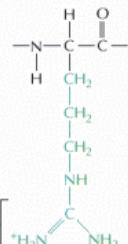
## BASIC SIDE CHAINS

lysine  
(Lys, or K)

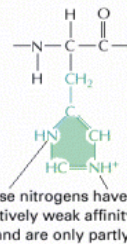


This group is very basic because its positive charge is stabilized by resonance.

arginine  
(Arg, or R)



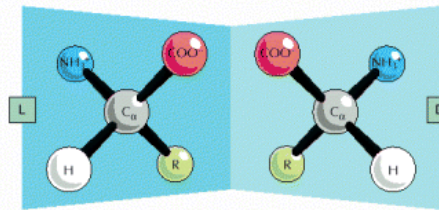
histidine  
(His, or H)



These nitrogens have a relatively weak affinity for an  $H^+$  and are only partly positive at neutral pH.

## OPTICAL ISOMERS

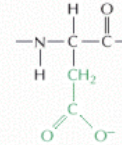
The  $\alpha$ -carbon atom is asymmetric, which allows for two mirror image (or stereo-) isomers, L and D.



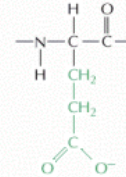
Proteins consist exclusively of L-amino acids.

## ACIDIC SIDE CHAINS

aspartic acid  
(Asp, or D)

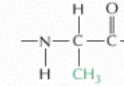


glutamic acid  
(Glu, or E)

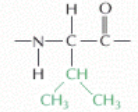


## NONPOLAR SIDE CHAINS

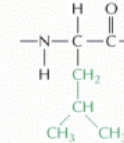
alanine  
(Ala, or A)



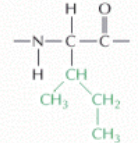
valine  
(Val, or V)



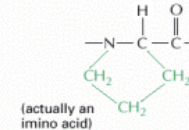
leucine  
(Leu, or L)



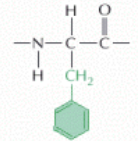
isoleucine  
(Ile, or I)



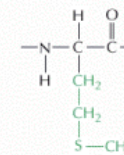
proline  
(Pro, or P)



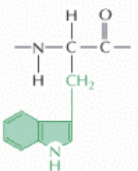
phenylalanine  
(Phe, or F)



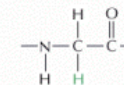
methionine  
(Met, or M)



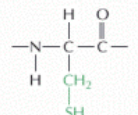
tryptophan  
(Trp, or W)



glycine  
(Gly, or G)



cysteine  
(Cys, or C)

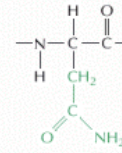


Disulfide bonds can form between two cysteine side chains in proteins.

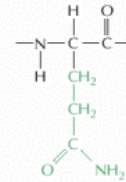


## UNCHARGED POLAR SIDE CHAINS

asparagine  
(Asn, or N)

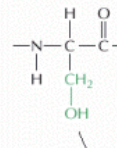


glutamine  
(Gln, or Q)

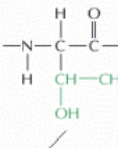


Although the amide N is not charged at neutral pH, it is polar.

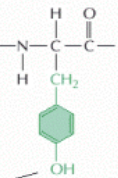
serine  
(Ser, or S)



threonine  
(Thr, or T)



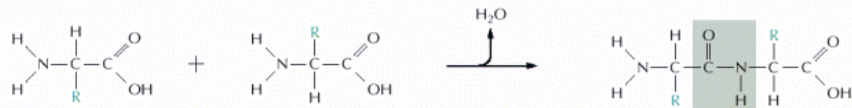
tyrosine  
(Tyr, or Y)



The -OH group is polar.

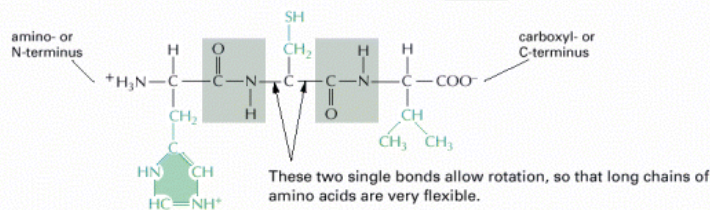
## PEPTIDE BONDS

Amino acids are commonly joined together by an amide linkage, called a peptide bond.



Peptide bond: The four atoms in each gray box form a rigid planar unit. There is no rotation around the C-N bond.

Proteins are long polymers of amino acids linked by peptide bonds, and they are always written with the N-terminus toward the left. The sequence of this tripeptide is histidine-cysteine-valine.

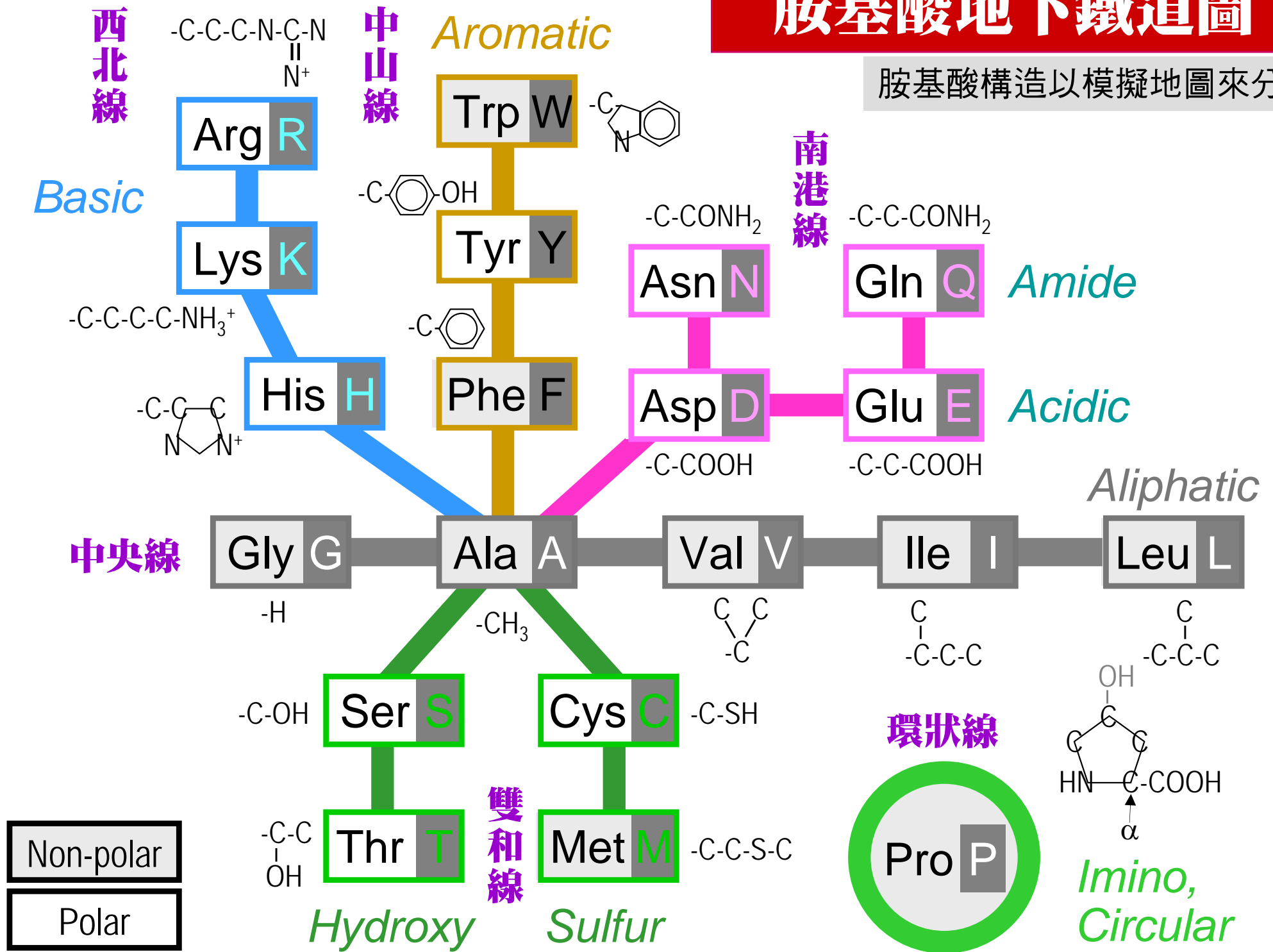


更豐富的圖形說明表及文字



# 胺基酸地下鐵道圖 6

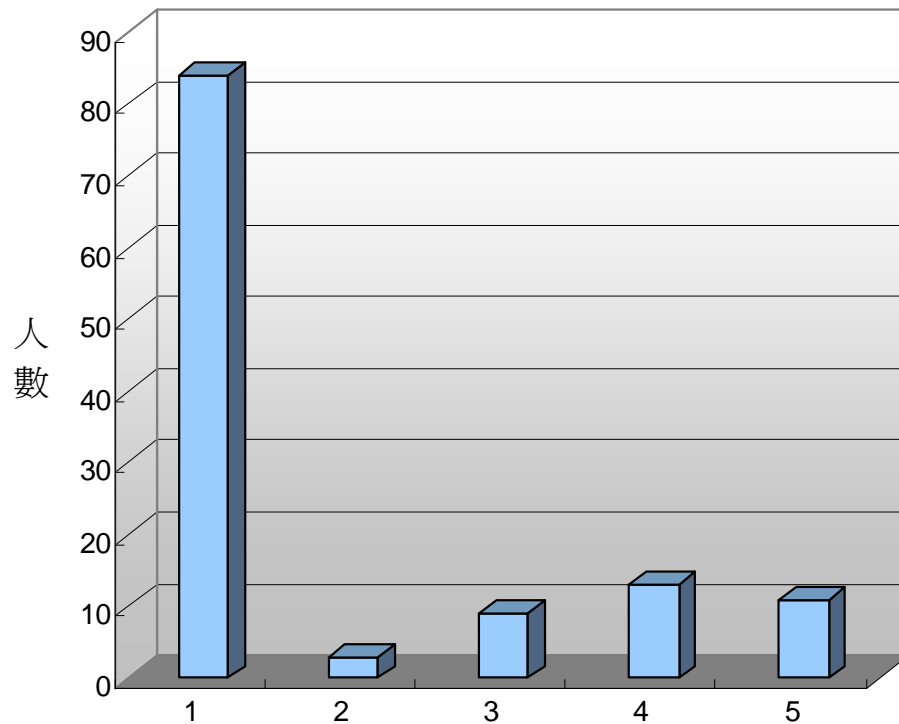
胺基酸構造以模擬地圖來分類



上課前	工作提要
基本	<ul style="list-style-type: none"> <li>(1) 儘早決定課程範圍，預留足夠 <b>時間</b>，以充分準備上課資料。</li> <li>(2) 把課程內容一一 <b>轉換</b> 成教材，記得要以學生的觀點為出發。</li> <li>(3) 至少完成所負責課程範圍的 <b>講義</b>，可以是文字檔或投影片。</li> <li>(4) 儘早完成講義 <b>第一版 (first draft)</b>，並不時修改內容及格式。</li> <li>(5) 把上課資料公佈在 <b>課程平台</b>，並讓學生知道所有 <b>重要規定</b>。</li> </ul>
進階	<ul style="list-style-type: none"> <li>(6) 建立自己的 <b>課程網頁</b>，適時加入影音資料，提升學習印象。</li> <li>(7) 申請教學助理，帶領 <b>TA 團隊</b>，與學生對話，共同經營班級。</li> </ul>
上課時	工作提要
基本	<ul style="list-style-type: none"> <li>(1) 每堂課前 <b>充分預習</b>，熟悉每一張投影片，並條列記下重點。</li> <li>(2) 一定要控制好 <b>時間</b>，不要在規定時間內，塞入太多投影片。</li> <li>(3) 開始上課就簡要描述當日 <b>重點</b>，讓學生預知將要學到什麼。</li> <li>(4) 難免 <b>焦慮緊張</b>，充分備課並熱忱講授，就能得到學生肯定。</li> </ul>
進階	<ul style="list-style-type: none"> <li>(5) 必要時，可自行在課堂中進行教學效果之 <b>回饋問卷 (KQS)</b>。</li> <li>(6) 每上課段落，對關鍵性概念提出問題，以 <b>表決器</b> 帶動討論。</li> </ul>

# 有關生命源起的看法？

(我的通識課上課實例)



- (1) 我支持演化論
- (2) 我支持創造論
- (3) 我支持智慧設計
- (4) 我都可以接受
- (5) 都不接受

## 學生很想知道全班表決結果

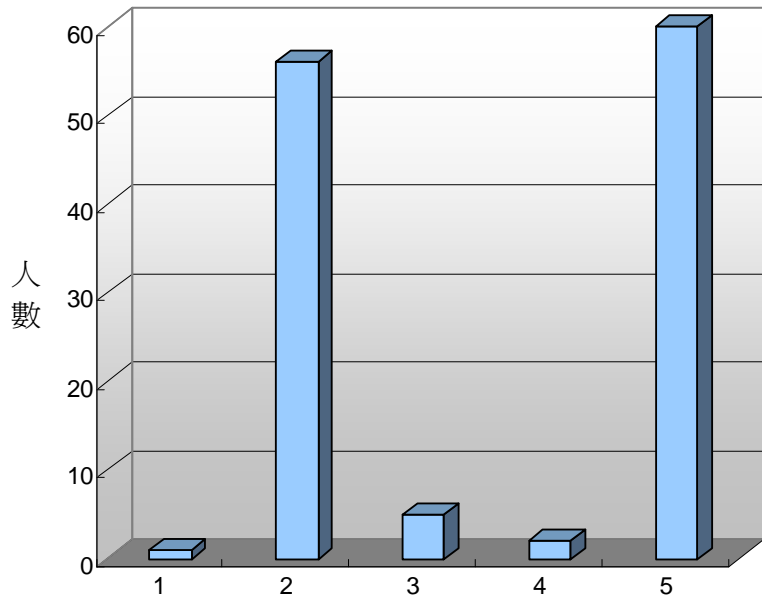
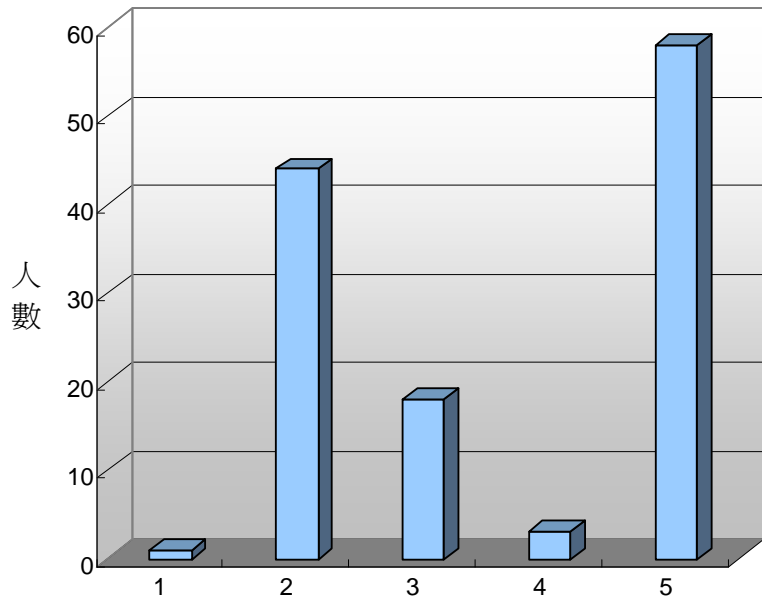
考試不能考這種題目 利用 clicker 即時回應





# 有關遺傳基因何者正確？

9



- (1) 遺傳學理論最早由摩根提出
- (2) 基因貯藏在細胞核的染色體
- (3) 細胞所有基因表現能力相同
- (4) 基因複製不容許有任何錯誤
- (5) 基因是由密碼 A,T,C,G 組成

可促進大班級之師生互動





# 把自己的舞台經營好

文學院演講廳 (卡奈基黑立言先生演講) 10

影音水雷空

高亮度投影機



自我評估

成功特質	權衡	我
1 自信	10	
2	10	
3	10	
4	10	

卡內基黑立言先生演講廳

溫度適中的**空調**  
(注意空氣是否清新)



清晰且方便的擴**音器**



善用**雷射筆**



**飲水**有時很重要



階梯教室



潛在因素：有效維護影音設備，環境影響上課品質！

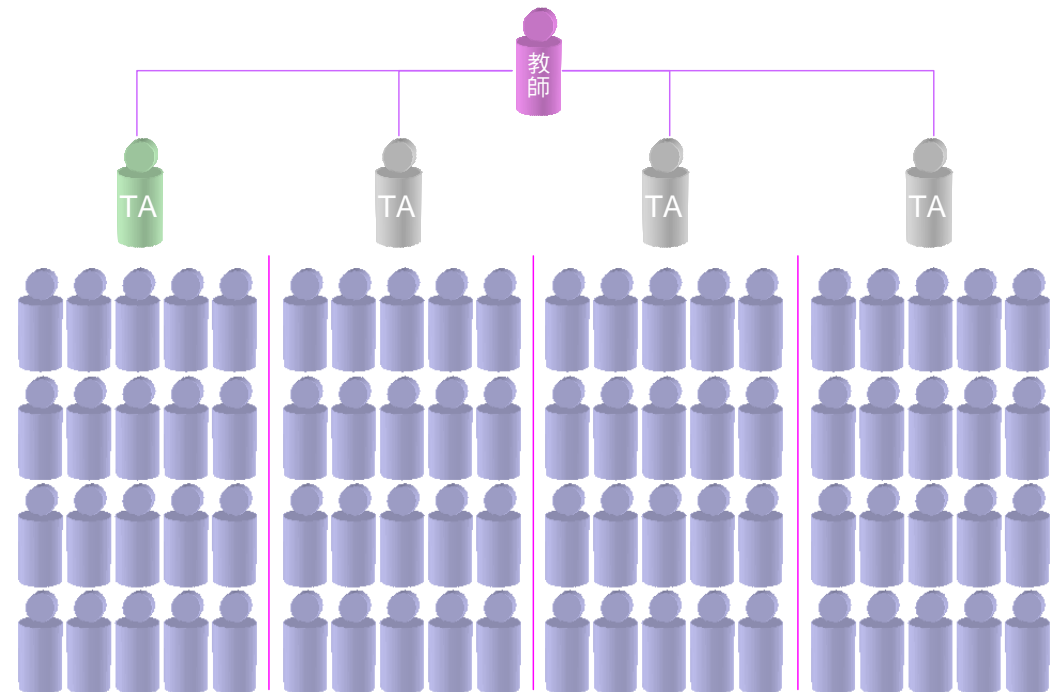


- (1) 歐美高教轉向：學生學習成效 (**learning outcome**)。
- (2) 1 學分的定義：課堂 50 分鐘 + 學生自學 2 小時。
- (3) 鼓勵學生學習：Office-hour、TA、讀書小組等。
- (4) 常常反思：我要讓學生學到什麼？是否達成目標？
- (5) 嚴格要求學生的老師，通常都會受到長期的懷念。

## 大班 TA 要更努力

### 教學助理 TA 的重要：

教師不再是單打獨鬥  
以 TA 協助帶領學生  
TA 是未來的優秀師資





## 在教學中心服務幾年後 ... 發覺

- (1) 新進教師的第一年經驗很重要
- (2) 每學期開學的第一堂課很重要
- (3) 大學生的第一年生活史很重要
- (4) 大學部最後一年收網整合亦然
- (5) 研究生第一年的養成也很重要

**慎始**

- 一、要全面兼顧教學、研究與服務幾乎是不可能的。
- 二、需先站穩研究表現，才能追求其他兩塊之卓越。
- 三、但教學必須及早耕耘，開始沒教好就很難挽回。
- 四、教學成果將會回饋到研究，因為實驗要靠學生。
- 五、剛開始不必追求高點數論文，但一定要發出去。
- 六、若大家研究表現差不多，教學成果將成為關鍵。
- 七、除了科學成果報告外，校內有很多啟發性演講。
- 八、找一個與自己興趣相投的服務工作，利人利己。
- 九、人才絕對是所有問題最終因素，資源才是其次。
- 十、對個人而言，時間掌控規劃與反思能力最重要。

# 人才是邁向頂尖的唯一關鍵

*Human resource is critical to achieve the university excellence*



# 以教育彩繪臺灣的未來

*Education brings Taiwan a colorful future*