國立交通大學 93 學年度碩士班入學考試試題

科系名稱：普通生物 (763) 考試日期：93 年 4 月 18 日 第 3 節
系所班別：教育研究所 組別：丙組 第一頁, 共 1 页
※作答前, 請先核對試題、答案卷 (試卷) 與准考證上之所組件別與考試科目是否相符!!

Part A (80 %)

1. 下列有關細胞構造的敘述，何者不正確？
   (a) 次質網獨立於細胞核，是細胞捕捉外來颗粒時的主要的構造
   (b) 高基氏體將蛋白質包裝至囊泡中，再運送至細胞的特定部位
   (c) 粒線體和葉綠體內均有 DNA，為細胞主要產生 ATP 之處
   (d) 細胞骨架附於細胞台形體，並與細胞及胞內物質運動有關。

2. 下列有關碳水化合物的敘述，何者不正確？
   (a) 動物的肝糖和植物的纖維素都是碳水化合物
   (b) 碳水化合物是提供生物體能量重要的來源之一
   (c) 葡萄糖、果糖和麥芽糖都屬於單糖
   (d) 幾丁質為含氮的多糖類，是昆蟲和螃蟹外殼的主要成分。

3. 下列有關生物分子的敘述，何者不正確？
   (a) 蛋白質是一長段的胺基酸序列     (b) ATP 為細胞中主要的能量攜帶者
   (c) 磷脂類由甘油、脂肪酸、磷酸根所組成
   (d) 核苷酸是由一個糖、一個含氮鹼基與至少一個磷酸根所組成

4. 轉錄 (transcription) 是指
   (a) 以訊息 RNA 為模板製造蛋白質     (b) 以 DNA 為模板製造訊息 RNA
   (c) 將蛋白質輸送至細胞外             (d) 以訊息 RNA 為模板製造 DNA

5. 真核細胞的糖解作用 (glycolysis) 是在何處進行？ (a) 粒線體 (b) 細胞核 (c) 液泡 (d) 細胞質膜。

6. 下列有關真核細胞的細胞週期之敘述，何者不正確？
   (a) 細胞週期可簡單分成有絲分裂期和間期 (interphase)
   (b) 間期通常是指細胞各項功能停滯的時期
   (c) S 期指 DNA 複製的時期             (d) 人體內大部分細胞停留在 G1 期

7. ________ 是將正常基因轉移至受體細胞內以改正遺傳缺失的方法，而以類似技術在農業上所產生新品種的作物稱為______。 (a) 核酸雜交法，GMO (b) 基因療法，EST (c) 基因療法，GMO (d) 核酸雜交法，EST。
8. 下列何種免疫球蛋白與抵抗感染的免疫力關係最為密切？
   (a) IgA    (b) IgD    (c) IgG    (d) IgM    (e) IgE

9. 下列有關 DNA 複製過程的描述，何者正確？
   (a) 只需 DNA 聚合酶一種酵素參與複製反應
   (b) DNA 聚合酶具有極高的效率，但相對的準確性不高
   (c) 複製後的 DNA 分子兩股均為全新製造出來的
   (d) DNA 的複製有起始也有終點

10. 真核細胞用以生長蛋白質的 RNA 在製造後，通常會經過那一種修飾？
    (a) 在 3’端加上带有甲基與磷酸根的核苷酸
    (b) 將 exon 序列移除
    (c) 在 3’端加上一長串的腺嘌呤核苷酸
    (d) 在大部分的 A 上的會進行大量的甲基化。

11. 脈搏量測
    (a) 血壓    (b) 心跳    (c) 呼吸速率    (d) 血流速度

12. 鎖刀形細胞貧血最初出現在亞洲、中東及非洲，後來此病因非洲人被帶入美洲而引入北美。在微生物學來說，這是___的例子。
    (a) 基因浮動 (genetic drift)    (b) 突變 (c) 基因流動 (genetic flow)    (d) 天擇

13. 下列有關 Archaea 細菌的描述何者錯誤？
    (a) 有些可生長在攝氏 100 度的高溫環境    (b) 是地球主要的甲烷生產者
    (c) 具有植物細胞的葉綠體以行光合作用    (d) 和一般細菌一樣為原核生物

14. Prions
    (a) 可引起動物體罕見的致命性神經退化疾病    (b) 為單股 DNA 分子
    (c) 是一種 RNA 病毒    (d) 引起的病程極為迅速 通常在感染兩週之內發病

15. 下列何種酵素在低 pH 值 (pH=2) 下作用最佳？
    (a) amylase    (b) lipase    (c) nuclease    (d) pepsin    (e) trypsin

16. 頓囊切除的病人，在飲食上需特別限制哪一類食品的攝取？
    (a) 糖類    (b) 蛋白質    (c) 脂肪類    (d) 纖維質
17. 下列有關真菌的描述，何者不正確？
(a) 大部份為腐生菌，少數能引起動、植物的疾病
(b) 白色念珠菌為一臨床常見的真菌，能引起陰道炎等疾病
(c) 能產生許多重要的藥物如盤尼西林和劑毒物質如黃麴毒素
(d) 其生活史以單細胞的酵母體（yeast cell）為主

18. 下列有關線蟲（nematodes）的描述，何者正確？
(a) 線蟲只在植物造成疾病  (b) 廣東住血吸蟲是一種線蟲
(c) 線蟲 Caenorhabditis elegans 是第一個基因完全被定序的多細胞生物
(d) 是一種具有真體腔的蠕蟲類

19. 下列關於植物合爾蒙的描述，何者有誤？
(a) 細胞素促進細胞分裂並減緩葉子老化 (b) 乙烯促進果實的成熟和脫落
(c) 離層素促進水分流失和種子發芽 (d) 生長素和吉爾素均促進莖的延長

20. 下列何者有關骨質疏鬆症（osteoporosis）的描述，何者有誤？
(a) calcitonin 能減緩鈣由硬骨移出，因此可用以減緩病情
(b) 此病好發於更年期停經後的婦女
(c) 補充雌性素一直是標準療法，但是仍有許多爭議
(d) 與運動過度有密切關係。

21. 聚合酶連鎖反應（PCR）
(a) 為一種心肺復甦急救法
(b) 只有少數國家型實驗室能進行的一種極為困難的操作技術
(c) 能在短時間產生大量產生一段特定序列DNA的方法
(d) 是一種生物特殊的演化方式

22. 下列哪種性質不是癌症細胞的特點？
(a) 癌症細胞細胞膜與細胞質與正常細胞有極大變異
(b) 癌症細胞的附著力降低，易於轉移
(c) 癌症細胞有不正常的生長與分裂
(d) 癌細胞極有可能是致命的。

23. 人類胚胎發育形成器官（organogenesis）時期發生在
(a) 胚胎在輸卵管時  (b) the first trimester
(c) the second trimester (d) the third trimester
24. 下列何者不屬於結締組織（connective tissue）？
   (a) Cartilage    (b) Bone    (c) Blood    (d) Epithelium    (e) Adipose body

25. 抗生素盤尼西林（penicillin）殺菌的作用機制？
   (a) 抑制細菌細胞壁的形成    (b) 抑制細菌蛋白質的合成
   (c) 抑制細菌細胞壁的合成    (d) 抑制細菌核酸的複製

26. 下列有關神經傳導物質（neurotransmitter）作用的敘述，何者有誤？
   (a) 一種神經傳導物可因作用細胞不同而表現興奮或抑制的活性
   (b) 多巴胺（dopamine）分泌過剩可導致精神分裂
   (c) 乙醯膽鹼酯（acetylcholine）是最專一的一種興奮性神經傳導物
   (d) 血清素（serotonin）是一種影響睡眠、情緒、和注意力的神經傳導物

27. 下列有關人體必需的微量元素的敘述，何者不正確？
   (a) 維他命是一群有機分子，僅需微量即可提供生物體的營養
   (b) 素食者可藉搭配不同的植物性食物得到所需的營養源
   (c) 動物可自行合成本身所需的脂肪，不必自外界攝取
   (d) 鈣和磷是成骨必需的元素

28. 下列有關人體器官功能的敘述，何者不正確？
   (a) 腎負責透析血液以濾除小分子或藥物
   (b) 腎可將濾過的小分子包括水、醣、維他命、和有機物等再吸收使用
   (c) 肝負責調節血糖使維持在約百分之零點一的血糖濃度
   (d) 過胖減重可以手術截短大腸，減少養分的再吸收

29. 下列有關人體系統功能的敘述，何者不正確？
   (a) 運動過後，血的酸度提高會使心跳增加
   (b) 大腦右半葉負責言語的表達，意外受損會導致失語症
   (c) 肾臟是三種作用各不相同的器官
   (d) 精子到達輸卵管與卵結合

30. 有關基因體的研究，下列敘述何者不正確？
   (a) 人類的基因僅佔基因體的百分之一
   (b) 基因晶片和蛋白質研究都屬於功能基因體學的範疇
   (c) 藥用植物的基因體大於人類基因體
   (d) 人類基因體序列解碼後，許多遺傳疾病的成因可因此確認
II. 問答題 (20%)  
1. 半年前，歐美政府因狂牛病例數目大增，曾經下令將含有膠原蛋白的各類化妝品從商品櫃移除，請問原因為何？(5%) 
2. 半年前，許多民眾因為禽流感肆虐而拒食家禽，請問你的看法並請說明原因。(5%) 
3. 請舉兩例說明何謂奈米生物？並請說明其重要性。(5%) 
4. 就你所知，請解釋何謂生物資訊？並請舉例說明其重要性。(5%) 

Part B. 請依據下面的有關細胞(cell)概念研究報告回答下列問題 (20%) 
1. 該研究的目的為何？ 
2. 該研究顯示學生有關於 cell and cell process 的迷思概念為何？ 
3. 你認為學生可能產生這些迷思概念的原因為何？ 
4. 請針對學生主要有關於 cell and cell process 的迷思概念設計一教學活動，協助學生概念改變(conceptual change)？

Representation of the cell and its processes in high school students: an integrated view


This paper presents an integrated view of the ideas and conceptual problems of high school students with respect to the cell, its processes, structure and relation to the functions of multicellular organisms. The theme of cell has divided into eight topics, with a questionnaire for each topic. In these topics, different levels of representation and understanding are distinguished between general considerations about plants and animals, those connected with processes at organ and system levels and, finally, the level of cell processes. Data from 1200 students were analysed. Results show that students have an analogical mechanism that establishes an isomorphism between the representation of the functioning of multicellular organisms of cell processes. A series of problems in understanding was also shown. Results imply that these problems are mainly due to students' lack of differentiation between some processes at organism and organ level, and have important implications for learning this subject. Finally, some suggestions are made for teaching.
<table>
<thead>
<tr>
<th>Topic</th>
<th>General</th>
<th>Levels</th>
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<td>General</td>
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<tr>
<td></td>
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<td>Levels</td>
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<tr>
<td></td>
<td></td>
<td>Cellular</td>
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<tr>
<td>Respiration</td>
<td>Energy is obtained from respiration so that the</td>
<td>Unicellular organisms respire anaerobically</td>
</tr>
<tr>
<td></td>
<td>organisms can perform their functions (40.6%)</td>
<td>because they are simple (15.6%)</td>
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<td></td>
<td>Oxygen purifies blood (39.6%)</td>
<td>Unicellular organisms do not have the same</td>
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<td>Respiration is an exchange of gases (59.3%)</td>
<td>type of respiration as multicellular</td>
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<td>Aerobic respiration takes place in the organs or</td>
<td>organisms (15%)</td>
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<td>oxygen in the organs or tissues (36.6%)</td>
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<td></td>
<td>Only land organisms can be aerobic (10%)</td>
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<tr>
<td>Water in plants</td>
<td>Water is food or a nutrient that provides energy</td>
<td>The semi-permeable membrane lets the water</td>
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<td>cas (44%)</td>
<td>cells needs go through (37%)</td>
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<td>Water is the solvent of nutritional substances</td>
<td>Water goes through pores, tubes or vessels</td>
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<td>(33%)</td>
<td>in the membrane (10%)</td>
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<td></td>
<td>Water participates in photosynthesis and</td>
<td>For osmosis to take place there must be</td>
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<tr>
<td></td>
<td>respiration (31%)</td>
<td>different amounts of liquids on both sides</td>
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<tr>
<td></td>
<td>Photosynthesis is a process where plant needs</td>
<td>of the membrane (10%)</td>
</tr>
<tr>
<td></td>
<td>sunlight, water and minerals from the ground</td>
<td>The membrane stabilizes liquids, there</td>
</tr>
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<td></td>
<td>that takes up through its roots and as result</td>
<td>must be an equilibrium (10%)</td>
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<td></td>
<td>there is an exchange of gases (36%)</td>
<td>The vacuole is a water store (53%)</td>
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<td>In an environment with an excess of water,</td>
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<td></td>
<td>the cell only takes the water it needs</td>
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<td></td>
<td></td>
<td>(10%)</td>
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<td></td>
<td></td>
<td>The nucleus regulates the amount of water</td>
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<td></td>
<td></td>
<td>in the cell and shares out the nutrients</td>
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<td>(13.8%)</td>
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<tr>
<td>Water in animals</td>
<td>Water cleans, transports and separates compounds (75%)</td>
<td>Water goes through the organs and tissues by means of cell layers (26.3%)</td>
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<td>------------------</td>
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<tr>
<td>Water is a food (50.3%)</td>
<td>Water is a solvent for organisms (19%)</td>
<td>Water eliminates waste from cell (26.3%)</td>
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<tr>
<td>Plant nutrition</td>
<td>Photosynthesis takes place during the day and respiration at night (38.6%)</td>
<td>The leaves take the nutrients the plants need (10%)</td>
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<tr>
<td>Photosynthesis is an exchange of gases (55%)</td>
<td>Plants take nutrients like water, proteins and mineral salts from the environment (21%)</td>
<td>Dark phase of photosynthesis takes place at night and during this oxygen is released (38.6%)</td>
</tr>
<tr>
<td>Plant nutrition</td>
<td>The light phase takes place during the day and in this phase energy is absorbed (10%)</td>
<td>Leaves absorb sunlight and its energy (14%)</td>
</tr>
<tr>
<td>An organic compound in one that has life or is one that comes from living things (16%)</td>
<td>Photosynthesis is a process in which the plant needs sunlight, water and minerals from the ground that takes up through its roots and result an exchange of gases (36%)</td>
<td></td>
</tr>
<tr>
<td>Animal nutrition</td>
<td>Blood transport nutrients (40.3%)</td>
<td>In animals, food is first degraded and then synthesized (10%)</td>
</tr>
</tbody>
</table>
### Table 1. continued

<table>
<thead>
<tr>
<th>Topic</th>
<th>General</th>
<th>Organism</th>
<th>Cellular</th>
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<tbody>
<tr>
<td><strong>Levels</strong></td>
<td><strong>Organic compounds are found in living things (12%)</strong></td>
<td>Spiders, paramecia, yeasts and the human being can be autotroph (43.7%)</td>
<td>Cell organelles are like organs (10%)</td>
</tr>
<tr>
<td><strong>Cell shapes</strong></td>
<td>Factors that alter cell shape can be genetic, environmental and social (12.3%)</td>
<td>Cells modify their shape through the growth and development of the organism of which they form part (41%)</td>
<td>Digestion in the cell is a trituration, disintegration, or filtration (10%)</td>
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<td></td>
<td>Plant cells can have different shapes (51.6%)</td>
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<td>Plant cells are all the same (25.6%)</td>
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<td>Animal cells are generally round (43%)</td>
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<td>Cell from the same organs or different organisms are different due to the size and shape of the organs (40.3%)</td>
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<tr>
<td></td>
<td>Structures like bone (64%), cartilage (74%) or hair (60%) are not made up by cells</td>
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<td></td>
<td>Nails (84.3%) and the pupil (58.3%) are made up of cells</td>
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<tr>
<td><strong>Cell size</strong></td>
<td>Cell size can be affected by food, water, disease and genetic factors (49%)</td>
<td>Cells change in size along with the growth of a multicellular organism (30%)</td>
<td>Cell that perform different functions have different sizes (19.6%)</td>
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<td>The size of the cell is like that of molecules and atoms (72.3%)</td>
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<td>The cell size in the same organs of different organisms is different due to the difference in size organs (10%)</td>
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<td>The cell size in an organ depends on the type and size of the organism (23%)</td>
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</table>
Reproduction
For sexual reproduction to exist, sexual contact is necessary (11%)  

Plants reproduce asexually, there is no contact between them (10%)  

Pollen is like a seed (10%)  

In human reproduction, two cells join together and act together (they continue to be two) (14.7%)  

Human beings do not originate from one cell because human are multicellular (29.3%)  

In tissue regeneration, the new cells are initially different due to many factors such as: being young, strong, differences in genetic information, after a certain period of time they become the same because they get old (10%)  

The equitable contribution of genetic material from both progenitors is not identified in human being (10%)  

Asexual reproduction is equivalent to cell multiplication (34%)  

Cell multiplication is obtained from division, without previous processes (32%)  

Cell is an homogeneous entity that divides itself (34%)  

Mitosis is a bipartition (34%)  

Meiosis is a sexual reproduction mechanism (10%)  

Chromosomes only intervene in reproduction (10%)  

DNA or the genetic code ensures that the cells that are produced are the same (11%)  

The nucleus is the organelle in which reproduction is carried out (16%)
Figure 1. Multicellular-cellular and confusing and misunderstanding terms schemes.
Results

In order to show students' ideas, from the general processes of living things to cell in all the topics, the results were organized in three main categories: general processes, processes in pluricellular organisms, and cell processes. Table 1 shows the students' ideas for each topic. Percentages follow each idea, and these percentages formed by joined similar or complementary ideas is the mean of each percentages.

Several problems concerning comprehension that had originated in previous ideas were identified. These problems appear across all levels from general to cellular. The most significant are:

- the articulation between structural units cells and multicellular organisms;
- the functioning of cell membrane;
- confusion between photosynthesis and respiration;
- the classification of organisms as simple and complex and the incorrect inferences made about the cell;
- confusion between meiosis and mitosis;
- the differentiation of concepts like genetic code, chromosome, DNA, etc.;
- structural organization and external morphological differences are transferred to cell processes
- problems with recognizing a variety of cell forms and size.

Conclusions

The perspective provided by the analysis is one that shows serious problems with respect to the appearance of numerous previous ideas that show students' lack important knowledge of various processes of pluricellular organisms, which they use as an analogy for representing the cell.

Results show that in students' constructions of an integrated representation – including levels of differentiation and articulation – of a cell and its processes, several levels of comprehension are present and range from general functions of living organisms to cell structure and functioning. There are some difficulties present in the comprehension of the functioning of organs and apparatus belonging to macroscopic organisms that are transferred to the cell. This is persistent among students, resulting from the analogy students make between different levels of cell organization.

The use of the analogical scheme 'multicellular–cellular' by students might have implications for difficulties, as they have to establish abstract representations for cellular structures and functions. Above all, implications concern the construction of explanations about multicellular functioning, starting from conceptualization about the cell itself. This scheme does not permit an understanding of the differences and similarities between plant and animals.
Likewise, results exhibit different processes – at a multicellular level – that involve comprehension problems – between functions and processes – expressed, for example, by confusion among mitosis and meiosis concepts. Problems of understanding and persistence of previous ideas in this field might be related to a long process of schooling in biology that emphasizes description of processes among living things. This needs further analysis.

Longitudinal views – general living processes to cell – might be useful for analysing other themes and concepts in biology that students have special difficulty in understanding. It might also be useful to analyse, in great depth, students’ difficulties in constructing representations of processes at a cellular level. Another question to analyse is how dangerous or useful can isomorphism be for the comprehension of complex themes in biology, as it is shown in this and other studies.