Student Code: _____

22nd INTERNATIONAL BIOLOGY OLYMPIAD

July 10-17, 2011

Taipei, Taiwan

PRACTICAL TEST 2

ANIMAL PHYSIOLOGY AND ANATOMY

動物生理與解剖學

Total Points: 100

Duration: 90 minutes

時間：90 分鐘

Dear Participants,

親愛的參賽者：

- In this test, you have been given the following 2 tasks:

  在本考場中你要完成兩件工作：

  Task I: The observation of the sciatic nerve of American bullfrog (57 points)

  工作 1：觀察美洲牛蛙的坐骨神經（57 分）

  Task II: The observation of tissue morphology and the match of their functionality (43 points)

  工作 2：觀察組織形態並與其功能配合（43 分）

- Check your **Student Code** on the **Answer Sheet** before starting the test.

  檢查你**答案卷**上的學生**考號**

- Write down your results and answers in the **Answer Sheet. Answers written in the Question Paper will not be evaluated.**

  將答案與結果寫在**答案卷**上，**寫在考卷上的答案是不計分的。**

- Make sure that you have received all the materials listed for each task. If any of the listed items is missing, **raise your sign.**

  檢查並確認你有兩件工作列在表上的所有材料，若有缺少，**請舉牌**。

- **Use pen only.**

  不可用鉛筆。

- **You must complete task I first.**

  你必須先完成工作 1。

- Stop answering and put down your pen immediately after the end bell rings.

  結束鐘聲響時停止做答，並立刻放下筆。

- After test, enclose both the **Answer sheets and Question paper** test sheets in the provided envelope. Our Lab assistants will collect it promptly.

  考試結束，將**答案卷**與**考卷**都放入信封中，助教會過來收取。

- No paper or materials should be taken out from the laboratory.

  考試紙或材料均不得帶出實驗室

Good Luck!!

祝好運

Equipment and Materials:

裝備與材料

For task I: The observation of the sciatic nerve of American bullfrog.

工作 1：觀察美洲牛蛙的坐骨神經

Instruments/materials 儀器與材料	**Quantity 數量**	**unit 單位**
Bullfrog specimen 牛蛙標本	1	Piece 個
Dissecting tray (containing a cooler) 解剖盤 (含有一冰寶)	1	Piece 個
Round plastic petri dish 圓形培養皿	1	Piece 個
Ringer's solution (in wash bottle) 林格試液	500	mL
Pin (in a glass bottle) 大頭針(在玻璃瓶中)	10	pieces
Cotton line (in a glass bottle) 棉線(在玻璃瓶中)	2	Pieces 條
Electric stimulating device 電刺激裝置	1	Set 套
Wet paper 濕紙巾	1	Set 包
Plastic glove 塑膠手套	1	Pair 副
Dissecting equipment : scissors (large) 剪刀(大) 解剖用具 scissors (small) 剪刀(小) fine forceps 鑷子	1 1 2	pair 支 pair 支 pairs 支

For task II: The observation of tissue morphology and the match of their functionality

工作 2：觀察組織形態並與其功能配合

Instruments/materials **儀器與材料**	**Quantity** **數量**	**Unit** **單位**
Microscope 顯微鏡	1	set 檯
Tissue section (marked A to J) 組織切片（編號 A ~ J）	10	slides 片
Color pictures (numbered 1 to 9) on 3 sheets of A4 paper 彩色圖片（編號 1~9）在 3 張 A4 紙上	1	set 套

Task I (57 points)

The observation of the sciatic nerve of American bullfrog.

工作 1：觀察美洲牛蛙的坐骨神經 （57 分）

Introduction:

The sciatic nerve is a branch of the sacral plexus. It is the thickest and longest nerve tract in the body, extending from the vertebral column to the foot. The sciatic nerve includes the distributed sensory and motor nerves that control most sensory and motor activities of the lower extremities. Mediated by the sciatic nerve, sensory signals from the lower limbs are transmitted to the brain. Similarly, muscle contraction of the lower extremities can be stimulated by nerve impulses from the brain. The aim of this experiment is to observe and isolate the sciatic nerve from the bullfrog.

前言

坐骨神經是薦骨神經叢的一支。它是身體中最粗最長的神經，可由脊柱延伸到足部，包括分佈到下肢的感覺及運動神經，可控制大多數的下肢活動。坐骨神經可將下肢的感覺訊號傳到腦。相似的，下肢肌肉的收縮可由腦傳來的神經衝動所刺激。本實驗的目的是觀察並分離美洲牛蛙的坐骨神經。

Experiment Procedure:

Step 1 to 5: (To keep the tissues wet, a small amount of Ringer's solution may be added onto the tissue anytime. Do not allow the tissues to dry out.)

實驗步驟
步驟 1~5：（要保持組織的潮濕，須常用小量林格試液加在組織上。注意不可讓組織乾掉）

1. Carefully check if all the experiment instruments/materials are fully provided. Raise your sign if you have any problem.

   仔細檢查所有實驗儀及材料，若有問題，**請舉牌**。

2. Put the bullfrog specimen on the provided dissecting tray.

   將牛蛙標本放在解剖盤上。

3. First, carefully observe the 10 pairs of spinal nerves extending from the vertebra of the bullfrog. Next, locate the sciatic nerve that is assembled by pairs of spinal nerves VII, VIII and IX (as shown in Fig. 1).

   首先，小心檢查由牛蛙脊柱延伸出的 10 對脊神經。其次，找出坐骨神經，它是由第 VII、VIII、IX 對脊神經聚合成的（如圖 Fig. 1 所示）。

4. Turn on the switch (on/off) on the electric stimulating device. The red light will be lighted up immediately, indicating that the device is functioning.

   打開電刺激裝置的開關，紅燈會馬上亮起來，表示此裝置的功能是正常的。

5. Simultaneously stimulate the sciatic nerve with the two electric wires that are separately connected to the (+) and (-) electrodes of the electric stimulating device. Fig. 3 indicates the position of sciatic nerve emerging form the spinal cord. Observe the contracting response of the hind limb.

以分別連接到電刺激裝置(+)及(-)極的兩支電線同時刺激坐骨神經，圖 Fig. 3 顯示坐骨神經由脊髓伸出的位置，觀察下肢的收縮反應。

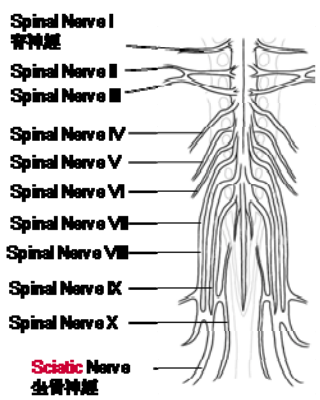

Fig. 1. Spinal nerve
脊神經

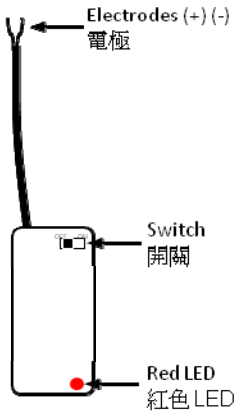

Fig. 2. Electric stimulating device 電刺激裝置

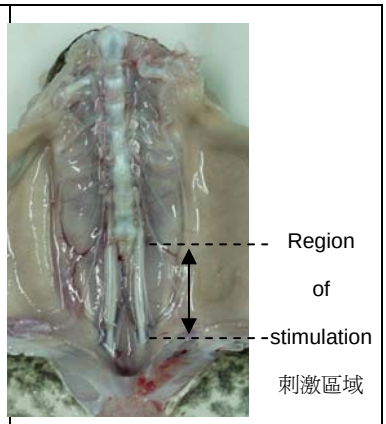

Fig. 3. Sciatic nerve
坐骨神經

Q.1.1. (9 points) When you have finished the above five steps, **lift the sign** to notify the Lab assistant to videotape the contraction.

Q1.1. (9 分) 當你完成上述 5 步驟，**請舉牌**通知助教以錄影記錄其收縮。

Step 6 to 10: (To keep the tissues wet, a small amount of Ringer's solution may be added onto the tissues any time)

步驟 6~10：（要保持組織的潮濕，注意常加小量林格試液在組織上。）

6. Use a pair of scissors to circularly cut open the skin at the upper part of **one** thigh of the bullfrog. Starting from the cutting point, completely peel off the skin by hand to remove it from the hind limb (Fig. 4). It may be necessary to cut some connections between the skin and underlying tissues.

   用剪刀環剪開牛蛙**一邊**大腿的皮膚，用手由大腿最上方的環剪處完全脫下腿部的皮膚（如圖 Fig. 4），可能須用剪刀分開某些皮膚與其下方組織的連結處。

7. Lay the bullfrog on the dissecting tray with its back facing up.

   將牛蛙背部向上放在解剖盤上。

8. Push two pins separately into both ends of gastrocnemius and separate it from tibiofibula (shinbone) (Fig. 5).

   用兩根針分別插在腓腸肌的兩端，將其與脛骨分開（要如圖 Fig.5）。

9. The sciatic nerve is located in the trough surrounded by thigh muscles. Carefully separate the muscles on both sides of the trough and let the light yellow colored sciatic nerve be exposed. Pass through a cotton line underneath the sciatic nerve to label it.

   坐骨神經位於被大腿肌肉包圍的凹溝處，小心分開大腿肌肉將淡黃色的坐骨神經暴露出來，再小心地用棉線穿過其下方以標示坐骨神經。

10. Stimulate the cotton line-labeled sciatic nerve with the provided electric stimulating device and observe the contracting response of gastrocnemius.

以電刺激裝置來刺激此棉線標示的坐骨神經，觀察腓腸肌的收縮。

Fig. 4. Demonstration of skin peeling

剝下腿部皮膚的示範

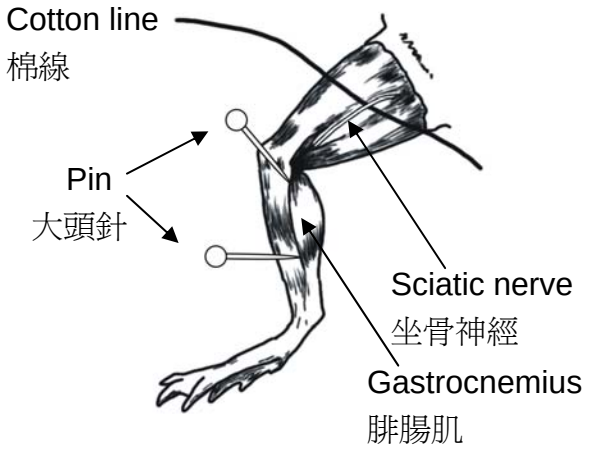

Fig. 5 Sciatic nerve and gastrocnemius

坐骨神經及腓腸肌

Q.1.2. (8 points) When you have finished the steps 6 to 10, **lift the sign** to notify the Lab assistant to videotape the contraction.

Q1.2. (8 分) 在完成上述步驟 6~10 時，**請舉牌**通知助教來錄影記錄收縮。

Step 11 to 12: (To keep the tissues wet, a small amount of Ringer's solution may be added onto the tissues any time)

步驟 11~12：（要保持組織的潮濕，注意常加小量林格試液在組織上。）

11. Completely separate and isolate the intact sciatic nerve-gastrocnemius muscle preparation from the bullfrog specimen and place it in a petri dish, as shown in Fig. 6. (Sciatic nerve must be at least 2 cm long).

    將「坐骨神經-腓腸肌」完整地由牛蛙分離出來，如圖 Fig. 6 所示置放於培養皿中，坐骨神經最少要有 2 cm 長。

12. Stimulate the sciatic nerve with the electric stimulating device and observe the contracting response of the gastrocnemius.

    以電刺激裝置來刺激坐骨神經並觀察腓腸肌的收縮。

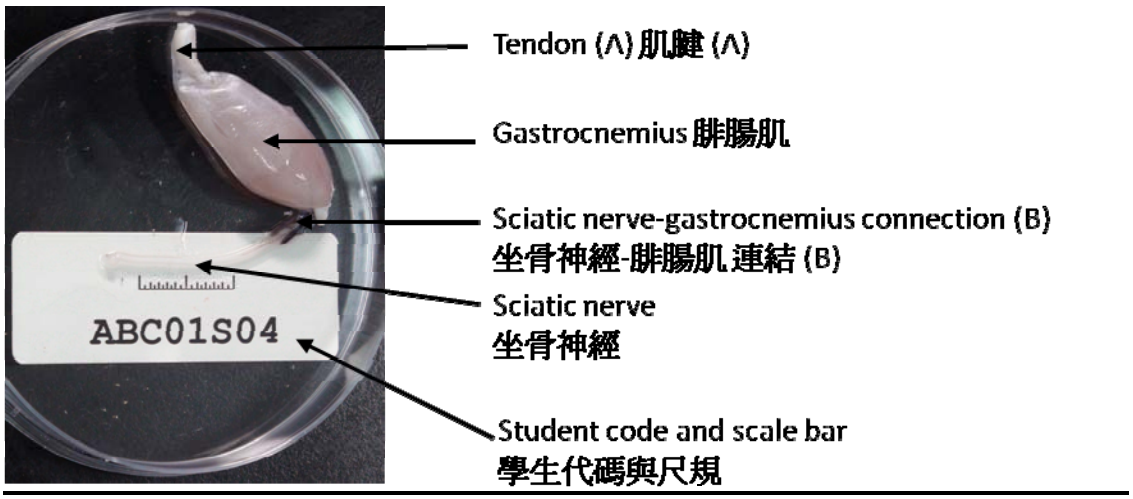

Fig. 6 Isolation of 「sciatic nerve-gastrocnemius」tissue

「坐骨神經-腓腸肌」組織的分離

Q.1.3. (40 points) When you have finished steps 11-12, ~~write down the results of your observation on the answer sheets. Then,~~ **lift the sign** to notify the Lab assistant for checking the results and videotape the contraction.

Q1.3. (40 分) 在完成上述步驟 11~12 時，**請舉牌**通知助教來檢查結果並錄影記錄收縮。

Task II (43 points)

Identify tissues based on their morphology and match their functionality

工作 2：根據形態辨認組織並與其功能配對　（43 分）

Introduction:

The vertebrate physiological system is established by the functional coordination of 11 organ systems, which include the skin, skeletal, muscle, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary, and reproductive systems.

前言

脊椎動物的生理系統建立在 11 個器官系統功能的配搭上，包括皮膚、骨骼、肌肉、神經、內分泌、循環、淋巴、呼吸、消化、排泄、生殖等。

Identify the specimens on the slides (30 points)

Slides A to J are tissue sections from vertebrates. Identify the tissues or cell types, based on their characteristic features, using microscope.

組織切片的辨識　（**30** 分）

編號 A ~ J 玻片爲脊椎動物的組織切片。用顯微鏡觀察並根據其特徵來辨識其組織或細胞的類型。

1. Vein 靜脈	2. Artery 動脈	3. Ganglion 神經節	4. Neuron 神經元	5. Blood（frog） 血液(蛙)
6. Blood 血液 （human）(人)	7. Ovary 卵巢	8. Testis 睪丸	9. Lung 肺	10. Skeletal muscle 骨骼肌
11. Smooth muscle 平滑肌	12. Cardiac muscle 心肌	13. Kidney 腎臟	14. Cartilage 軟骨	15. Bone 硬骨
16. Pancreas 胰臟	17. Intestine 腸	18. Gastric tissue 胃組織	19. Skin 皮膚	20. Rectum 直腸

Q.2.1. (30 points) Match each slide specimen (A to J) with its correct name from 20 different tissue/organ names listed in above table. (Note: only one correct answer for each specimen). Fill in the correct number in the answer sheets.

Q2.1. (30 分) 將（A ~ J）組織切片與上表中所列的 20 種不同組織/器官名字配對。（注意：每個樣本只有一個正確答案）。將正確的**數字代碼**寫在答案紙上。

Identify the sliced tissue and match their correct functions (13 points)

辨認組織圖片並與其功能配對　（13 分）

Fig. 1-9 are the enlarged pictures of parts of different mammalian tissues. Based on their structural features, identify the tissue ~~determine the precise sources of them~~ and answer the questions below.

圖片 Fig. 1~9 爲哺乳動物不同組織的放大照片，根據它們的構造特徵辨認組織並回答下面的問題。

The functions of 11 organs are listed in the following table. Each specific function is assigned an alphabetic letter (A to K).

下表中列出 11 種的器官功能，每種特殊功能以一個英文字母（A ~K）爲代碼。

Symbol 符號	**Functional description 功能描述**
A	Producing vitamin D_3 維生素 D_3 的產生
B	Producing erythropoietin 紅血球生成素的產生
C	Producing urea 尿素的產生
D	Producing Surfactant to reduce the surface tension 產生表面活性物質以降低表面張力
E	Regulating the homeostasis of the pH of body fluid 調控體液 pH 值的恆定
F	Helping the vein compression and promoting blood stream back to the heart 幫助靜脈的收縮及血液回流到心臟
G	Digesting proteins 蛋白質的消化
H	Producing secretin 胰泌素的產生
I	Producing inhibin 回饋抑制促性腺激素的產生
J	Major organ for the storage of calcium and phosphate 鈣與磷儲存的主要器官
K	Producing progesterone 黃體素的產生

Q.2.2. (13 points) Correctly write down the functional symbols, i.e. the alphabetic letters (A to K), on the answer sheets. Match the organ with their functionalities. **Note**: some organs may have more than one function (1 point will be deducted for each incorrect answer and minimum score will not be less than zero).

Q2.2. (12 分) 在答案卷上寫出其功能的正確代碼，即字母（A~K）。

將各圖片中的器官與上表中所列的功能配對。注意：有的器官可能會超過一種功能（每個錯誤的答案會被倒扣 1 分，扣到 0 分爲止）。