NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF SCIENCE AND TECHNOLOGY

LABORATORY MANUAL

COURSE CODE: BIO192

COURSE TITLE: GENERAL BIOLOGY PRACTICAL II

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LAB I

The Kingdom Protista

The Protists are the first group of eukaryotic organisms. They are diverse and do not have much in common apart from a relatively simple organization as unicellular, or multicellular organisms that do not have specialized tissues or organs. There are three groups of Protists they are,
The Protozoan Protists eg. Amoeba and Paramecium
The Algal Protists eg. Euglena ans Spirogira
The Fungal Protists eg. slime mould and mushroom

Protozoans

(A) Identification of Protozoans from pond water

General information

Protozoans are unicellular organisms living independently or in colonies of similar cells. Most of them are microscopic organisms. They can be found in aquatic habitats such as streams, ponds, oceans and in moist soil. However, others live as parasites on animals and plants. Examples of protozoans include Amoeba, Paramecium etc.

Preparation of slides or fresh specimens of pond water:

- Place one drop of pond water in the center of the clean slide using the pipette.
- Cover the drop by lowering the cover slip gently down unto it in a slanting position. Ensure no air bubbles are trapped (those air bubbles are frequently mistaken for organisms).
- Use the coarse focusing knob and the lower power objective to ensure the sample is properly focused.
- Observe your preparation under the microscope using both low and high power objectives to identify any of the protozoans.
- Drawing under high power and label fully at least two protozoans you identify.

Questions

i. Indicate briefly the functions of the parts you have seen and labeled.
ii. Mention five characteristics of each of the protozoa.
iii. Classify each protozoa to species level.

(B) Algae

Examining the external feature of Algae

General Information

Algae are members of the phylum Chlorophyta. A few algae are single celled while most others are many celled with different body forms. Algae have thick cell walls and large vacuoles. Most of them have organized nucleus each of which has a delaminating nuclear envelop. Most algae possess chlorophyll. In addition to these they possess other coloured pigments which may mask the green colour of their chlorophyll. They lack true roots, stems and leaves. They also lack vascular tissues like xylem and phloem of higher plants. They are restricted in aquatic or moist habitats.

Prepare your slide as in (A) above.

- Mount the prepared slide unto a microscope and examine using low and high power objectives.
- Draw and label at least two algae you can identify in the pond water.

Questions:

i. What type of algae did you observe?
ii. Give five characteristics of algae.
iii. Is algae plant or animal? Give reasons for your answer.
iv. Classify the algae observed from kingdom to species level.
v. What type of nutrition do you find in green algae?

ANSWERS

(A) Protozoans

Drawings

i. Functions of the labeled parts

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ii. Five characteristics of each protozoa

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iii. Classification of each protozoa

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(B) Algae

Drawings

i. The type of algae you observed

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ii. Five characteristics of algae

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iii. Alga is a ……..
Reasons
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iv. Classification of the observed algae
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v. The type of nutrition found in green algae is
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LAB II

Fungi

Examination of external features of fungi

General Information

Fungi belong to a different kingdom of mostly multicellular eukaryotic organisms. Unlike pants, fungi do not have chlorophyll and do not produce their own food. Fungi are heterotrophs that secrete enzymes to break down materials outside the body. They then absorb these products of

digestion and use them as food. Most fungi are saprophytes that live on dead organisms, some are parasites that feed on living organisms while a few are symbionts that live in association with other organisms. Most fungi have a body made up of tangled filaments called a mycelium. A mycelium is in turn made of filaments called hyphae. The mycelium attaches to a food source, and the hyphae although microscopic present a large surface area through which food can be absorbed. Most fungi reproduce both sexually and asexually. Fungi are classified into divisions. Three divisions of fungi include zygote forming fungi, Ascomycete sac fungi and club fungi. Imperfect fungi are another group of fungi that have sexual stage of reproduction. Fungi are found growing on bread, orange, food remains etc.

(A): Examining mycelium

- Examine the mycelium on the bread using hand lens. Note the horizontal hyphae and the erect which terminate in spherical heads.
- Using an office pin or needle take a small portion of the mycelium and smear it on a glass slide containing drops of water.
- Now add a drop of lactoph cotton blue. Cover with a cover slip and examine under the low and high power objectives.
- Draw and label your observations.

Question

i. What structures and characteristics of fungi can be identified in the mycelium?
ii. Classify the specimen from kingdom to species level.

(B) Observing a slime mould
Use a hand lens to observe a culture of *Physarum polycephalum*, record your observations.

Questions:
i. Describe the appearance of the slime mould.
ii. What characteristics of animals did you observe in the slim mould?
iii. Classify the specimen from kingdom to species level.

(C) Examining Bacidiomycetes- Mushroom

- Obtain an *Agaricus compestris* mushroom.
- Examine the structure of the mushroom. Locate the stalk, the umbrella-shaped cap and the rows of gills on the underside of the cap. Record your observations.
- Using forceps, carefully remove one gill from the mushroom cap.
- Place the gill in a drop of water on a glass slide and cover with a cover slip.
- Use the microscope to observe the gill under both low and high power. Each gill has thousands of extension called basidia. Under the microscope most of the cells of the gill will appear as triangles. On the edge of the gill, locate the cup-shaped basidia and the attached Bacidiospores.
- Obtain a specimen of bracket fungus, Bacidiomycete that grows on trees.
- Use a hand lens to examine the underside of the Fungus, record your observation.

- Draw and label the parts of the mushroom you observed.
- Draw and label several basidia with basidiospores from the gill you observed under the microscope

Questions:

i. Describe the appearance of a mushroom.
ii. What part of the mushroom do you normally eat?
iii. *Agaricus compestris* is an edible mushroom, is it safe to eat all types of mushrooms? Explain your answer.

ANSWERS

(A) Examining mycelium

Drawings

i. Structures and characteristics of fungi that can be identified in the mycelium

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ii. Classification of mycelium

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(B) Observing a slime mould

i. Description of the appearance of the slime mould

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ii. Characteristics of animals observed in the slim mould

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iii. Classification of slime mould

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(B) Bacidiomycetes- Mushroom

Drawings

i. Describe of the appearance of a mushroom
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ii. The part of the mushroom eat
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iii. It safe to eat all types of mushrooms. Yes / No
Reasons
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LAB III
Seedless plants I
Brayophytes

Structure and Reproduction of *Pilytrichum* Moss

General Information
The Bryophytes were the earliest land plants and are a transitional group between terrestrial and aquatic plants. Unlike the algae, they are all multicellular and are more complex. Example Mosses. Mosses are commonly seen in forests and wood lands, growing on the trunks of trees. They can also be seen on the walls of old drains, old buildings and other brick works especially if these have been damp for a long time. A common species seen in Nigeria is *Funaria* species.

(A) Structure of moss

- Examine the mosses provided using hand lens.
- Note the short stalk anchored by a number of root-like structures and surrounded by a tuft of leaf-like structures.
- From the middle of this tuft, in some of the gametophytes, you may see some slender structures growing out.
- Make diagrams of the gametophytes; one bearing a sporophyte and another not bearing a sporophyte.

Questions:

i. Are mosses vascular plants? Give reasons for your answer.
ii. List three characteristics of bryophytes.
iii. Classify the specimen to species level.

(B) Reproduction

- Detach one sporophyte from the gametophyte. A sporophyte consists of one salk with a capsule on it. The green leafy part is the female gametophyte. Note that the capsule has a cap on it.
- To examine the content of the capsule, carefully remove the cap. Then place a drop of water on a glass slide and squeeze the contents of the capsule into the water. Cover with a coverslip and locate the capsule's contents under low power objective.Then observe under high power.
- Examine the prepared slide of the moss *protonema*. A *protonema* is a moss of tangled green filaments that germinates and grows from a spore.
- Examine the prepared slide of the moss antheridia and archegonia. These repeoductive organs are located in the upper tip of the gematophyta.

Questions

i. What are the structures inside the moss capsule called?
ii. How does a moss capsule disperse its content?
iii. Does the *protonema* contain any structures? If so, what might they be?
iv. What structural differences allow the moss to be more successful on land than alga?
v. Why is moss not usually found growing in areas of little rainfall?

ANSWERS

(A) Structure of moss

Diagrams

i. Mosses are vascular plants. Yes or No …….
Reasons
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ii. Three characteristics of bryophytes
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iii. Classification of the specimen
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(B)
i. The structures inside the moss capsule are called …….
ii. A moss capsule disperse its content by
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iii. The *protonema* contain some structures. Yes or No
If yes list them
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iv. The structural differences that allow the moss to be more successful on land than alga
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v. Moss is not usually found growing in areas of little rainfall because
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LAB IV
Seedless plants II
Pteridophytes
External features of Ferns
Special characteristics of ferns

General Information
Pteridophytes are non-seed vascular plants, example ferns. The sporophyte is the dominant phase of their life cycle and they disperse by spores.
Ferns like the moss grow commonly in the forests, farmlands and wood lands. Sometimes they grow from the ground unlike the moss. The most familiar structure usually seen in the saprophyte is the fern frond. The root usually become well established and able to absorb water and food materials from the soil while the leaves and other aerial portion containing chlorophyll manufacture food by photosynthesis.

(A) Characteristics of the Sporophyte fern

- You are provided with a fern plant.
- Using your hand lens, examine the whole fern plant.
- Identify the structures of the fern.
- Examine the underside of the frond for brownish yellow spots (sori).
- With the scalpel cut off a 0.5 cm piece rhizome from the fern.
- Place the rhizome in the dissecting tray.
- While holding the rhizome with the forceps, cut a very thin cross section of the rhizome with the scalpel.
- Prepare a wet mount slide of the rhizome cross section.
- If it is too thick, place it on a glass slide without the cover slip.
- Place the slide unto the stage of the microscope and observe it under low power; note the epidermis and the vascular tissue; xylem surrounded by the phloem.
- Draw and label the cross section of the rhizome.

(B) Characteristics of the Gametophyte fern

- Obtain the fern frond that contains sori.
- Use the hand lens to examine a single sorus.
- Place a drop of water on a clean glass slide, the use the scalpel to gently scrape a sorus into the drop of water on the slide.
- Examine the sorus under the low power of a microscope .
- Locate the club-shaped structures that were scraped from the sorus (sporangia) that contain spores.
- Draw a single sporangium.
- Prepare a second slide of only spores by removing a few sporangia from a sorus unto a clean dry slide.

- Add 1 drop of ethyl alcohol to the sporangia on the slide.
- Examine the sporangia under the low power objective.
- Observe what happens to the spore cases of the sporangia.
- Draw a few of the spores that were ejected from the sporangia.

Questions:

i. Classify the specimen provided.
ii. What are the functions of the sori found on the leaves?
iii. Why is it advantageous for the spores to be located on the bottom surface of the fern fronds?
iv. Is the gametophyte plant haploid or diploid? Explain your answer.
v. How are the ferns similar to mosses?
vi. Why are ferns found in a greater range of habitat than mosses?
vii. Ferns are difficult to tear from the main part of the plant. Explain why this is so.

ANSWERS

Drawings

i. Classification of the specimen
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ii. Functions of the sori found on the leaves

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iii. It is advantageous for the spores to be located on the bottom surface of the fern fronds because

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iv. The gametophyte plant is …….

Reasons

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v. Ferns are similar to mosses in the following ways

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vi. Ferns are found in a greater range of habitat than mosses because

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vii. Ferns are difficult to tear from the main part of the plant because

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LAB V
Seed Plants I
Subdivision: Spermatophytina

General Information

The seed – bearing plants of the subphylum Spermopsida are more complex structurally than the plants of any other grouping. Plants in this subphylum reproduce sexually by means of seeds. Based on the appearance of their seeds, seed – bearing plants are divided into two classes. The seeds of the angiosperms, or the flowering plants are enclosed in a protective structures called fruits. The seeds of the gymnosperms, or coniferous plants are found unprotected on structures called cones.

The seed – bearing plants develop specialized plant tissues. For the most part, these tissues are similar in both angiosperms and gymnosperms.

A. Gymnosperms

(Class: Gymnospermopsida)

The gymnosperms include ancient lines of plants and the long evolutionary history of the gymnosperms include many extinct forms. Some gymnosperms are known both as fossil and as living forms. Today, these groups are represented by only a remnant of a once vast assemblages of species and genera. Among the living forms of gymnosperm are short stubby almost herblike plants, shrubby and even vinelike forms and many tree types.

Although some gymnosperms are restricted in their geographical range as a group, they are found throughout the temperate and tropical zones and even in the arctic regions. The greatest development of living gymnosperms have been attained by the coniferous forms in the temperate climate of both hemispheres. In general, gymnospermous plants are found in fairly dry situations and in some instances, even in semi-desert regions.

Practical Exercise on Gymnosperm

You are provided with fresh and preserved specimens and permanent slides of several species of Gymnosperms. Examine them carefully and make well labeled diagrams of the specimens.

Pinus:

- Male and Female cones.
- Longitudinal sections of Male and Female cones.
- L.S. of ovary.
- L.L. os archegonia with egg.
- 1° year carpellate cone ie. With pollen, pollen grains (microsporangia)

Encephalartos: freshleaves

- Examine and draw the male cone and the male sporophyll with the pollen grains (microsporangia) attached to its undersurface. Draw some of the sporangia. Draw the female sporophyll as well.

Cycas: Male and female cones.

Megasporophyll.
Zamia: Longitudinal section of the ovule.
Mature female and male cones.
Taxua: Male and female cones.
Ephedra: Male strobilus
Ginkgo biloda: Leaves
Archegonia
Free nuclear stage.

ANSWERS

Drawings

LAB VI

Seed Plants II
Subdivision: Spermatophytina
B. Angiosperms

General Information

Angiosperms are the flowering plants. In angiosperms, the sporophyte has reached its greatest specialization, while the gametophyte has become greatly reduced. They are the dominant element of our land flora, and in number of species exceed all other green plants. Most angiosperm families are tropical in their distribution.

Angiosperms are subdivided into two subclasses thus; dicotyledonidae and monocotyledonidae. These subclasses differ from each other in a number of characters as will be demonstrated in this practical class.

Part A: Morphological and Internal structures of dicotyledonous root and stem

Materials:

- Water leaf plant
- Razor blade
- Wash glass
- Glass slide
- Microscope
- Cover slip
- Iodine solution

Procedure:

- Examine, draw and label the plant provided.

Make as many possible cross-section of the water leaf root and stem.

1. Place the sectioning of the root and stem into different wash glasses containing water.
2. Drop a drop of water on a clean glass slide.
3. Remove a piece of the section of the root.
4. Mount the section on a glass slide.
5. Add a drop of iodine on the mounted section.
6. Observe draw and label under low and high power objectives.
7. Repeat the procedure for the stem. Draw and label your observation.

Questions:

i. What are the differences between the transverse sections of the stem and the root.
ii. What are the similarities between the transverse sections of the stem and the root.
iii. Classify the specimen up to species level.

Part B: Morphological and Internal structures of monocotyledonous stem and root.

Materials:

- Young maize plant
- Razor blade
- Wash glass
- Water
- Glass slide
- Microscope

- Cover slip

Procedure:

- Examine, draw and label the plant provided.

1. Wash the roots of the young maize plant obtained.
2. Make transverse-section across the stem and across the root.
3. Examine them under the low power objective
4. Make drawings of your sections and label them

Questions:

i. Compare the internal structures of the monocotyledonous stem and that of the root. State the structure differences between the stem and root.

ii. Compare and contrast the morphlogical characteristics of the water leaf and maize plant.

iii. Classify the specimen up to species level.

ANSWERS

Drawings

A: Morphological and Internal structures of dicotyledonous root and stem

i. Differences between the transverse sections of the stem and the root:

Transverse section of the stem	Transverse section of the root

ii. Similarities between the transverse sections of the stem and the root

Transverse section of the stem	Transverse section of the root

iii. Classification of the specimen

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B: Morphological and Internal structures of monocotyledonous stem and root

ia. Differences between the internal structures of the monocotyledonous stem and the root:

Monocotyledonous stem	Monocotyledonous root

ib. Similarities between the internal structures of the monocotyledonous stem and root

Monocotyledonous stem	Monocotyledonous root

ii. Compareison of the morphlogical characteristics of the water leaf and maize plant

Morphology of water leaf plant	Morphology of maize plant

iii. Classification of the specimen

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LAB VII
Invertebrates

General Information

Invertebrates are animals without back bones. This is a very large group that includes several animals. Invertebrates like all other organisms are divided into groups based on certain distinguishing characteristics; cell layers and body cavities. The number of layers making up the body varies among the invertebrates. Two body layers as seen in Cnidarians- jelly fish and sea anemone and three body layers as seen in more advanced invertebrates- worms, mollusks, arthropods and echinoderms

Animals that possess three basic cell layers can be divided into groups based on the structure of their body cavity. Animals that lack body cavity are called acoelomates . Animals with body cavity that is only partially lined with mesoderm are called pseudocolomates while animals that have body cavity completely lined with mesoderm are called cooelomates.

In this investigation, you will examine the external features of some advanced invertebrates.

Part A. External features of invertebrates.

Materials:

- Tape worm
- Round worm
- Earth worm
- Land snail
- Hand lens
- Wash glass
- Forceps

Procedure:

1. Identify specimens A – D.
2. Make a well labeled diagram of the specimens and classify appropriately.

Questions

i. List three characteristics of worms.
ii. In which segment is the clitellum located in earthworm?
iii. What is the function of shell in snail?
iv. Classify specimens A – D up to species level.

Phylum Arthropoda

General Information

The phylum Arthropoda is made up of several different subphyla. Members of the phylum Crustacea include crabs. Iobsters, crayfishes and shrimps. The crustaceans are familiar as food sources. Cockroach and spider are members of the phylum arthropoda and class insect. The class insect contains more than 900,000 species which is about five times as many as in all animal groups combined. . Insects are mainly land animals that occupy almost almost every environmental habitat on land.

In this investigation, you will examine the external features of the arthropods provided.

Part B: Eexternal features of the Arthropods.

Materials:

- Cockroach
- Spider
- Prawn
- Centipede
- Hand lens
- Wash glass

Procedure:

1. Identify specimens A – D.
2. Make a well labeled diagram of the specimens and classify appropriately.

Questions:

i. Mention three characteristics of phylum Arthropoda
ii. What are the differences between specimen A and C?
iii. What are the differences between specimen B and D?

iv. Classify specimens A – D up to species level.

ANSWERS

Part A. External features of invertebrates.

Drawings

i. Three characteristics of worms.

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ii. The clitellum located in the …… segment is in earthworm.

iii. The function of shell in snail is

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iv. Classification of the specimen A

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Classification of the specimen B

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Classification of the specimen C

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Classification of the specimen D

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Part B: External features of the Arthropods.
Drawings

i. Three characteristics of phylum Arthropoda

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ii. Differences between specimen A and C

Specimen A	Specimen C

iv. Differences between specimen B and D

Specimen B	Specimen D

iv. Classification of the specimen A

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Classification of the specimen B

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Classification of the specimen C

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Classification of the specimen D

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LAB VIII
Vertebrates I

General Information

Vertebrates are animals that are more highly developed than the invertebrates. The vertebrates have complicated end more efficient systems. They have jointed skeleton made up of bones and cartilages. They have two pairs of limbs. Their body is bilaterally symmetrical. The vertebrates include five principal groups of mammals namely Pisces eg. Fish, Amphibians eg toad, Reptilian eg lizard, Aves eg. birds and mammals eg. Rabbit.

A. Pisces (Fishes)

Fishes are members of the phylum Chordata and subphykum vertebrata. The largest class of fishes, class Osteichthyes, contains fishes with skeleton made of bone. Fishes exhibit many adaptations for life in the aquatic environment. As such, they have striking physiological as well as anatomical features very special to them that aids their harmonious existence.

In this investigation, you will examine the morphological structures of members of the class pisces.

Materials:

Fresh preserved fishes (eg tilapia and cat fish)

- Hand or table lens
- Petri dishes
- Hand gloves
- Scalpels or knife or razor blade

Procedure:

1. You are provided with different fish specimens.
2. Examine the external features of the specimen.
3. Classify, draw and label each specimen.
4. Examine the tilapia or cat fish (*Clarics lazera*).
5. Remove a scale each from tilapia and cat fish and prepare a wet mount on a clean glass slide.
6. Observe under a microscope.
7. Make an enlarged diagram of each specimen.

Question:

i. What differences can you find between a bony fish and a cartilaginous fish?
ii. Classify the specimens up to their species level.
iii. List some adaptive features you observed.

B. Amphibians

External features of amphibians eg. Toad

General Information

Amphibians are animals that have adaptations for living in terrestrial as well as aquatic environments. Example toads and frogs. They possess various structural modifications to suit their mode of living. These include presence of webbed feet, as well as adaptable respiratory structures suitable for aquatic terrestrial life.

Materials:

- A freshly preserved frog or toad specimen
- Petri-dish/ dissecting tray
- Hand lens/ table lens
- Hand gloves

Procedure:

1. You are provided with fresh specimen of a toad and a frog.
2. Study carefully and make large labeled diagrams.
3. Determine whether your specimen is either male or female by their features.

Questions:

1. Make a list of the differences between a toad and a frog.
2. List their adaptive features.
3. Why is frog's egg laid in long gelatin fluid?
4. Classify toad to its species level.

ANSWERS

A. Pisces (Fishes)

Drawings

i. Differences between a bony fish and a cartilaginous fish

Bony fish	Cartilaginous fish

ii. Classification of the specimen A

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Classification of the specimen B

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iii. Some adaptive features observed

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B. Amphibians

Drawings

i. Differences between a toad and a frog

A toad	A frog

ii. Adaptive features of a toad or frog

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iii. Frog's egg is laid in long gelatin fluid

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iv. Classification of toad or frog

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LAB IX
Vertebrates II

General Information

Members of the class reptilia are called reptiles eg. Snakes, lizards, crocodiles etc. They are ectothermic (cold blooded). They are adapted for reproduction on land, mostly land dwelling, but some species spend much time in water.

Birds belong to the class Aves. They are endothermic or warm blooded vertebrates. All birds are descended from ancestors that are capable of flying, a number of modern birds cannot fly. Each type of bird has special adaptations that enable it to live successfully in its environment.

In this investigation, you will examine the external features of members of the class reptilian and aves.

Introduction:

Materials:

- Lizard
- Bird (Pigeon)

- Hand lens

Procedure:

- Examine carefully the specimens provided and notice the body shape, the body covering and the body division.

Questions:

i. Make a large fully labeled diagram of the specimens to show the external features.
ii. How are the lizards' feet adapted to life on land?
iii. The ability of the lizard to loss its tail and then regenerate a new one is a successful adaptation for the lizard? Yes/No. Give reasons for your answer.
iv. Classify each specimen from kingdom to the species level.
v. Make a list of structural adaptive features of each specimen and the significance of each structural feature.

ANSWERS

i. Drawings

ii**.** Adaptation of lizard's feet to life on land

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iii. The ability of the lizard to loss its tail and then regenerate a new one is a successful adaptation for the lizard? Yes/No.
Reasons
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iv. Classification of lizard
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Classification of bird
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v. List of structural adaptive features of each specimen and the significance of each structural feature

Adaptive features	Significance of the structural feature

Coordinator's Signature: ……... Date: …….

LAB X

Mammals (Rabbit/ Rat)

Morphological features of mammals

General information:

These are animals that have hairs/ fur covering their bodies. They are homoeothermic and have the most highly developed brain of all animals. This enable them to perform a wide range of complicated behaviours. Some mammals' behaviour are not learned while others are either learned or acquired through experience. Mammals give birth to their young ones alive.

Materials:

- Freshly killed animal/ preserved taxidermy of a Rabbit.
- Dissecting needles
- Sharp scalpel knife
- A pair of forceps
- Cotton wool and water

Procedure:

1. You are provided with a specimen of a small mammal.
2. Examine its external features.
3. Take note of the hair that cover the entire body
4. In the females notice the nipples and how many they are.

Question:

i. Draw and label the specimen fully.
ii. What important functions does the hair coat serve to the body of the mammal?
iii. List the characteristics and adaptive features of the mammal provided.
iv. Classify the animal to species level.

ANSWERS

Drawing

ii. Important functions of the hair coat to the body of the mammal

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iii. Characteristics and adaptive features of the mammal provided.

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iv. Classification of the specimen

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Coordinator's Signature: ……... Date: …….