Student Code: _____

20th INTERNATIONAL BIOLOGY OLYMPIAD

12th – 19th July, 2009

Tsukuba, JAPAN

PRACTICAL TEST 1

ANIMAL AND PLANT ANATOMY

Total Points: 100

Duration: 90 minutes

Dear Participants,

親愛的參賽同學，

- In this test, you have been given the following 2 tasks:
- 以下的考試分為兩個部份：

  Task 1: Animal anatomy (50 points)

  第一部分：動物解剖(50 分)

  Task 2: Plant anatomy (50 points)

  第二部份：植物解剖(50 分)

- **You must write down your results and answers in the ANSWER SHEET. Answers written in the Question Paper will not be evaluated.**
- 你必須將答案寫在答案卷上，否則不予計分。
- Please make sure that you have received all the materials and equipment listed for each task. If any of these items are missing, please raise your hand.
- 確定你有全部的實驗器材，如有缺少請舉手。
- At the end of the test, put the Answer Sheet and Question Paper in the envelope. The supervisor will collect this envelope.
- 考試完畢後，請將答案卷及試題卷放入信封袋中，監試人員將收取信封袋。

Good Luck!!

Task 1 (50 points)

第一部份(50 分)

Animal Anatomy

動物解剖

Materials and Equipment 材料與器材	Quantity 數量
1. Vessel containing two caterpillars anesthetized 瓶中裝有兩隻已經麻醉的蠶蛾幼蟲	1
2. Vessel containing one caterpillar non-anesthetized 瓶中裝有一隻未麻醉的蠶蛾幼蟲	1
3. Dissecting plate 解剖盤	1
4. Forceps 鑷子	2
5. Scissors 剪刀	1
6. Disposable pipette 拋棄式滴管	1
7. Dissecting needle equipped with holder 有柄的解剖針	2
8. Dissecting pins 解剖用之固定針	20
9. Compound binocular microscope (equipped with illuminator) 具有光源的解剖顯微鏡	1
10. Set of color pencils: one “O” (orange), one “B” (blue), and one “G” (green) 有色鉛筆一組：1 枝 “O”(橘色)，1 枝 “B”(藍色)和 1 枝 “G”(綠色)	1
11. Photo of a dissected caterpillar (included in your envelope) 一張已經解剖過的蠶蛾幼蟲照片(信封袋內)	1
12. A Petri dish for discarding dissected larva 一個存放棄置幼蟲的培養皿	1

Introduction

Even in insects which undergo complete metamorphosis, the body structure of the adult and larva are basically common. After closely observing a non-anesthetized caterpillar and dissecting and closely observing anesthetized caterpillars or moth (*Bombyx mori* Linné) larvae (silk worm), answer the following questions. When you dissect the caterpillars, do it in the dissecting plate filled with water, using suitable equipments such as forceps, scissors, dissecting needle with holder, dissecting pins.

簡介

雖然有些昆蟲的發育須經過完全變態的過程，但昆蟲的成體和幼體之間，身體的構造基本上是相通的，先仔細觀察一隻未麻醉的蠶蛾幼蟲，再觀察已經麻醉並解剖的蠶蛾幼蟲後，請回答下列問題。當你解剖這些幼蟲時，請先在解剖盤中加水後再進行。解剖過程中請使用鑷子、剪刀、解剖針及固定針。

Q.1.1. (1 point×2 = 2 points) The insect body is composed of three regions, the head, thorax and abdomen. Show the boundary between the head and thorax by drawing an orange line with orange color pencil “O” and the boundary between the thorax and abdomen by drawing a blue line with blue color pencil “B” on the photo of the caterpillar in the Answer Sheet.

昆蟲的身體由頭、胸及腹部三部份所組成，請用橘色“O”的筆劃線，將答案卷上幼蟲照片中的頭部和胸部區分出來。再用藍色“B”的筆劃線，將胸部和腹部區分出來。

Q.1.2. (3 points) On each side of the caterpillar's head, you will find an eye patch. How many small eyes are in the eye patch of one side of the caterpillar head in front of you? Answer using numerals (eg, 4, 6, 9).

在幼蟲頭部的兩側，可見到一個眼斑，請你計算每一個眼斑中有多少小眼，並將數量填於答案卷上(例如 4,6,9)

Q.1.3. (3 points) Insects breathe by means of a tracheal system, with external openings called spiracles. How many pairs of spiracles do the caterpillars in front of you have? Answer using numerals (eg, 4, 6, 9).

昆蟲藉由氣管系統來進行呼吸，氣管系統與外界相通的孔道稱爲氣孔。請計算在你面前的幼蟲有多少對的氣孔，並將對數填於答案卷上(例如 4,6,9)

Q.1.4. (6 points +[2 + 2]×3 points = 18 points) The photo in your envelope shows a dorsal view of a dissected caterpillar. Dissect the anesthetized caterpillars by yourself exactly as shown in photo.(You may use the second caterpillar if required). When you have finished the dissection, call your assistant by raising your hand. Your assistant will take a photograph of your specimen for evaluation (**6 points**) .(You should check your photography of your dissected specimen after it has been taken.)

Closely observe the internal structures of the caterpillar, focusing on where the tubular structures A, B and C arise. Answer the name and function of each of the tubular structures A, B and C by choosing the appropriate answer for the name from numerals 1-10 and function from the alphabet a-j.

信封袋中的相片顯示一隻已經解剖的蠶蛾幼蟲的背面觀。請解剖這隻已經麻醉的蠶蛾幼蟲如照片所示(解剖過程中如果不慎毀壞，可再用另一隻幼蟲)，當你完成解剖時，請舉手通知監試人員，監試人員會照相將你的結果記錄下來，以供評分用。(6 分)
(請記得確認監試人員所照的相片，是否能完全呈現你所完成的解剖結果)

仔細觀察蠶蛾幼蟲的內部構造，注意觀察三種管狀構造 A,B 及 C 出現的地方，依據下列所提供的名稱 1-10 及功能 a-j ，回答此三種管狀構造 A,B 及 C 的名稱及功能。

Names 1: salivary gland; 2: oviduct; 3: malpighian tubule; 4: appendix;

名稱 1： 唾液腺 2:輸卵管 3:馬氏管 4:盲腸

5: trachea; 6: prothoracic gland; 7: silk gland; 8: corpora allata;

5:氣管 6：前胸腺 7：絲腺 8:咽側腺

9: fat body; 10: seminal duct

9：脂肪體 10：輸精管

Functions a: secretion of juvenile hormone; b: support of digestion;

功能 a：分泌年輕激素 b：幫助消化

c: respiration; d: secretion of silk; e: secretion of prothoracic hormone;

c:呼吸 d：分泌絲 e：分泌前胸腺激素

f: restoration of fat; g: excretion; h: transport of egg;

f：儲存脂肪 g：排泄 h：輸送卵

i: transport of sperm; j: secretion of saliva

i:輸送精子 j：分泌唾液

Q.1.5. (2 points×3 = 6 points) The insect body contains different kinds of internal organ systems. Closely observing non-anesthetized and dissected caterpillars, show the positions of the central nervous system, digestive system (gut) and circulatory system (heart), by drawing them into the image of the caterpillar prepared in the Answer Sheet using the colors as indicated below.

昆蟲的身體具有不同的器官系統，仔細觀察未麻醉和已經解剖的幼蟲，觀察中樞神經系統，消化系統(消化管)及循環系統 (心臟血管) 所在的位置，並利用下列指定顏色的筆，將所觀察到的位置和範圍畫於答案卷所提供的圖像上。

Central nervous system - orange color pencil “O” 中樞神經系統以橘色 “O”的筆畫出

Digestive system - blue one “B” 消化系統以藍色 “B”的筆畫出

Circulatory system - green one “G”. 循環系統以綠色 “G”的筆畫出

Notice: If you can show the positions of the systems in the image of the caterpillar, there is no need to copy their exact shapes: however, in drawing the digestive systems, you should clearly show both ends.

注意：只需將各系統所在的位置和範圍畫出即可，不需畫出詳細形狀。但消化系統 (消化管) 例外，你必須將兩端清楚的畫出。

Q.1.6. (4 points) The central nervous system of insects is composed of the aggregations of cell bodies or the ganglia and the bundles of nerve fibers or the nerve cords connecting ganglia. How many ganglia does the dissected caterpillar have?

昆蟲的中樞神經系統是神經元的細胞體的集合，或由神經結以及連接神經結的神經纖維束或神經纖維索所組成。觀察你所解剖的幼蟲具有多少對神經結？(請以阿拉伯數字表示有幾對)

Q.1.7. (4 points×3 = 12 points) Show the positions of the anteriormost, anterior-second and posteriormost ganglia by drawing arrows and labeling with “A” for anteriormost, “2” for anterior – second and “P” for posteriormost with black pencil in the image of the caterpillar used in **Q.1.5**.

利用 **Q.1.5**.所提供的圖，在圖上標示出最前面、次前面以及最後等 3 個神經結的位置，用黑筆以“A” 標示出最前面神經結的位置，“2” 標示出次前面神經結的位置，“P” 標示出最後神經結的位置。

Q.1.8. (2 points) How many nerve cords are there between each pair of ganglia? Answer using numerals, choosing the correct number from 1 to 4.

請問在每一對的神經結之間有多少條神經索，請選擇 1 到 4 中正確的數字，填寫於答案卷中。

Task 2 (50 points) 第二部分（50 分）

Plant Anatomy 植物解剖

In this task, fruit and flower morphology are examined and the developmental process is studied. 在此部分，將觀察花與果實的形態，並探討其發育過程。

Part A Seed morphology and reserve substances

A 部分：種子形態及儲存物質

Materials and equipment 材料與器材	Quantity 數量
1.Petri dishes containing seeds labeled I to IV 裝有種子的培養皿四個，標示爲 I – IV	4
2. Stereomicroscope (used in Task 1) 解剖顯微鏡（用於第 1 部分）	1
3. Forceps (used in Task 1) 鑷子（用於第 1 部分）	2
4. Knife 刀片	1
5. Scalpel 解剖刀	1
6. Bottles of staining and rinsing solutions (IKI, IKI-R, CBB, CBB-R, OR, OR-R) 瓶裝的染料及沖洗劑(IKI, IKI-R）、 (CBB, CBB-R）、(OR, OR-R)	6
7.Small Petri dishes for staining 染色用的小培養皿	12

Introduction 前言

Morphology and reserve substances vary across plant species. Reserve substances can be distinguished by staining.
不同種類的植物，其形態及儲存物質不同，所儲存物質可藉染色來加以區分

Q.2.A.1. (27 points)

There are 4 kinds of seed (I to IV) in Petri dishes. The seeds labeled IV are *Vigna angularis*, a kind of legume which are given as an example. The seeds have been soaked for 24 hours. From some seeds, the seed coat was removed. Dissect the seeds using scalpel or knife, and stain each of them and their sections separately using all three staining solutions. Then, observe the stained seed samples including the sections of tissues under the stereomicroscope, and examine the degree of staining. Look at the samples carefully and fill the degree of staining in the Box of Q.2.A.1. in the answer sheet using the following symbols: "±" for weak staining, "+" for medium staining, "++" for strong staining. Use "-" for samples not stained, and "N" for seeds which do not have the indicated tissue..

培養皿(I - IV)中分別裝有四種不同的種子，培養皿 IV 所裝的種子是一種稱爲 *Vigna angularis* 的豆類種子，以此種子作爲例子。此種子已浸泡 24 小時。其中有些種子的種皮已被剝除。使用刀片或解剖刀來解剖這些種子，分別以三種染料將種子及其切片染色，並在解剖顯微鏡下觀察染色結果（包括種子及其切片組織），仔細觀察其染色程度，並在答案卷上的 Q.2.A.1 表格中填入不同的染色程度差異："±"代表輕度染色；"+"代表中度染色；"++"代表強度染色；"-"代表無法染色；"N" 代表種子中缺乏此組織。

Caution

-Some seeds are potential allergens. Wear gloves and do not touch them with your bare hands.
-Do not allow the staining solutions to contact your skin. If they touch your skin, rinse the area thoroughly with distilled water.

注意！

某些種子可能是過敏原，請戴上手套，勿直接以手觸碰。

勿讓皮膚沾上染料，若不小心沾上，請用蒸餾水充分沖洗。

Staining and rinsing solutions:染料及沖洗劑

Staining solution 染料	Rinsing solution 沖洗劑	Stain for 被染色的物質	Color 顏色	Property 性質
IKI	IKI-R	Starch 澱粉	Purple 紫色	Aqueous solution 水溶液
CBB	CBB-R	Protein 蛋白質	Blue 藍色	Contain ethanol and acetic acid 含有酒精及醋酸的溶液
OR	OR-R	Lipid 脂質	Red 紅色	Contain ethanol 含有酒精的溶液

Staining method:染色方法

- Use small Petri dishes for staining and rinsing.
  使用小培養皿來作染色與沖洗
- Stain for 5 to 10 minutes in staining solution.
  在染料中浸染 5-10 分鐘
- Then, rinse the specimens well with rinsing solution.
  再用沖洗劑充分沖洗染色後的材料

Part B Development of fruits

B 部分：果實的發育

Materials and equipment 材料與器材

1. Tomato fruits labeled (A) 番茄果實標示爲(A)	3
2. An apple fruit labeled (B) 蘋果果實標示爲(B)	1
3. Drawings of flowers labeled (I and II) and strawberry fruits (included in your envelope) 信封內有一張手繪圖：包括有兩種花(I and II)和草莓果實的圖形	1
4. Forceps (used in Task 1) 鑷子（用於第 1 部分）	2
5. Knife 刀片	1
6. Colored pencils (orange (O), blue (B), green (G)) (used in Task 1) 彩色鉛筆：橘色(O)、藍色(B)、綠色(G)；（用於第 1 部分）	3
7. White tray 白色解剖盤	1

Introduction 簡介

A fruit may develop from some part of a single flower. Therefore, the morphological features of a fruit are closely related to those of its flower.
果實可能由單一朵花的某個部分發育而成，故果實的形態與其花的構造關係密切。

Q.2.B.1. (4 points)

There are fruits of tomato (A) and apple (B). Cut the fruits transversely and vertically on a paper towel in the white tray. Compare the fruits and flower drawings (I and II).

現有番茄(A)與蘋果(B)兩種果實。請在白色解剖盤上舖上一張紙巾，再將果實放在盤中作橫切及縱切後，與花(I and II)手繪圖作比較。

Enter the number of the flower (I or II) that corresponds to each fruits (A, B) in the Box of Q.2.B.1. in the Answer Sheet.
在答案卷中的 Q.2.B.1 表格中，分別填入(A, B)果實是由相對應的何種花 (I or II)所發育而來

Q.2.B.2. (11 points)

Using a black pencil, draw and indicate ovules (or seeds), carpels (and/or tissue derived from carpel), and sepals on the vertical illustrations of the fruits (A1 and B1) of Q.2.B.2. in the Answer Sheet. Then, color the following tissues on the same fruit drawings (A1 and B1) in the colors designated. Refer to the strawberry drawings.

Ovule (or seeds): color pencil O (orange)

Carpels (and/or tissue derived from carpel): color pencil G (green)

Sepals: color pencil B (blue)

用黑色鉛筆在答案卷的 Q.2.B.2 果實縱切圖(A1 and B1)上畫出胚珠（或種子）、心皮（或由心皮發育而成的組織）、以及萼片的形狀及位置，然後在此果實縱切圖(A1 and B1)上，用下列指定顏色的鉛筆將不同構造塗上不同的顏色。【參考手繪圖中草莓果實的作圖和著色方式】

胚珠（或種子）：橘色鉛筆 O

心皮（或由心皮發育而成的組織）：綠色鉛筆 G

花萼：藍色鉛筆 B

Q.2.B.3. (8 points)

Complete the drawings of the transverse illustrations of the fruits (A2 and B2) of Q.2.B.3. in the Answer Sheet. Draw additional lines and color the ovules (or seeds) and carpels (and/or tissue derived from carpel) in the colors designated.

Ovule (or seeds): color pencil O (orange)

Carpels (and/or tissue derived from carpel): color pencil G (green)

請完成答案卷中 Q.2.B.3 的(A2 and B2)果實橫切圖(圓圈範圍)，畫出果實內部不同構造的形狀及位置，再用下列指定顏色的鉛筆將不同構造塗上不同的顏色：

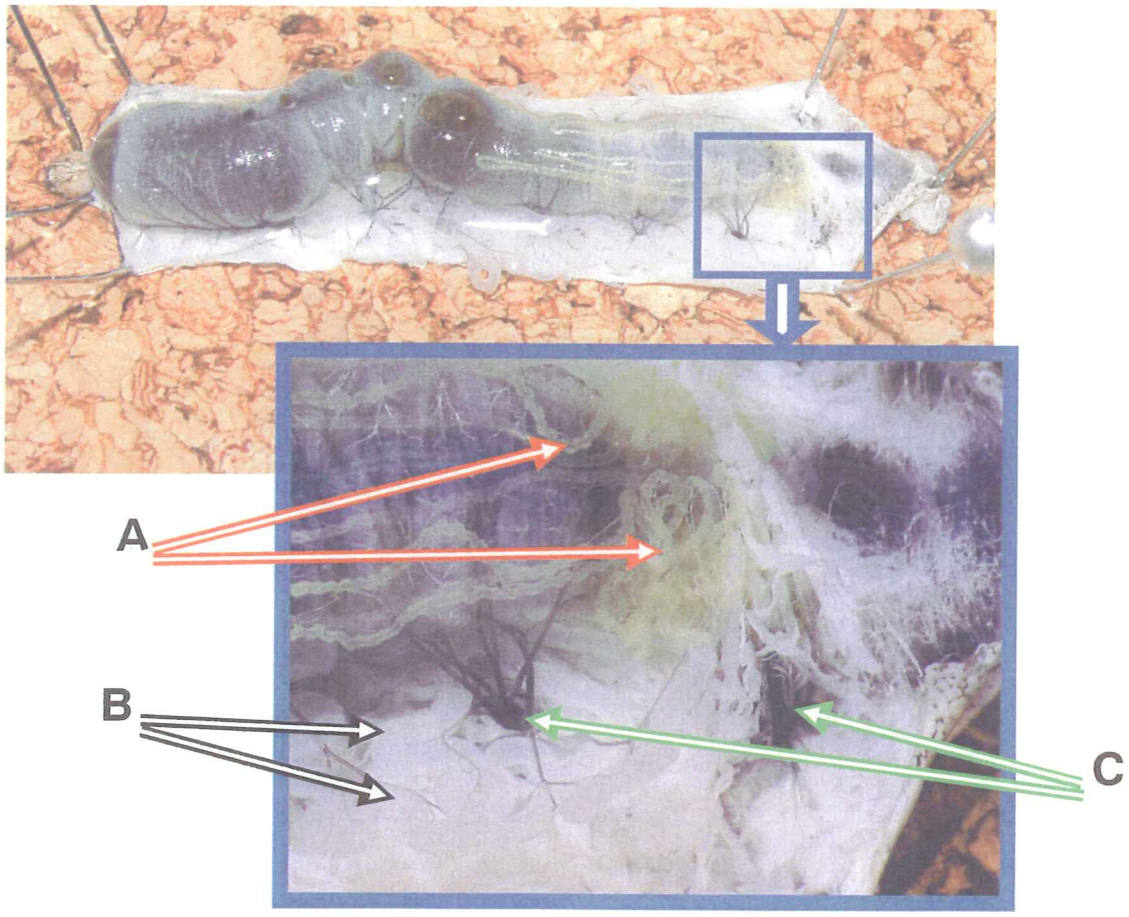
胚珠（或種子）：橘色鉛筆 O

心皮（或由心皮發育而成的組織）：綠色鉛筆 G

Q.1.1. (1 point ×2 = 2 points)

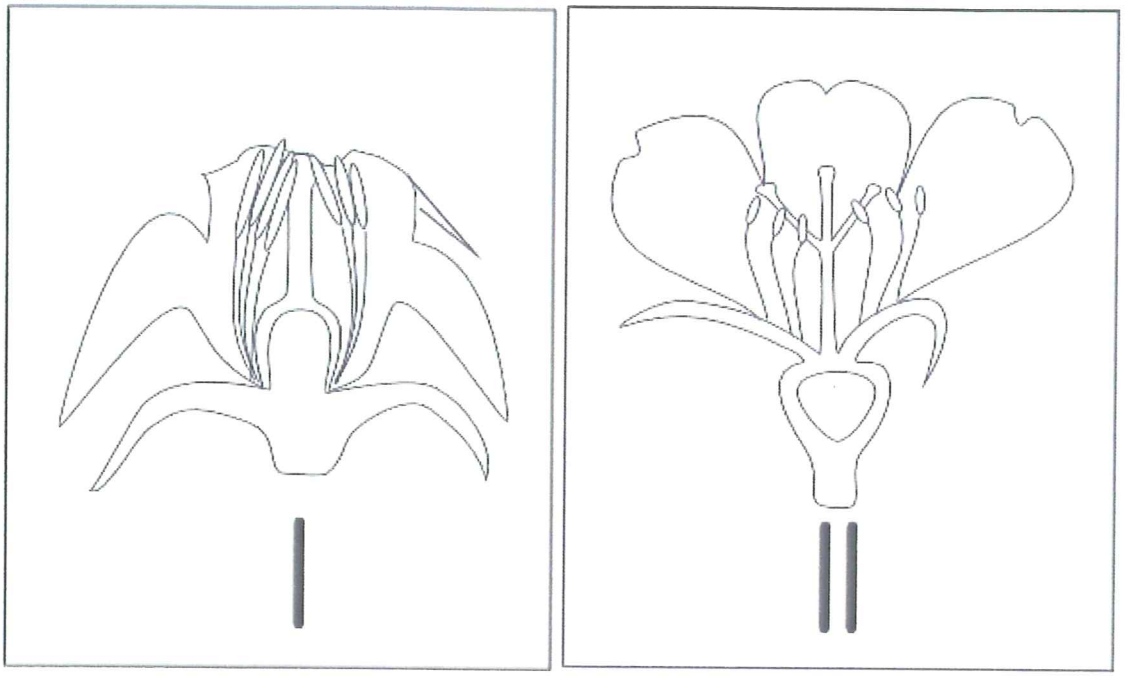
Task 1

Photo of dissected caterpillar, dorsal view



Task 2

Flowers I and II



Sample drawings of a strawberry