30th International Biology Olympiad
SZEGED, HUNGARY

Practical Exam 3. 實作題第 3 題

Plant Anatomy 植物解剖學

Ecology 生態學

Animal Anatomy 動物解剖學

16^{th} July 2019 考試時間: 2019-7-16

COUNTRY 國家
LANGUAGE 語言

Practical Exam 3. 實作題第三題

General instructions 一般性說明

This exam consists of three subtasks:

- Subtask 1. Plant identification (30 points)
- Subtask 2. Composition of grasslands (20 points)
- Subtask 3. Examination of a chicken’s neck and wing (50 points)

本實作包括三個部分

- 第一部分. 植物鑑定 (30 分)
- 第二部分. 草原的組成 (20 分)
- 第三部分. 檢視雞的脖子和翅膀 (50 分)

1. Please remember to **attach your barcode sticker** to all pages of the answer sheet.
2. Write your answers in the separate answer sheet provided. **Only answers given in the answer sheet will be considered**.
3. Ensure you received all necessary materials and equipment listed on the next page. If any items are missing indicate this by raising your red card within 10 minutes following the start of the exam.
4. During experiments ensure all materials and equipment is handled properly. Any spilled solutions or broken equipment will not be replaced.
5. Stop answering and put down your pen immediately when the bell rings signalling the end of the exam.
6. No paper, materials or equipment should be taken out of the laboratory.

1. 請記得把你的**條碼貼紙貼在答案紙的每一頁上**。
2. 把答案分別寫在所提供的答案紙上。**只有寫在答案紙上的答案才會評分。**
3. 檢查條列在下一頁中的所有材料與器具。倘若有缺任何一項，須在實作開始的前 10 分鐘內，舉起紅卡尋求補充。
4. 在實作進行中，確定正確操作所有材料與器具。任何溢出的溶液或損壞的器具將不更換。
5. 實作結束、鈴聲響起時，應立刻放下筆、停止作答。
6. 不可將紙張、材料或器具帶出實驗室。

CAUTION! The experiment deals with materials that are fragile and sharp. Exercise caution when handling them. **WEAR ALL SAFETY EQUIPMENT PROVIDED AT ALL TIMES!**

小心！實驗所操作的材料相當脆弱或尖銳，應小心操作。**應全程佩戴所有安全配備**！

WEAR ALL SAFETY EQUIPMENT PROVIDED AT ALL TIMES OTHERWISE THE LAB ASSISTANT WILL ASK YOU TO LEAVE THE ROOM.
請注意! 務必全程穿戴

Materials and equipment 材料與器具

- Two unknown grass samples labelled A and B

- Magnifier with built in light
- Small scissors
- Dissecting pin
- 3 pcs longer pins (to affixing organs if required)
- Small tweezers
- Large tweezers
- 2 pcs of chicken neck and 2 pcs of chicken wings (washed)
- 2 pcs small sealable bottles with saline
- 1 small bottle of distilled water
- 1 squirt bottle

- 兩種未知的禾草，分別標示為 A、B。
- 具光源的放大鏡
- 小剪刀
- 解剖針
- 3 支 長針 (必要時，用以固定器官)
- 小鑷子
- 大鑷子
- 2 支雞脖子和 2 支雞翅 (皆已清洗)
- 2 小瓶可彌封的生理鹽水
- 1 小瓶蒸餾水
- 1 支清洗瓶

SUBTASK 1. PLANT IDENTIFICATION 第一部分. 植物鑑定

Members of the grass family (Poaceae) have compound inflorescences, the base units of which are the spikelets (**Fig 1**). Spikelets can be considered simple inflorescences themselves, usually giving place to more flowers, but there are one-flowered spikelets as well. On the axis (**a**) of the spikelet, a palea can be found below the flowers, one on each side (**b, c**), but there are cases when only one palea can be found. Flowers (**d1, d2**) are located between the two paleas, on the spikelet axis. All flowers are very simplified, the perianth in most of the cases consists of only two lemmas. Lemmas are distinguished based on their position, one is called outer (or lower) lemma (**e**), the other is called inner (or upper) lemma (**f**). The outer lemma can be found on the spikelet axis, while the inner lemma is in the flower itself, on the flower axis (**i**). The outer lemma often has an awn (**g**), which can be glabrous, rough or hairy. In the centre of each flower there is the ovary, on top of it with the stigma (**h**) that is adapted to air pollination, and is often feathery. The stamens arise from below the ovary (**j**). There are lodicules below the stamens (**k**).

禾本科 (Poaceae) 植物有複合型的花序，其花序的基本組成單位為小穗 (Fig 1)。小穗本身可視為簡單的花序，通常有多朵花所組成，但也有僅由一朵花組成者。在小穗的軸 (a) 上，花的下方有內稃 (palea) ，左右各一片 (b, c)，但有時候只有一片內稃。在小穗的軸上，兩片內稃之間有兩朵花 (d1, d2)。所有的花都很簡化，花被片大多僅有 2 片 穎 (lemmas)。穎可以其位置而區分為外穎 (outer lemma; e)、內穎 (inner lemma; f)。外穎為在小穗軸上，而內穎則在花軸 (i) 上。外穎通常具有芒 (g)，芒的形態可以是光滑、粗糙或毛狀。在每朵花的中央是子房，其上有適於風力傳粉的羽狀柱頭 (h)。雄蕊 (j) 從子房下方長出，雄蕊下方有鱗被 (k) (lodicules)。

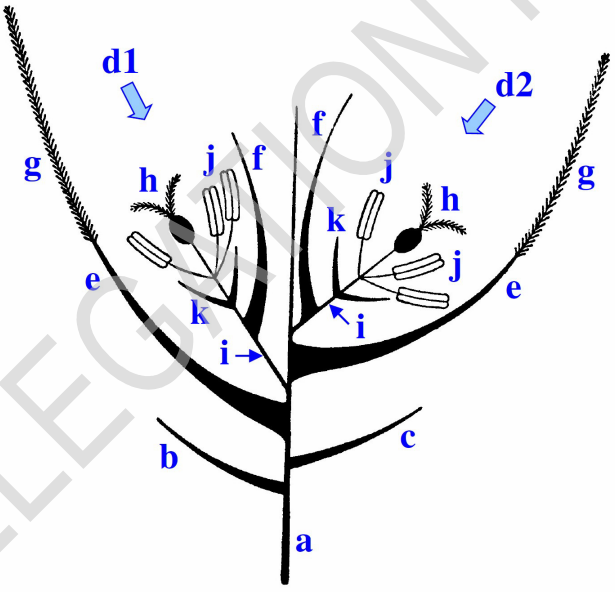


Fig.1 Schematic figure of a two-flowered spikelet

Fig. 1 兩朵花所構成的小穗示意圖。

Q.3.1.1 Identify the two grass species (A and B) in the vials provided using the dichotomous key below. Indicate the steps you take in the flow diagram in your answer sheet by writing the number of steps in the correct order. Mark any unused cells in the flow diagram with an **X**.

利用下列的檢索表來鑑定瓶中的兩種禾草物種 (A 和 B)。在答案紙上依序寫下檢索步驟的編號，整串檢索流程的空格，若有未用完者，需標示”X”。

1. a. Spikelets form a raceme (an indeterminate inflorescence in which the main axis produces a series

of flowers on lateral stalks, the oldest at the base and the youngest at the top), they are sitting directly on the main inflorescence axis or connected to it by a short (1-3 mm), not branching pedicel. **Go to 2.**

b. Spikelets are connected to the main inflorescence axis by branching pedicels. If pedicels are short, the inflorescence is a contracted panicle, if pedicels are long, spikelet form an open panicle. **Go to 7.**

a. 小穗形成總狀 (一種無限花序，其主軸產生一系列具花柄的花，基部的花最老、頂端者最年輕)，小穗直接著生在花序軸上，或具有短 (1-3 mm) 而不分支的花柄上。 **Go to 2.**

b. 小穗藉分支的花柄著生在花序主軸上。若花柄短，則花序呈現短縮的圓錐型；若花柄長，小穗形成鬆散的圓錐型。**Go to 7.**

2. a. There is only one spike on the stem apex. **Go to 3.**

   b. The inflorescence is a cluster of spikes, there are more (usually 3-7) spikes terminally on the stem, starting from the same height. Individual spikes are 3-6 cm long. Small, approximately 2 mm long, violet, 1-2-flowered spikelets stand individually on one side of the spike axis. The stem is prostrate-erect, 10-30 cm tall, the plant has stolons (slender, prostrate or trailing stems, producing roots and sometimes erect shoots at their nodes). The leaves are fibrous, 5-15 cm long, 2-4 mm wide, with a rough edge. **Species I.**

   a. 在莖軸上只有一個花穗 (穗狀花序)。**Go to 3.**

   b. 花序由一堆花穗所構成，通常 3-7 個花穗叢生在莖頂。個別花穗長 3-6 cm，而小型、長約 2 mm、紫色的、1-2 朵花的小穗則單獨著生在花穗軸的一側。植株的莖傾斜至直立，高 10-30 cm，且有走莖 (細長、傾斜或蔓延的莖，有時會在莖節處產生根及直立的莖)。葉呈現纖維質，長 5-15 cm、寬 2-4 mm，葉緣粗糙。 **物種 I**

3. a. The spikelet has 2 paleas. **Go to 4.**

   b. The spikelet has only 1 palea. 10-20 mm long spikelets connect to the spike axis with their edge, seating on alternating sides of the axis, therefore the spike is pronouncedly flattened. There are 6-10 flowers in a spikelet and 16-40 spikelets in a spike. The stem is cylindrical, erect, loosely spreading or upright in curves. **Species II.**

   a. 小穗有兩片內稃。**Go to 4.**

   b. 小穗僅有一片內稃。小穗 10-20 mm 長，交互地著生在花穗軸的兩側，故花穗呈現明顯扁平狀。小穗中有 6-10 朵花，而 16-40 個小穗形成一個花穗。植株的莖為圓柱狀、直立、疏鬆散生或呈曲線直立。**物種 II**

4. a. Spikelets stand alone on the axis side seats (relief along the length of the axis). **Go to 5.**

   b. Spikelets stand two by two or three by three on the axis side seats. The spike is wide on the top and is narrowing to the base, 5-10 cm long, the axis is fragile, falling apart at maturation. The palea of mid-spikelets has long hairs. The lemma is 10 mm long at most, its awn is 20-30 mm long. The plant is bushy, the leaf blade is slightly hairy. **Species III.**

   a. 小穗沿著花軸側生 (散生在花軸上)。**Go to 5.**

   b. 小穗以兩個或三個一組著生在軸上。花穗在末端處寬、基部處窄，長 5-10 cm，花軸柔軟，成熟時會分解開來。花穗中段的小穗之內稃有長毛，穎長達 10 mm，芒則 20-30 mm 長。植株灌木狀，葉片略有覆毛。**物種 III**

5. a. Spikelets are sessile. **Go to 6.**

   b. Spikelets are connected to the main inflorescence axis by 1-3 mm long pedicels. The spike inflorescence is nodding. Spikelets have 6-15 flowers, slightly compressed, their wider side turns towards

inflorescence axis. The lemma is long awned, the awns are at least the same length as the lemma. Leaves are soft, lower ones are hairy. **Species IV.**

a. 小穗無花柄。**Go to 6**.

b. 小穗以 1-3 mm 的花柄著生在軸上。穗狀花序向下垂。小穗有 6-15 朵花，略為聚生，其較寬的一側彎像花序軸。穎具長芒，且芒的長度至少與穎等長。葉柔軟，較低處的葉多毛。 **物種 IV**

6. a. The spike inflorescence is flat, 2-6 cm long, 1-2.3 cm wide. Spikelets stand densely, at 1 mm from each other, they are ascending, 8-15 mm long, having 3-5-flowers. The palea has 1-3 veins, the lemma is short awned. Mat-forming plant, the stem is 25-60 cm long. **Species V.**

   b. The spike inflorescence is at least 8 cm long. Spikelets lie on the axis, the distance between them is at least 2 mm, they are 10-20 mm long, having 5-7-flowers. The palea has 3-7 veins, the lemma is awned or not. The plant has long stolons, the stem is 40-150 cm long. **Species VI.**

   a. 穗狀花序扁平，長 2-6 cm、寬 1-2.3 cm。小穗密集著生，兩兩間距 1 mm，小穗斜上延伸 8-15 mm 長，內含 3-5 朵花。內稃有 1-3 條脈，穎具短芒。植株可生長成地墊狀，其莖長 25-60 cm。**物種 V**

   b. 穗狀花序至少 8 cm 長。小穗著生在莖軸上，兩兩間距至少 2 mm，小穗 10-20 mm 長，內含 5-7 朵花。內稃有 3-7 條脈，穎具芒或無。植株具有長走莖，其莖長 40-150 cm。**物種 VI**

7. a. Spikelets are one-flowered. **Go to 8.**

   b. Spikelets consist of 2 or more flowers. **Go to 9.**

   a. 小穗內含一朵花。**Go to 8.**

   b. 小穗內含兩朵以上的花。**Go to 9**

8. a. The outer lemma is 15-17 mm long, its awn is 25-33 mm long. The awn above the lemma is hairy, feathery. Spikelets stand loose on the flower axis. Outer and inner lemmas grow onto the caryopsis (a dry, indehiscent, one-seeded fruit in which the seed coat is closely fused to the fruit wall). The leaf is 0.5-1 mm in diameter, usually rolled, sometimes flat. **Species VII.**

   b. On the back of the outer lemma, a geniculate awn rises, extending over the lemma, protruding 2-7 mm from the spikelet. The contracted spike-like panicle is evenly cylindrical, 3-9 cm long, 8-10 mm wide. Paleas are joined to almost their mid-points or above. Leaf blade is flat, 3-10 mm wide. **Species VIII.**

   a. 外穎長 15-17 mm，它的芒長 25-33 mm，穎上方的芒多毛、羽毛狀。小穗疏鬆著生在花軸上。外穎和內穎長成穎果 (一種乾燥、不開裂、單一種子的果實，其中的種皮與果皮癒合)。葉片的直徑為 0.5-1 mm，通常捲呈管狀，有時平展。**物種 VII**

   b. 外穎的背面有如膝彎曲的芒，延伸超過內稃，從小穗延伸 2-7 mm。短縮的穗狀圓錐花序呈現圓柱形，長 3-9 cm、寬 8-10 mm。穎在中段或以上具關節。葉片平展，3-10 mm 寬。**物種 VIII**

9. a. The spikelet axis is, at least under the lower flower, lying on the lemma base, with short hairs. **Go to 10.**

   b. The spikelet axis is totally glabrous. **Go to 11.**

   a. 在花下方、穎基部的小穗軸有短毛。**Go to 10.**

   b. 小穗軸光滑無毛。**Go to 11**

10. a. The spikelet is 2-flowered, approximately 10 mm long. One of the flowers is small and infertile, the other is mature and awned. The inflorescence is a narrow panicle, 10-30 cm long. The lemma is 7-9 mm long, its awn arises in the lower third of the back side, the awn of lower flowers is 10-20 mm

long. The plant is 100-150 cm tall, slightly mat-forming. Leaf blade is 20-40 cm long, 5-10 mm wide. **Species IX.**

b. The spikelet is 2-4-flowered, 15-30 mm long. The inflorescence is a 15-30 cm long loose panicle, spikelets are located on long, nodding lateral branches. The plant is 60-150 cm tall, bushy. Leaf blade is 30 cm long, 10-16 mm wide. **Species X.**

a. 小穗內含兩朵花，長約 10 mm，其中一朵花小且不孕，另一朵成熟且具芒。花序為細窄圓錐形，長 10-30 cm。穎長 7-9 mm，它的芒從穎背面進基部 1/3 處長出，較基部的花所具有的芒長 10-20 cm。植株 100-150 cm 高，略可形成地墊。葉片長 20-40 cm、寬 5-10 mm。**物種 IX**

b. 小穗內含 2-4 朵花，長 15-30 mm。花序為 15-30 cm 長的疏鬆圓錐狀，小穗位在長而下垂的分支上。植株 60-150 cm 高，灌木狀。葉片長 30 cm、寬 10-16 mm。**物種 X**

11. a. The spikelets are heart-shaped, round or triangular, 4-7 mm long and wide, laterally slightly compressed, 4-12-flowered, nodding. The lemma is blunt tipped, without awn. The inflorescence is a loose panicle, 8-20 cm long. The plant is 15-75 cm tall. Leaf blade is 4-16 cm long, 1.9-3.2 mm wide. **Species XI.**

    b. The spikelets are narrower, 3-4 mm wide. The lemma is 2.6-3.4 mm long, its awn is 0.8-1.2 mm long. The inflorescence is a panicle, 2-5 cm long. The plant grows in dense clusters, is small, 10-30 cm tall. The leaf blade is folded along the main vein, its diameter is 0.4-0.6 mm. **Species XII.**

    a. 小穗呈心形、圓形或三角形，長和寬 4-7 mm，側面略為壓縮；內含 4-12 朵花，下垂。穎具鈍尖，無芒。花序為疏鬆圓錐狀，長 8-20 cm。植株 15-75 cm 高。葉片長 4-16 cm、寬 1.9-3.2 mm。**物種 XI**

    b. 小穗較窄，3-4 mm 寬，其芒長 0.8-1.2 mm。花序為 2-5 cm 長的圓錐狀。植株密集生長，小型、10-30 cm 高。葉片沿主脈捲起，其直徑為 0.4-0.6 mm。 **物種 XII**

Q.3.1.2 Indicate the identity of the two grass species (A and B) in your answer sheet with an **X**.

請在你的答案卷中以”X” 符號指出 A 與 B 兩種禾本科植物的身分。

SUBTASK 2. COMPOSITION OF GRASSLANDS 草原的組成

Xerophilous loess grasslands are Central Europe's typical plant associations, rich in species. Their stock-forming plant species originate mainly from drought-tolerant grasses. Their grazed and slightly degraded communities are characterized by Festuca pseudovina, Stipa capillata and Cynodon dactylon. In this task, you will determine the relative abundance of three grass species and any association between them, based on an actual field survey. During field the sampling, we have observed the species occurring in 500 successive quadrats along a line. The side lengths of quadrats were 10 x 10 cm.

旱生黃土草原是中歐典型的植物群叢，物種豐富，它們的植物物種主要來自抗旱草種，此放牧及略微退化的群落主要代表是羊茅草 (Festuca)、針茅草 (Stipa) 及狗牙根 (Cynodon)。在此次實作中，你將根據實地田野調查的結果判別此三種草相對豐度，及草種間在出現與否上的關連性。在田野調查的取樣中，研究者觀察到這些種類出現在樣線上連續分布的 500 個方格中，每一方格面積是 10 x 10 cm。

Q.3.2.1 Complete the three contingency tables in your answer sheet with the mutual occurrences (a-d as well as) of the three different pairs of species in the first 40 quadrats (Table 1). Letters entered in each cell (a, b, c, d) serve to denote the variables of mutual occurrences (a: number of quadrats where both species were present, b and c: number of quadrats where only one or the other species was present, d: number of quadrats in which none of the examined species was present, + present, - not present). The variable n is the number of sampling units (quadrats), which is 40 in this case.

前 40 個方格中 (Table 1) 此物種之三種不同的配對之相互出現 (a-d as well as)。把你的結果填入答案卷的三個關連表內。在每一方格中字母 (a, b, c, d) 代表其共存現象的變化 (a：代表二種植物共存的方格數, b 及 C 代表二種植物出現一種植物的方格數，d 代表☒有任何一種受檢測植物出現的方格數，+ 代表有，- 代表無)，變數 n 是取樣單位 (方格)，在此研究是 40。

All present species have been surveyed of which the following table only shows the occurrence of the three tested grass species sequentially in the first 40 quadrats. The value of 1 indicates the presence and 0 the absence of the given species.

在此處所有草種都被記錄，下表中只顯示前 40 個方格順序中此三種研究草種之有無。1 代表有某一物種，0 代表無。

Festuca pseudovina	00000 00000 00000 00000 00101 00000 00001 11011
Stipa capillata	01100 11101 11010 10000 11110 01111 10110 00010
Cynodon dactylon	11000 00000 00010 00000 01000 00000 00000 00000

Table 1. Occurrence data from the first 40 quadrants

表 1. 前 40 個方格中物種出現的資料

Conclusions on the relationship of the spatial pattern of species were drawn from the occurrence of species in the quadrats in the entire sample (500 quadrats). The relationship was analysed using a χ2-test (chi-square test) referring to a positive or negative dependence or independence of occurrences.

從整個樣本 (500 個方格) 物種出現情況中所得之物種空間分布樣態的結論。使用卡方檢測 (χ2-test) 分析該測試是屬正向、負向相關或獨立事件。

The contingency tables for all quadrats (n = 500) sampled during the survey for the three pairs of species

are as follows:

在調查期間對三對物種抽樣的所有方格 (n = 500) 的關連表如下：

		Festuca		
		+	-	
Stipa	+	*a* = 22	*b* = 271	*a*+*b* = 293
	-	*c* = 90	*d* = 117	*c*+*d* = 207
		a+*c* = 112	*b*+*d* = 388	*n* = 500

		Festuca		
		+	-	
Cynodon	+	*a* = 130	*b* = 163	*a*+*b* = 293
	-	*c* = 24	*d* = 183	*c*+*d* = 207
		a+*c* = 154	*b*+*d* = 346	*n* = 500

		Cynodon		
		+	-	
Stipa	+	*a* = 14	*b* = 140	*a*+*b* = 154
	-	*c* = 98	*d* = 248	*c*+*d* = 346
		a+*c* = 112	*b*+*d* = 388	*n* = 500

Q.3.2.2 Determine the number of degrees of freedom (df) required for your χ^2-test in a four field contingency table and write it in the appropriate cell in your answer sheet.

在具有四個欄位的關連表中，確定卡方檢測 (χ^2-test) 所需的自由度 (df) ，並將其填入答案表中的對應方格中。

Q.3.2.3 Based on the formula provided, calculate the χ^2-value for the last contingency table rounded to two decimal places and note it in your answer sheet. The first two χ^2-values have already been filled in for you.

根據提供的公式，計算最後一個關連表的卡方值，四捨五入到小數點後兩位，並記在答卷中。前兩個卡方值已列入表中。

$$\chi^2 = \frac{(n-1)(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

Equation 1. The χ2 formula, where the individual letters refer to the labelled fields (a-d) in the contingency table.

公式 1、卡方公式，其中每一個字母表示關連表中的標示欄位 (a-d)。

Q.3.2.4 Indicate the level of statistical significance (p-value) based on the χ^2 table (Table 2.) by writing one of the letters (A-D) in the appropriate cells in your answer sheet.

根據卡方表 (表 2.) 在答案卷中適當的格中寫入一個字母 (A-D)，顯示其統計顯著性級別 (p 值)。

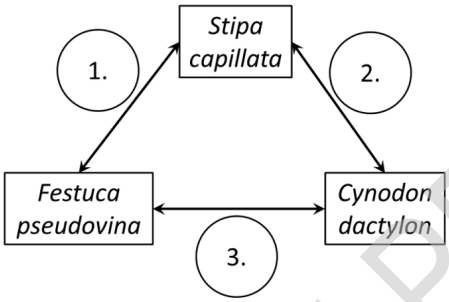
	p-value			
	A	**B**	**C**	**D**
df	p>0.05	0.05≥p>0.01	0.01≥p>0.001	0.001≥p
1	χ^2<3.841	3.841≤χ^2<6.635	6.635≤χ^2<10.83	10.83≤χ^2
2	χ^2<5.991	5.991≤χ^2<9.210	9.210≤χ^2<13.82	13.82≤χ^2
3	χ^2<7.815	7.815≤χ^2<11.35	11.35≤χ^2<16.27	16.27≤χ^2
4	χ^2<9.488	9.488≤χ^2<13.28	13.28≤χ^2<18.47	18.47≤χ^2
5	χ^2<11.07	11.07≤χ^2<15.09	15.09≤χ^2<20.52	20.52≤χ^2
6	χ^2<12.59	12.59≤χ^2<16.81	16.81≤χ^2<22.46	22.46≤χ^2
7	χ^2<14.07	14.07≤χ^2<18.48	18.48≤χ^2<24.32	24.32≤χ^2
8	χ^2<15.51	15.51≤χ^2<20.09	20.09≤χ^2<26.13	26.13≤χ^2
9	χ^2<16.92	16.92≤χ^2<21.67	21.67≤χ^2<27.88	27.88≤χ^2
10	χ^2<18.31	18.31≤χ^2<23.21	23.21≤χ^2<29.59	29.59≤χ^2

Table 2. Critical values of χ^2-distribution at various degrees of freedom (df)

表 2、不同自由度卡方分佈的臨界值 (df)

Q.3.2.5 Based on the above, evaluate the spatial relationships (1-3) between the three grass species with a X in your answer sheet.
A. Positive relationship
B. Independent
C. Negative relationship

根據上述情況，評估三種草種間的空間分布關係 (1-3)，在答案卷中用 X 表示。
A. 正向關係
B. 獨立
C. 負向關係



SUBTASK 3. EXAMINATION OF A CHICKEN’S NECK AND WING 檢查雞脖子和雞翅膀

Please note that all the animal tissues provided are obtained from chickens bred and slaughtered for food consumption.

Health and Safety Notices 安全指示

- **Always pay attention to the correct usage of the tools. Work cautiously.**
- **Wear rubber gloves.**
- **Do not place your hand or fingers in front of the tip or the cutting edge of the scissors or the dissecting pins.**
- **When cutting or scraping, always move the tip or edge of dissecting tools away from your body.**
- **If you got injured, report it immediately**

- 留意工具的正確使用方式並小心操作。
- 要戴手套。
- 不要把手或手指擺在解剖剪刀和解剖針前。
- 剪裁與刮除時尖端不要向著身體。
- 如果你受傷了要立刻報告。

Materials and tools 材料與工具

- 2 pieces of chicken neck and 2 pieces of chicken wings
- Small scissors, dissecting pin, small forceps
- BOTTLE: small sealable bottle **with code marking** (filled with physiological saline solution)
- SACHET: small sealable sachet **with code marking**
- magnifier (with lighting)
- longer pins (3 pcs, to fix the organs if required)
- spraying flask (for moistening the organs during dissection, if required)
- 兩塊雞脖子和兩塊雞翅膀
- 小剪刀、解剖針和小鑷子
- 上貼編號的密封罐中有生理食鹽水
- 一個密封的小盒子
- 一個有燈光的放大鏡
- 若有必要可以拿來固定臟器的長針
- 若有必要可以拿來濕潤臟器的噴霧器

Contents 實驗內容

1. Dissection and observation of a chicken neck (Q3.3.1-5)X MARKS
2. Dissection and observation of chicken wings (Q3.3.6-14)X MARKS

· 解剖與觀察雞脖子 (Q3.3.1-5 小題)

· 解剖與觀察雞翅膀 (Q3.3.6-14 小題)

Recommendations 建議

· Use the descriptions of anatomical names and directions on the following two pages!

· Read the questions carefully before starting the dissection!

· Always consider innervation, position, origin, insertion, and function of a muscle!

· 使用下面頁面所提供的解剖學術語與指引

· 解剖前要仔細看清楚問題

· 仔細考慮每一條肌肉的支配、位置、起始點、插入方式與功能性

INDICATE ALL YOUR ANSWERS BY WRITING AN "X" IN THE APPROPRIATE BOX ON THE ANSWER SHEET! 在適當的答案紙空格中使用"X"符號來回答問題

PUT ALL STRUCTURES THAT HAVE TO BE SUBMITTED IN THE CONTAINERS SPECIFIED AND LEAVE THEM ON YOUR TRAY AT THE END OF THE PRACTICAL! 把所有解剖後應該繳交的結構擺在指定的袋子中然後在實驗結束時把它們擺在你的托盤中

Anatomical definitions and explanations 解剖學上的定義與解釋

- Median sagittal plane: a longitudinal plane in the midline that divides the body/organ into a left and a right side, or divides the body/organ into two, approximately similar halves.
- Transverse plane: it divides the body or the given structure into a frontal (anterior) and a back (posterior) part. The part in front of this plane (positioned nearer to the skull) is the cranial, while the one behind this plane (positioned nearer to the tail) is the caudal part.
- Flexion: the articulating bones move closer to each other, the angle between them is decreasing
- Extension: the articulating bones move away from each other, the angle between them is increasing
  - Rotation: the bones or part of a bone turn along their longitudinal axis in the joint
- Proximal: the part positioned nearer to the trunk along the main longitudinal axis of the limbs
- Distal: the part positioned further away from the trunk along the main longitudinal axis of the limbs
- Dorsal: at the upper side or back
- Ventral: at the underside or abdomen
- Cranial: towards the head, cephalic
- Caudal: towards the tail
- Antagonist muscles: muscles that move in an opposite way compared to each other
- Synergist muscles: muscles that act in the same way, participating in moving an articulation to a certain direction.
- Tubercle: a small nodular eminence
- Epicondyle: protuberance

- 中央矢狀平面 (Median sagittal plane)：體中線的縱向平面，將身體/器官分成左側和右側，或將身體/器官分成兩個大致相似的半部。橫向平面 (transverse plane)：將身體分為前後部分。前面靠近顱骨，而這個平面靠尾部的部分是尾部。
- 屈曲 (Flexion)：當鉸接的骨骼彼此靠近，它們之間的角度會減少
- 延伸 (Extension)：當鉸接骨骼彼此遠離，它們之間的角度會增加
- 旋轉 (Rotation)：骨骼或骨骼的一部分沿關節的縱軸旋轉
- 近體端 (Poximal)：靠近軀幹體軸的部分
- 遠體端 (Distal)：由體軸遠離軀幹的部分
- 背部 (Dorsal)：在上側或後側
- 腹部 (Ventral)：在下側或腹部
- 顱骨 (Cranial)：朝向頭部
- 尾端 (Caudal)：朝向尾部
- 拮抗肌 (Antagonist muscles)：肌肉以相反的方式相互移動
- 協同肌 (Synergist muscles)：以相同方式產生作用的肌肉，參與將關節往某方向移動的活動
- 結節 (Tubercle)：小的結節隆起
- 上髁 (Epicondyle)：突起

Anatomical directions and planes in birds (Figure 1) 鳥類解剖結構的方向與平面 (圖一)

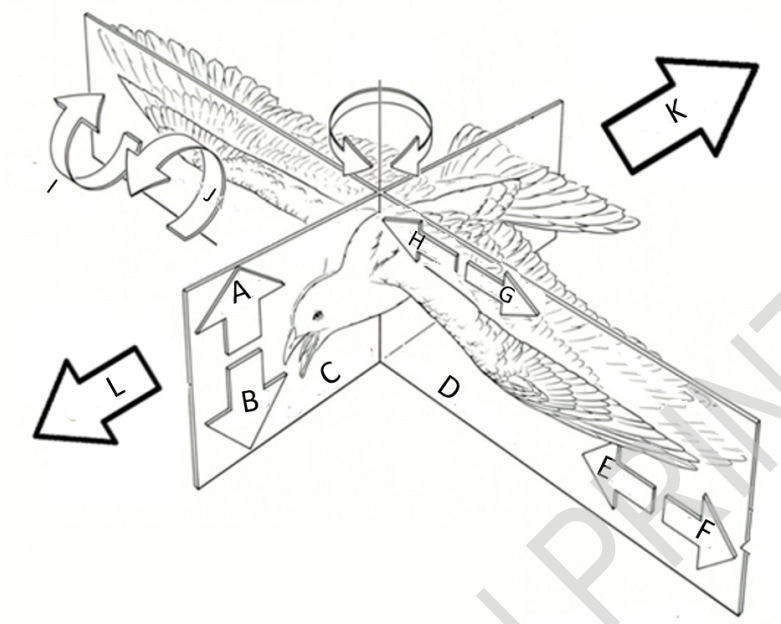


Figure 1. A - Dorsal (背面). B - Ventral (腹面). C - Sagittal plane (矢狀面). D - Transverse plane (橫切面). E - Proximal (近體端). F - Distal (遠體端). G - Lateral (側方). H - Medial (中央部位). I - Supination of wing (翅膀的仰旋動作). J - Pronation of wing (翅膀的俯旋動作). K - Caudal (尾端). L - Cranial (頭顱端).

Part I. Dissecting and examining the neck 第一部分 解剖與檢驗雞脖子

Dissection tips 解剖小秘訣

- Dissect the larger diameter end of the neck!
- Cut the soft tissue parts between the vertebrae (e.g. muscles) in a circular way –this makes is easier to reach the joints!
- 解剖雞脖子比較粗的那端
- 環狀切開各椎骨之間的軟組織這樣比較容易找到關節

Q.3.3.1 Dissect a cervical vertebra so that you can examine its surfaces, processes and internal structure as well as its connections with the adjacent vertebrae. Based your observations, indicate on your answer sheet if each of the following statements is true (T) or false (F).

解剖頸椎以便檢查其表面，肌肉作用過程和內部結構，以及它與相鄰椎骨的連接方式。根據你的觀察結果，在答案紙上回答為真（T）或假（F）。

A. The connection of the vertebra is characterised by a saddle or sellar joint (Articulatio sellaris), in which a concave (hollowed inward) and a convex (domed) surface comprise a joint.

椎骨連接的特徵在鞍座或鞍關節（Articulatio sellaris），在這個位置上具有凹凸兩面所組合而成的關節。

B. The vertebra is connected with a sledge or gliding joint (Articulatio delabens), in which flat joint surfaces glide upon each other.

椎骨本身與滑動關節（Articulatio delabens）連接，而這個位置具有表面平坦互相滑動的關節表面。

C. Regarding the bone connections between vertebrae, the gaps between the precisely fitted surfaces of the bones are filled in by ligaments and fibrous connective tissue, visible to the naked eye (syndesmosis).

有關椎骨之間的骨骼連接，兩塊精確吻合的骨骼表面間隙是由韌帶和纖維結締組織填充，而且可由肉眼觀察（也就是韌帶聯合）。

D. The spinous processes are underdeveloped, therefore the neighbouring vertebrae are not connected by the muscles attaching to the spinous processes.

棘突並不發達，因此相鄰椎骨並非通過附著於棘突的肌肉所連接

Q.3.3.2 Examine the intervertebral joints and their movements. Which of the following movements occur at the intervertebral joints? Based your observations, indicate on your answer sheet if each of the following statements is true (T) or false (F).

檢查椎間關節及其運動。請問椎間關節會發生以下哪種運動？並根據您的觀察結果，回答以下陳述為真（T）或假（F）。
A. Dorsal flexion

背方屈曲
B. Ventral flexion

腹方屈曲
C. Lateral flexion

側方屈曲
D. Rotation

旋轉

Q.3.3.3 Examine the spinal cord in the cervical segment. Based your observations, indicate on your answer sheet if each of the following statements is true (T) or false (F).

檢查頸段的脊髓，並根據您的觀察結果，註明以下每個陳述為真（T）或假（F）。
A. A blood vessel can be found in the midline of the ventral surface of the spinal cord, in the median sagittal plane.

血管可以在脊髓腹側表面中線，也就是中央矢狀平面中找到。
B. Up to 4 (2 pairs) of spinal nerves can be counted within a 2.5 cm segment of the spinal cord.

在脊髓的 2.5 公分區段內可數到多達 4（2 對）脊神經。
C. The dura mater (outermost membrane of the 3 membranes of the spinal cord) itself cannot be distinguished around the spinal cord, because the dura mater and the periosteum (dense fibrous membrane covering the surface of all bones, in general) of the vertebral bodies are strongly attached together

硬腦膜（脊髓 3 層膜的最外層）本身無法在脊髓周圍被辨識，因為椎骨本體的硬腦膜和骨膜（一般覆蓋所有骨頭表面的緻密纖維膜）緊緊地連在一起。

Q.3.3.4 Dissect a single vertebra and separate it from the rest of the neck. Based your observations, indicate on your answer sheet if each of the following statements is true (T) or false (F).
解剖單一椎骨並將其與頸部的其餘部分分離。根據您的觀察結果，指出以下何者為真（T）或假（F）。

A. The vertebral body has a sponge-like structure, it is not dense
椎體具有一個海綿狀結構，而且並不緻密。

B. No cartilages can be found between the vertebral bodies of chickens
雞的椎體之間缺乏軟骨。

C. A pair of bone processes can be observed both on the dorsal and ventral side of the vertebra
無論在脊椎的背方與腹方都可以找到成對的骨突。

D. One single vertebral foramen (hole) can be found on the dissected vertebra

在被解剖出來的椎骨上可以發現單一椎孔。

Q.3.3.5 SUBMISSION!
Dissect and prepare a single vertebra and make sure it fulfils the following criteria:
- Whole and intact body
- All processes are intact
- No muscles are attached
- No remnants of the spinal cord

Place the vertebra in the sachet with the code marking. Write this code in the box provided on your answer sheet!

交卷！
請解剖並準備單一椎骨並確保其符合以下標準：
- 整個和完整的身體
- 所有流程都完好無損
- 沒有肌肉附著
- 沒有殘餘的脊髓

將椎骨放入帶有代碼標記的小袋中。將此代碼寫在答題紙上提供的方框中！

Part II. Dissecting and examining a chicken wing 解剖並檢驗雞翅膀

Anatomy of the bones of the chicken wing 雞翅膀骨骼的解剖

Figure 2 shows the bones of the chicken wing (1-9), not necessarily in the order of their direct connections. In the limb, the **upper arm bone** (humerus) and the two forearm bones, the **radius** and the **ulna** are significantly elongated. Some of the carpal bones are individual bones, while others are fused with the metacarpals. The unified bone that developed this way has an elongated shape resembling a violin bow. Three fingers (digits I, II and III) are connected to this. The first (I) digit is the thumb, positioned at the side of the radius and consisting of a single phalanx, which bears the bastard wing (**alula**). The second (II), middle digit is the longest with two phalanges, while the third (III) vestigial digit also has one single phalanx, immediately next to II.

圖 2 顯示了雞翅的骨骼（1-9），但這個圖示未必是它們彼此之間連接的順序。在這個肢體中，上臂骨（肱骨）和兩個前臂骨，也就是橈骨與尺骨明顯延長。有些腕骨為單獨骨骼，但有些腕骨則與掌骨癒合。以這種方式發育的癒合骨骼具有類似小提琴弓的延長形狀。雞翅的三個手指（數字 I，II 和 III）就連接到此。第一指（I）位於橈骨的側方，由單個指骨組成，帶有小翼羽（alula）。第二指（II）最長並具有兩節趾骨，而第三指（III）是一個痕跡器官，只有一個趾骨，緊鄰 II。

Figure 2. Bones of a chicken wing 雞翅膀的骨骼

Figure 3 demonstrates the bone labelled with number 3 in more detail. Regarding the anatomical directions and plains, we considered the standard anatomical position as a basis: the wing is open in a lateral position (refer to Figure 1).

圖 3 更詳細地顯示標為 3 號的骨骼。我們認為標準的解剖方向和平面是一個基礎：而翅膀由側方開啟（參見圖 1）。

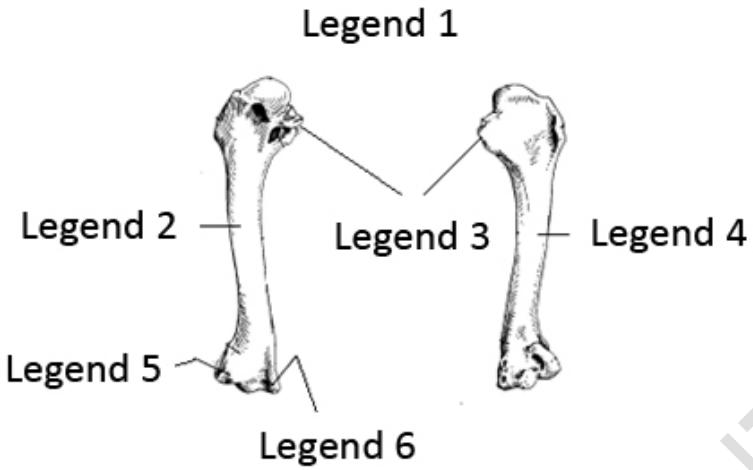


Figure 3. Legend 1 = Proximal end. Legend 2 = Cranial surface. Legend 3 = Tuberculum ventrale. Legend 4 = Caudal surface. Legend 5 = Epicondylus dorsalis. Legend 6 = Epicondylus ventralis.

圖 3、圖說 1 = 近體端；圖說 2 = 顱端表面；圖說 3 = 腹方結節；圖說 4 = 尾端表面；圖說 5 = 上髁背側；圖說 6 = 上髁腹側

Dissection tips

- Examine the superficial muscles first and the deeper muscles second, both on the dorsal and ventral sides of the wing.
- Remove the skin from the muscles.
- Open the common connective tissue sheath around the muscles.
- Separate the individual muscles using the tip of closed scissors, breaking the connective tissue between them so that only their own connective tissue sheath (epimysium) is left on them.
- MAKE SURE YOU KEEP ALL MUSCLES INTACT!

- 無論是雞翅膀背方或腹方，首先檢查淺層表面肌肉，然後再檢查檢查更深層的肌肉。
- 去除肌肉上的皮膚。
- 打開肌肉周圍的共同結締組織鞘。
- 使用剪刀的尖端將個別肌肉分離，打破它們之間的結締組織，使得只留下它們自己的結締組織鞘（外膜）。
- 請確保你保持所有的肌肉完整！

Q.3.3.6 Examine how the muscles, bones and joints react to you moving the wing.
Based your observations, indicate on your answer sheet if each of the following statements is true (T) or false (F). 檢查你在活動這個雞翅膀時其肌肉，骨骼與關節如何反應。根據您的觀察結果，指出以下每個陳述何者為真（T）或假（F）。

A. When extending the elbow joint, the bones of the forearm move relative to each other as well: the radius moves in distal, the ulna in proximal direction.
當伸展肘關節時，前臂骨骼也進行相對移動：橈骨在遠體端移動，而尺骨在近體端方向移動。

B. When extending the elbow joint, the bones of the forearm move together, both bones in proximal direction, while during flexion both bones move in distal direction.
當伸展肘關節時，前臂的骨骼一起同步移動，兩個骨骼都沿近體端方向移動，而在屈曲期間，兩個骨骼沿遠體端方向移動。

C. When the elbow joint is in flexion, the wrist joint will also bend, thus the metacarpals and digits also move towards the body as the humerus does.
當肘關節處於屈曲狀態時，腕關節也會彎曲，因此掌骨和手指也會像肱骨那樣向身體移動。

D. There is a muscle originating from the bottom (distal) end of the humerus and inserting at the top (proximal) end of the radius.
有一個肌肉來自肱骨的底部（遠體端），並插入橈骨的頂端（近體端）。

E. The muscle originating from the bottom (distal) end of the humerus and inserting at the top (proximal) end of the ulna is a flexor muscle.
來自肱骨底部（遠體端）並插入尺骨頂端（近體端）的肌肉是屈肌。

Q.3.3.7 The three-headed arm muscle, musculus triceps brachii extends the elbow joint, while the two-headed arm muscle, musculus biceps brachii is the antagonist muscle of the triceps. **Examine the origin and insertion of these muscles. Where are the insertion points of the triceps and the biceps muscles?** Indicate your answer by putting an X in the appropriate box on the answer sheet.
三頭臂肌，也就是肱三頭肌可伸展肘關節，而雙頭臂肌，也就是肱二頭肌則是肱三頭肌的拮抗肌。檢查這些肌肉的來源和插入方式。請問肱三頭肌和二頭肌肌肉的插入點在哪裡？請在答題紙上的方框中寫入 X 來表明您的答案。

3.3.7.1 Musculus triceps brachii 肱三頭肌

3.3.7.2 Musculus biceps brachii 肱二頭肌

Options (選項):

A. Radius 橈骨
B. Ulna 尺骨
C. Both radius and ulna 橈骨與尺骨
D. None of the above 兩者皆非

Q.3.3.8 Locate and examine the nerve running along the humerus between the triceps and the biceps on the ventral side of the wing. Based on what you can see, which of the following muscles does this nerve innervate? Indicate your answer by putting an X in the appropriate box on the answer sheet.
找到並檢查沿著雞翅膀腹側的肱三頭肌與肱二頭肌之間的肱骨的神經。根據你所看到的，以下哪些肌肉能夠進行神經支配呢？請在答案紙上寫入 X 來表明您的答案。

A. Biceps
肱二頭肌
B. Triceps
肱三頭肌
C. Both biceps and triceps
兩者皆是
D. None of the above
兩者皆非

Q.3.3.9 SUBMISSION!

Track the nerve running between the triceps and the biceps on the ventral side of the wing, along the humerus, innervating the forearm and also the digits. Excise a single continuous segment that is at least 8 cm long. Make sure you are left with the nerve only!
Place it in the bottle with the code marking. Write this code in the box provided on your answer sheet!

提交！

跟踪雞翅膀腹沿著肱骨的側肱三頭肌與肱二頭肌之間的神經、支配前臂和手指。切除至少 8 厘米長的單個連續肌肉段。確保你只留下神經！
將其放入帶有代碼標記的瓶子中。將此代碼寫在答題紙上提供的框中！

Anatomy of the muscles of the chicken wing 雞翅膀肌肉的解剖

The origin and insertion point of several (not all) wing muscles are listed below. **Note that m1-m4 are on the ventral side, while m5-m8 are on the dorsal side of the wing.**

下面列出了幾個（不是所有）雞翅膀肌肉的起始點和插入點。注意，m1-m4 位於腹側，而 m5-m8 位於雞翅膀的背側。

m1

- Origin: bottom protuberation of the humerus (ventral epicondyle)
- Insertion: the ulnar side of the wing carpal bone (ulnar carpal bone)
- 起源：肱骨底部隆起（腹側上髁)
- 插入：翼腕骨的尺側（尺骨腕骨）

m2

- Origin: humero-carpal ligament and the bottom protuberation of the humerus (ventral epicondyle)
- Insertion: phalanx of digit II
- 起源：肱骨 - 腕骨韌帶和肱骨底部隆起（腹側上髁）
- 插入：手指 II 的趾骨

m3

- Origin: proximal third of the body of the ulna
- Insertion: distal phalanx of digit II
- 起源：尺骨近端三分之一
- 插入：手指 II 的遠端趾骨

m4

- Origin: wing carpal bones, wing metacarpals, space between bones
- Insertion: end phalanx of digit II
- 起源：翼腕骨，翼掌骨，骨骼之間的空間
- 插入：手指 II 的末端趾骨

m5

- Origin: upper protuberation of the humerus (dorsal epicondyle) [note: this muscle is positioned at the side of the radius (radial position)]
- Insertion: wing metacarpals
- 來源：肱骨上部突起（背髁上部）[注意：此肌肉位於橈骨側（橈骨位置）]
- 插入：翼掌骨

m6

- Origin: upper protuberation of the humerus (dorsal epicondyle) [note: this muscle is located next to m10]
- Insertion: digits I and II
- 起源：肱骨的上部隆起（背上髁）[注意：這個肌肉位於 m10 旁邊]
- 插入：手指 I 和 II

m7

- Origin: from both the radius and ulna
- Insertion: phalanx of digit I

- 來源：來自橈骨和尺骨
- 插入：手指 I 的趾骨

m8

- Origin: upper protuberation of the humerus (dorsal epicondyle) [note: the outermost muscle attaching to the metacarpals, with dorsal and ulnar position in the forearm]
- Insertion: wing metacarpals
- 來源：肱骨上部突起（背上髁）[注意：最外側肌肉附著於掌骨，前臂背側和尺側位置]
- 插入：翼掌骨

Q.3.3.10 Examine the muscles on the ventral side of the forearm and the tip of the wing and Figure 4.

檢查圖四中所示雞翅膀尖端與前臂腹側的肌肉

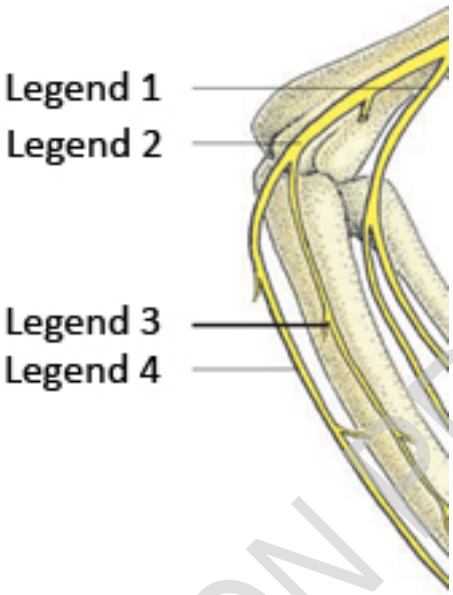


Figure 4. Legend 1 = Median nerve. Legend 2 = Ulnar nerve. Legend 3 = Ramus cranialis. Legend 4 = Ramus caudalis.

圖 4、圖說 1 = 正中神經；圖說 2 = 尺骨神經；圖說 3 = 顱側神經；圖說 4 = 尾側神經。

Based on your observations, which <u>one</u> of the following statements is true for the innervation of muscles m1 and m3? Indicate your answer by putting an X in the appropriate box on the answer sheet.

根據您的觀察，以下哪一項陳述適用於肌肉 m1 和 m3 的神經支配？請在答題紙上的方框中寫入 X 來表明您的答案。

A. from the nerves originating from the upper arm, only the branches of the median nerve innervate both muscles m1 and m3

來自上臂的神經，只有正中神經的分支支配肌肉 m1 和 m3

B. from the nerves originating from the upper arm, only the branches of the ulnar nerve innervate both muscles m1 and m3

來自上臂的神經，只有尺骨神經的分支支配肌肉 m1 和 m3

C. only the ulnar nerve innervate muscle m1, while muscle m3 is innervated only by the median nerve

僅尺骨神經神經支配肌 m1，而肌肉 m3 僅受正中神經支配

D. both muscles (m1 and m3) are innervated by both the ulnar and the median nerve

兩個肌肉（m1 和 m3）均由尺骨神經和正中神經支配

Q.3.3.11 **Consider the function of muscles m1-m8. Which one of the following pairs comprise synergist muscles?** Indicate your answer by putting an X in the appropriate box on the answer sheet.

考慮肌肉 m1-m8 的功能。以下哪一配對包含增效肌？請在答題紙上的方框中寫入 X 來表明您的答案。

A. m1 and m8
B. m2 and m7
C. m2 and m6
D. m3 and m4
E. None of the above

Q.3.3.12 **Examine the muscles at the ventral side of the forearm and the tip of the wing. For which one muscle is it true that the length of individual muscle fibres are shorter than the length of the main body of the muscle without tendons?** Indicate your answer by putting an X in the appropriate box on the answer sheet.

檢查前臂腹側和雞翅膀尖端的肌肉。對於以下哪一塊肌肉，單個肌纖維的長度短於無肌腱的肌肉主體的長度？請在答題紙上的方框中寫入 X 來表明您的答案。
A. m1
B. m4
C. m5
D. m8
E. None of the above

Q.3.3.13 **SUBMISSION!**
The ligament of m7 is also connected to the distal ligament of m5, therefore they have a common ligament.
Dissect these two muscles in their entire length, together with the common ligament and excise (as a whole) from the wing.
Place them in the bottle with the code marking (the same in which you put the nerve segment).
Write this code in the box provided on your answer sheet!
提交！
m7 的韌帶也與 m5 的遠端韌帶相連，因此它們具有共同的韌帶。
解剖出這兩條肌肉的整個長度與起源自雞翅膀的共同韌帶，然後把它們與雞翅膀分離。
將它們放入帶有代碼標記的瓶子中（與放置神經節段相同）。
將此代碼寫在答題紙上提供的方框中！

Q.3.3.14 **Dissect away all the soft tissue so you can observe the bones. How many carpal bones are articulated with the forearm bones?** Indicate your answer by putting an X in the appropriate box on the answer sheet.
解剖所有軟組織，以便觀察骨骼。前臂骨骼上有多少腕骨？請在答題紙上的方框中寫入 X 來表明您的答案。

A. The ulna is articulated with two carpal bones, while the radius only with one
尺骨與兩個腕骨間有鉸接，而橈骨卻只有一個

B. The ulna is articulated with one carpal bone, while the radius with two

尺骨與一個腕骨鉸接，但橈骨卻使用兩個
C. Both the ulna and the radius are articulated with two carpal bones
尺骨和橈骨都用兩塊腕骨鉸接
D. Both the ulna and the radius are articulated with one carpal bone
尺骨和橈骨均與一塊腕骨關節鉸接
E. The ulna is articulated with two carpal bones, while the radius with none
尺骨與兩個腕骨鉸接，而橈骨完全沒有

THIS IS THE END OF PRACTICAL PAPER 3.3. 這是實作題 3.3 的尾聲

MAKE SURE YOU PUT ALL THE STRUCTURES THAT HAVE TO BE SUBMITTED IN THE CONTAINERS SPECIFIED AND LEAVE THEM ON YOUR TRAY!

確認你已經把所有需要被繳交的結構擺在指定的袋子中並把它們留在你的桌面上！

MAKE SURE YOU COPY THE CORRECT CODES FROM THESE CONTAINERS INTO THE CORRECT BOXES ON YOUR ANSWER SHEET!

確認你已經把正確的代碼複製到你答案券上的正確方框中！