INTERNATIONAL BIOLOGY OLYMPIAD e. V. IBO

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PRACTICAL EXAM 3 - ANIMAL BIOLOGY

Max. total points 99
Exam duration 90 minutes
8 questions

In this exam you will dissect a cod (Gadus morhua). You will be scored on your ability to dissect and identify structures and organs of the fish. In addition, you will be asked about functions of structures. Thus the exam is about functional morphology of an ecologically and economically important fish species.

The exam consists of four parts.

Part 1. Identification of external structures (15 points)
Part 2. Identification of internal structures (37 points)
Part 3. An analysis of the heart (22 points)
Part 4. An analysis of the brain (25 points)

We suggest you read the entire exam file before you begin the lab work. It is important that you get an overview of the exam in order to avoid destroying parts of the fish you might need for later tasks. Please keep in mind that we can only provide one student to each fish :-)

INTRODUCTION

MATERIALS & EQUIPMENT

In order to do your lab work, you need the materials A-J listed below. Please, ensure yourself that all these items are on your table.
If anything is missing, contact the exam personnel immediately – and no later than 15 minutes after start of exam. If you need any assistance during the exam, please raise your pink card..

Material A. 1 cod

Material B. 1 pair of scissors
Material C. 1 tweezer
Material D. 4 pairs of gloves
Material E. Needles
Material F. Number strips (cut off individual numbered tags)
Material G. 1 dissection polystyrene board
Material H. 1 bag for waste
Material I. Cleansing tissues
Material J. 1 touch pen for tablet

NB: Keep the tablet plugged in during the entire exam.

1. IDENTIFICATION OF EXTERNAL STRUCTURES (15 POINTS)

Protocol

1. Place the cod on the polystyrene dissection board with its left side upwards and head towards the left (Fig. 2.1.).
2. Mark the positions, using needles with a numbered tag (Material F), of all 11 external morphological structures listed below.Use the numbers given below for each of the corresponding structures If a structure is present more than once, you only have to mark one of them. To create the tags, mount each numbered tag onto a needle by placing the tag on the polystyrene board and pressing the needle through the tag

External morphological structures

1. Caudal fin
2. Anal fin
3. Pelvic fin
4. Pectoral fin
5. Dorsal fin (only one of these)
6. Operculum
7. Nostril
8. Lateral line
9. Barbel/whisker
10. Anus
11. Urogenital aperture

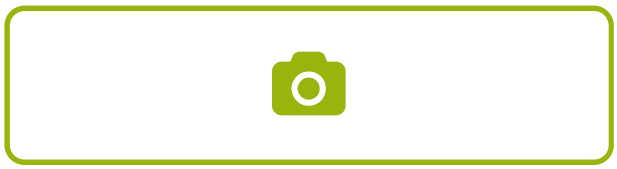
Protocol continued

3. Photograph the cod with all structures 1–11 indicated with numbered needles
Be sure that both the number tag and the structure can be seen in the photo; you may have to stand up while taking the photo. Notice that if a flag is missing or wrongly placed or if a number is not visible, you get 0 point for that particular structure.

Each correctly marked external structure earns you 1 point.

Q. 1 Photo of the cod with all 11 EXTERNAL morphological structures and numbered flags visible (max. 11 points)

Cod photo



Q. 2 Functions of external organs (1 point for each correct statement, max. 4 points)

Indicate if each of the following statements are true or false.

	TRUE	FALSE
In most fish, the lateral line consists of sensitive cells on the surface of the scales	○	○
In the cod the vertebral column bends and extends upwards into the upper lobe of the tail fin	○	○
In most modern fish the lateral line is a system sensitive to motions and vibrations in its surroundings	○	○
During accomodations the lens in a cod's eye changes shape the way it does in a mammalian eye	○	○

2. IDENTIFICATION OF INTERNAL STRUCTURES (37 POINTS)

Protocol

1. First, remove and discard the operculum as well as lateral musculature on the left side of the cod (as in Fig. 2.1).
2. Then separate the organs from the esophagus to the anus, and take them out as a unit; but leave the swim bladder in the fish. You may need to cut through the swim bladder
3. Place the organs on the polystyrene board.
4.Identify, in the dissected organs, the 11 internal structures described below, using needles with numbered tags (Material F),



Figure 2.1: Cod with left-side musculature removed; A numbered tag is placed on the eye to show how a correctly placed tag should look like, i.e. both tag and structure are clearly visible.

Internal morphological structures

1. Primary site for gas exchange
2. Urine-producing organ
3. Gas gland
4. The organ in which pepsinogen is secreted

5. The site where substances from the gall bladder and pancreas are secreted
6. The organ where the main absorption of nutrients takes place
7. Spleen
8. The organ where detoxification of blood takes place
9. Pyloric caeca
10. Swim bladder
11. Gill rakers

Protocol continued

5. Photograph the cod with all structures 1–11 indicated with numbered needles. Be sure that both the number tag and the structure can be seen in the photo. Notice that if a flag is missing or wrongly placed or if a number is not visible, you get 0 point for that particular structure.

Each correctly marked internal structure earns you 3 points.

Q. 3 Photo of the dissected cod with all 11 internal morphological structures and numbered flags visible (max. 33 points)

Cod photo

Q. 4 Functions of internal structures (1 POINT FOR EACH CORRECT STATEMENT, MAX. 4 POINTS)

Indicate if each of the following statements are true or false.

	TRUE	FALSE
Gas is secreted into the swim bladder by diffusion through its entire wall	○	○
The cod lacks a connection between the gas bladder and the alimentary canal	○	○
Catching cod may cause rupture of their swim bladder	○	○
The spleen is part of the immune system of the cod	○	○

3. STRUCTURE OF THE HEART (22 POINTS)

Protocol
1. Remove the heart from the fish and place it on the polystyrene board.
2. Mark the identity, using needles with numbered tags (Material F), of the four structures listed below.

1. Atrium
2. Ventricle
3. Bulbus arteriosus
4. Ventral aorta

Protocol continued
3. Photograph the heart with structures 1–4 indicated with numbered needles. Be sure that both the number tag and the structure can be seen on the photo.
Notice that if a flag is missing or wrongly placed or if a number is not legible/visible, you get 0 point for that particular structure.

Each correctly marked heart structure earns you 5 points.

Q. 5 PHOTO OF THE DISSECTED heart WITH ALL four STRUCTURES AND NUMBERED FLAGS VISIBLE (MAX. 20 POINTS)

Heart photo

Q. 6 FUNCTIONS OF heart STRUCTURES (1 POINT FOR EACH CORRECT STATEMENT, MAX. 2 POINTS)

Indicate if each of the following statements are true or false.

	TRUE	FALSE
The heart of the cod has two atria and one ventricle	○	○
The blood pressure of the cod is mainly created by the ventricle	○	○

4. STRUCTURE OF THE BRAIN (25 POINTS)

Protocol
1. Remove very carefully the central nervous system (brain and spinal cord) (as in Fig. 4.1).
2. Place the central nervous system on the polystyrene board
3. Mark the identity, using needles with numbered tags (Material F), of the seven structures listed below.

1. Tectum opticum (optic tectum)
2. Cerebellum (“little brain”)
3. Medulla spinalis (spinal cord)
4. Telencephalon (containing the olfactory center)
5. Sagittal otolith (sagittal otoliths are the largest of the three ear stones)
6. Optic nerve
7. Muscle(s) controlling eye movements

Protocol continued
4. Photograph the cod with all structures 1–7 indicated with numbered needles. Be sure that both the number tag and the structure can be seen on the photo.
Notice that if a flag is missing or wrongly placed or if a number is not legible/visible, you get 0 point for that particular structure.

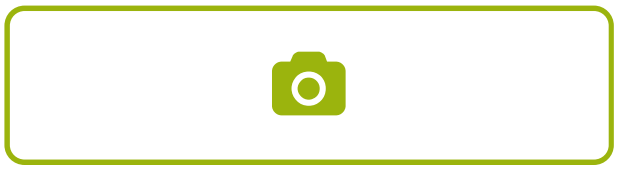
Each correctly marked brain and spinal cord structure earns you 3 points.



Figure 4.1: Removal of brain and spinal cord.

Q. 7 PHOTO OF THE DISSECTED brain and spinal cord WITH ALL seven STRUCTURES AND NUMBERED FLAGS VISIBLE (MAX. 21 POINTS)

Brain and spinal cord photo



Q. 8 FUNCTIONS OF brain and other STRUCTURES (1 POINT FOR EACH CORRECT STATEMENT, MAX. 4 POINTS)

Indicate if each of the following statements are true or false.

	TRUE	FALSE
The telencephalon is relatively smaller in fish than in mammals	○	○
Fish have 12 cranial nerves, the same as in mammals	○	○
Tectum opticum of the cod has two lobes, the left receives information from the left eye and the right from the right eye	○	○
Otoliths are homologous to the inner ear bones of mammals	○	○

END