

Chapter

1

The Living World

Introduction

How amazing is our nature!. And what makes it unique are living and non living things. The relationship between different organisms makes life on earth possible. Diversity among living organisms, ecological conflict and co operation among members of a population and among populations of a community make us think about life and its existence on earth. All living forms exhibit certain characteristics, normally referred as life features.

The learner is already aware of the local names of the plants and animals in their surroundings. This chapter gives an idea of what life is and scientific naming by introducing the hierarchy of classification and binomial nomenclature

Values and attitudes

- ❖ Develops a positive attitude towards nature and appraises its diversity.
- ❖ Recognizes their responsibility to give care and protection to various species in the ecosystem.



Concepts/ Ideas	Process/Activity with assessment	Learning outcome
<p>What is living</p> <ul style="list-style-type: none"> -Observing -Charting -Classifying -Communicating 	<ul style="list-style-type: none"> ☞ General discussion on the difference between Living and Non - living, observing the surrounding ☞ Video presentation on biodiversity. ■ Table regarding the difference between living and non living is prepared in the activity log 	<ul style="list-style-type: none"> ● Lists the difference between living and non-living.
<p>Diversity in living world</p> <ul style="list-style-type: none"> ➤ Nomenclature ➤ Classification ➤ Taxonomy <ul style="list-style-type: none"> -Charting -Observing -Inferring -Predicting -Classifying -Communicating. 	<ul style="list-style-type: none"> ☞ Video clips are shown to explain biodiversity. ☞ General discussion on Binomial nomenclature, and the definition of species. ☞ Field trips ■ Listing of scientific names of various animals in the activity log 	<ul style="list-style-type: none"> ● Identifies the common name and scientific names of organisms.
<p>Taxonomic categories</p> <ul style="list-style-type: none"> ➤ Kingdom ➤ Phylum ➤ Class <ul style="list-style-type: none"> -Observing -Identifying. -Explaining -Communicating 	<ul style="list-style-type: none"> ☞ General discussion using slide presentation. ☞ Flow chart showing hierarchy of taxonomic categories ■ Preparation of table showing taxonomic categories in activity log 	<ul style="list-style-type: none"> ● Identifies and Lists examples ● Prepares flow chart showing organisms with their taxonomic categories.
<p>Taxonomical aids</p> <ul style="list-style-type: none"> -Observing -Charting . -Communicating 	<ul style="list-style-type: none"> ☞ Discussion using Powerpoint presentation showing various taxonomical aids ☞ Discussion on key as a taxonomical aid. ■ Preparation of notes on various types of taxonomical aids in the activity log 	<ul style="list-style-type: none"> ● Lists the various taxonomical aids and explains its importance in identification and classification.

Through the Chapter....

CONCEPT : WHAT IS LIVING

- Growth
- Reproduction
- Metabolism
- Response to stimuli
- Cellular organization
- Self Consciousness

Suggested activity: General discussion

General discussion is conducted showing a slide presentation on the difference between living and nonliving.

Points to be discussed

- How do living organisms differ from non living with respect to their growth?
- How do different types of organisms produce their next generation?
- The food we consume is utilized for body building and energy production. How?
- What happens when intense light falls on our eyes?
- How is it that the living and non-living that are made up of the same molecules, differ each other?
- We don't place our fingers on burning candle flame, whereas a baby does. Why?
- What is life?
-

Consolidation

- Both the living and the non living grows, but growth is internal in living and external in non living.
- Living organisms reproduce by sexual and asexual methods.
- The sum total of all the chemical reactions in the body of living organisms is called metabolism.
- All living things respond to various stimuli.
- Cell is the fundamental unit of life.



- Animals and plants have consciousness, but man is the only self conscious animal.
- Life is a unique complex organization of molecules, which expresses through various metabolic reactions and leads to growth, reproduction, self regulation, response to external stimuli etc.
-

CONCEPT : DIVERSITY IN LIVING WORLD

- Nomenclature
- Classification
- Taxonomy

Suggested activity : General discussion

General discussion is conducted using slide presentation and video clips.

Points to be discussed

- Compare the abundance of life forms in the forest and the desert.
- What is the purpose of giving a unique name for a particular organism?
- How is an organism given a unique name?
- How can we overcome the problems created by including all organisms under the same group?
-

Consolidation

- The Living world is diverse.
- Nomenclature is the naming of organisms.
- Naming of an organism using the generic name and specific name is called binomial nomenclature.
- Grouping of organisms based on differences and similarities into different taxa or categories is called taxonomy.
-

☐ Table containing common names and scientific names of organisms are presented in activity log.

Assigned activity

Collect maximum number of scientific names of different animals.

CONCEPT : TAXONOMIC CATEGORIES

- Species
- Genus
- Family
- Order
- Class
- Phylum
- Kingdom

Suggested activity: General discussion

Showing a slide presentation on different species of organisms, the mentor initiates a general discussion on various taxonomic categories like species, genus, family etc.

Points to be discussed

- What is the lowest category of classification?
- Can you give the names of the higher categories?
-

Consolidation

- Group of individual organisms with fundamental similarities is called a species.
 - Based on similarities lower categories are grouped into higher categories like Genus, Family, Order, Class, Phylum and Kingdom.
 -
- Completed Table showing organisms with their Taxonomic Categories in activity log.

Assigned activity

Prepare a table showing taxonomic categories of any two animals.

CONCEPT : TAXONOMICAL AIDS

- Herbarium
- Botanical garden
- Museum
- Zoological park
- Taxonomic key



Suggested activity : Group discussion

General discussion using video presentation on various taxonomical aids.

Points to be discussed

- How can we make use of zoo botanical garden, herbarium etc for taxonomic study?
-

Consolidation

- Zoological park , botanical garden, herbarium, museum, taxonomic key etc are used as taxonomical aids.
- Activity log containing details of various taxonomical aids.

Assigned activity

- Prepare a herbarium of 5 different plants in your locality.

? Questions

1. In which of these organisms does growth, by cell division occur continuously throughout their life span.
a) *Musca domestica* b) *Homo sapiens*
c) *Mangifera indica* d) *Panthera leo*
2. The taxonomic categories of house fly are given in incorrect order. (muscidae - musca - arthropoda - insect - animalia - domestica - diptera)
Rearrange them in their ascending order.
3. Monkey, gorilla, gibbon and man are placed in the same order. Identify the order
a) Primata b) Carnivora
c) Diptera d) Hominidae
4. Find out the animal possessing self consciousness
a) *Musca domestica* b) *Homo sapiens*
c) *Panthera leo* d) *Felis domesticus*
5. Observe the relationship between first pair of word and suggest a correct generic name and specific epithet, write scientific name of two organisms suitable word for second pair

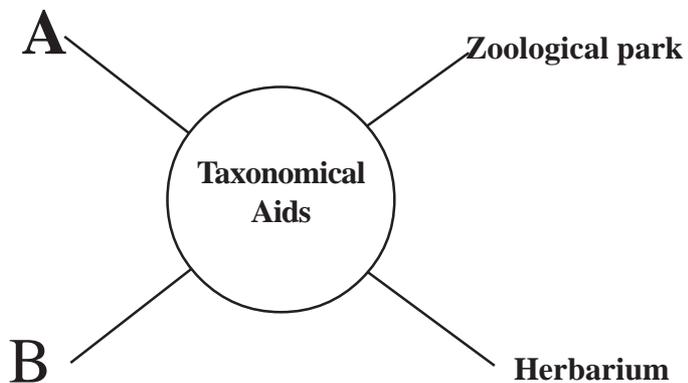
ICZN : International Code of Zoological Nomenclature

ICBN :

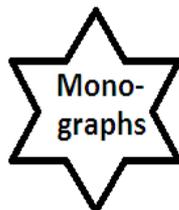
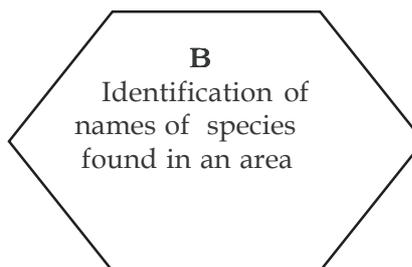
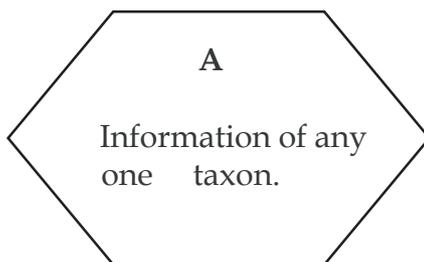
6 Two pools of generic name and specific epithet are given below.select th



7 Complete the following conceptual map with the missing link A and B



8 Match hexagons with stars corectly





Answer Key

Q.no	Value points	Split Score	Total Score
1	c	1+1	2
2	Arthropoda-Insecta-Diptera-Muscidae	¼x4	1
3	a	1	1
4	b	1	1
5	International code for Botanical Nomenclature	1	1
6	<i>Musca domestica</i> , <i>Panthera tigris</i>	½ each	1
7	A-Dried, pressed , preserved plants B Animals	½ each	1
8	A- Monograph, BFlora	½ each	1

Points to remember.....

Systematics and taxonomy

Systematics is derived from 'Systema' first used by Carolus Linnaeus. Systematics is a discipline of biology which deals with different kinds of organisms and the existing relationship amongst them by comparing the grouping of organisms at every level of classification from species to kingdom.

Taxonomy is the branch of biology that deals with identification, nomenclature, and classification of organisms.

Some Important Botanical gardens in South India

- Government Botanical Gardens, Ootacamund, Nilgiris district, Tamil Nadu
- IFGTB Botanical Garden - The Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore, Tamil Nadu
- Jawaharlal Nehru Tropical Botanical Garden and Research Institute (TBGRI), Trivandrum, Kerala (Biggest in India and conserves the largest number of plant species in Asia).
- Malampuzha Garden, Palakkad, Kerala
- Lalbagh, Bangalore, Karnataka
- Semmozhi Poonga, Chennai, Tamil Nadu
- Vellayani Agricultural College, Trivandrum, Kerala
- The Garca Branca Ayurvedic Botanical Garden, Loutolim, Goa.

Some Important Zoological parks and National parks in South India

- Amirthi Zoological Park, Vellore, Tamil Nadu
- Arignar Anna Zoological Park (Vandalur Zoo), Chennai, Tamil Nadu
- Chennai Snake Park Trust, Chennai, Tamil Nadu
- Madras Crocodile Bank Trust, Chennai, Tamil Nadu
- Kanpur Zoo, Kanpur, Uttar Pradesh
- Mysore Zoo, Mysore, Karnataka
- Parassinikkadavu Snake Park
- Thiruvananthapuram Zoo, Trivandrum, Kerala
- Thrissur Zoo, Thrissur, Kerala
- Periyar National Park, Kerala
- Eravikulam National Park, Kerala
- Silent valley National Park, Kerala
- Bandipur National Park, Karnataka



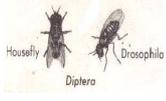
DICHOTOMOUS KEY TO INSECTS AMONG 10 ORDERS

INSECTS (Class Insecta) 3 pairs of legs

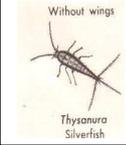
With wings

Without wings

Only one pair of wings



Two pairs of wings



Front and hind wings similar in texture

Front and hind wings different in texture

Wings and body not covered with scales

Wings and body covered with scales

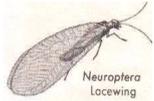


Front and hind wings similar in size and shape

Front and hind wings different in size



Body small or large, eyes large, wings much longer than body and held in a roof-like position over the body



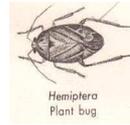
Body small (usually less than 1 cm), eyes small or no eyes at all



Body large, eyes very large (about half the size of the head)



Front wings hard, leathery, may have thin, clear edges. Mouthparts form a sucking tube.



Front wings long, narrow, leathery, with many veins. Hind legs may be long and folded for jumping



Front and hind wings broad. Front wings hard, without veins. When the insect is at rest, the front wings are held over the back and touch but do not overlap. Mouth parts for chewing



List of Some Latin and Greek Words Commonly Used in Systematic Names

Latin / Greek word	Language	English	Example
acutus	L	sharpened, pointed	American crocodile, <i>Crocodylus acutus</i> ;
archaeo-	G (arkhaios)	ancient	<i>Archaeopteryx</i>
arthro-	G (arthron)	joint	Arthropoda
branchia	LG (brankhion)	gills	Lamellibranchia (class, syn. Bivalva); Branchiopoda (class, brine shrimps)
corax	L corvus G (koraks)	crow, raven	common raven, <i>Corvus corax</i>
domesticus	L	house,	house sparrow, <i>Passer domesticus</i>
dino-, deino	G (deinos)	terrible	dinosaur, <i>Deinotherium</i>
echino-	L echinus G (ekhinos)	sea-urchin	diadema urchin, <i>Echinothrix diadema</i> ;
erectus	L	upright	<i>Homo erectus</i> (upright man)
familiaris	L	domestic, common	dog, <i>Canis lupus familiaris</i>
gaster, gastro-, gastr-	G	belly	common fruit fly, <i>Drosophila melanogaster</i>
hippo-	G	horse	seahorse, <i>Hippocampus</i>
haema-, hema	G	blood	Bacteria sps., <i>Haemophilus influenzae</i>
maculatus	L	spotted	Pearl spot ; <i>Etrophus maculatus</i>
octo-, octa-	G ὀκτα	eight	common octopus, <i>Octopus vulgaris</i>
sativus	L	sown, cultivated	pea, <i>Pisum sativum</i>
sapiens	L	wise	recent subspecies of humans: <i>Homo sapiens sapiens</i> ("very wise man")

Chapter

2

Animal Kingdom

Introduction

The beauty of the world is the diversity among organisms present in nature. We can observe various types of animals with different structures and forms. Since millions of species of animals have been identified, it becomes necessary to classify them and assign them to various systematic positions. It is also necessary to assign a systematic position to newly described species.

The learners are already aware of various organisms present on the earth and the diversity of life. They are also aware of the differences and similarities in the character of various organisms.

Values and attitudes

After completing the chapter the learner :

- ❖ Appreciates nature's diversity.
- ❖ Realises the importance of biodiversity the existence of life.
- ❖ Develops ecofriendly behaviour.



Concepts/ Ideas	Process/Activity with assessment	Learning outcome
<p>◆ Basis of classification</p> <p>■ Fundamental features</p> <ul style="list-style-type: none"> ➤ Levels of Organization ➤ Symmetry ➤ Diploblastic and Triplo-blastic condition ➤ Nature of coelom ➤ Segmentation ➤ Notochord <ul style="list-style-type: none"> – Observing, – Classifying, – Identifying – Communicating <p>→ Classification of animals</p>	<ul style="list-style-type: none"> ☞ General discussion using slide show of different types of coelom, symmetry, and segmentation. ☞ Slide presentation showing branching chart of Kingdom Animalia 	<ul style="list-style-type: none"> • Explains the fundamental features used for classification of organisms • Classifies and locates the position of animals among phylum
<p>■ Non-Chordata</p> <ul style="list-style-type: none"> ➤ Porifera ➤ Coelenterata ➤ Ctenophora ➤ Aschelminthes ➤ Platyhelminthes ➤ Annelida ➤ Arthropoda ➤ Mollusca ➤ Echinodermata ➤ Hemichordata <ul style="list-style-type: none"> – Observing, – Classifying, – Identifying – Communicating 	<ul style="list-style-type: none"> ☞ Discussion using slide presentation ☞ Field visit ☞ Collection of pictures and making picture album. 	<ul style="list-style-type: none"> • Compares the salient features of various phyla • Compares the different habit and habitat of various organism. • Differentiates the salient features of animals • Recognizes the adaptation of animals.

Concepts/ Ideas	Process/Activiy with assessment	Learning outcome
<p>■ Chordata</p> <p>➤ Urochordata</p> <p>➤ Cephalochorda</p> <p>➤ Vertebrata</p> <ul style="list-style-type: none"> • Agnatha <ul style="list-style-type: none"> Class Cyclostomata • Gnathostomata <p>Superclass Pisces</p> <ul style="list-style-type: none"> Class Chondrichthyes Class Oestechthyes <p>Superclass Tetrapoda</p> <ul style="list-style-type: none"> • Amphibia • Reptilia • Aves • Mammalia <ul style="list-style-type: none"> — Observing — Classifying — Listing — Communicating 	<p>☞ Discussion using video presentation</p> <p>☞ Collection of pictures and making picture album.</p> <p>☞ A field visit to a Zoo , Aquarium or Sea shore</p> <p>☞ Visit to a Bird Sanctuary, Snakepark, Museum</p>	<ul style="list-style-type: none"> • Compares the charecters present in different classes of Phylum Chordata. • Differentiates the salient features of various animals. • Recognizes the ad-aptations seen in chordates.



Through the Chapter.....

The mentor exhibits pictures of the most familiar organisms of four groups like insects, fish, birds, mammals etc. Asks them to prepare a table of more animals which are related to each cited animals.

Points to be discussed

- Why do you enlist various animals into various categories ?

Consolidation

- Animals are classified on the basis of certain fundamental features.

CONCEPT : Basis of classification

- Levels of organizations
 - Open and closed circulatory system
- Symmetry
- Diploblastic and triploblastic organisms
- Nature of coelom
- Segmentation
- Notochord

Activity suggested: General discussion

A general discussion is conducted using a slideshow on fundamental features

Points to be discussed

- Which are the levels of organization?
- How can we classify organisms based on the arrangement of external organs around the central axis of the body?
- How are organisms grouped based on primary germ layers.
- Name the space in between the body wall and the alimentary canal and classify animals based on this.
- Compare the external appearance of the earthworm and ascaris. (projected pictures)
- Which structure in our body helps to stay in an erect posture?
-

Consolidation

- Animals show various levels of organization- cellular level, tissue level and organ system level.

- Types of circulatory system
 - open and closed circulatory system
- Symmetry is the arrangement of similar body parts on either side of a central axis
- Based on symmetry animals are of 3 types - asymmetric, radially symmetric and bilaterally symmetric
- Based on primary germ layers, organisms are classified into Diploblastic and triploblastic
- In higher organisms, a cavity is seen between the body wall and alimentary canal called coelom- acoelom, pseudocoelom and true coelom.
- Body of certain groups of animals shows true segmentation (metamerism).
- Body of animals are kept in erect posture by vertebral column which is developed from a structure called notochord.
-

CONCEPT: Classification of Animals

- Non - Chordata
- Chordata

Activity suggested: General discussion

A general discussion is conducted using slide presentation of classification. Fundamental characters are cited with examples.

Points to be discussed

- How are animals classified based on the fundamental characters ?
-

Consolidation

- Animals are classified into different phyla based on their fundamental and structural features.
-



CONCEPT : Classification of Non Chordata

■ Non-Chordata

- Porifera
- Coelenterata
- Ctenophora
- Aschelminthes
- Platyhelminthes
- Annelida
- Arthropoda
- Mollusca
- Echinodermata
- Hemichordata

Points to be discussed

- What are the salient features of Phylum Porifera, Coelenterata, Ctenophora, Aschelminthes, Platyhelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata.?
- Identify the invertebrate animals with parasitic characters among invertebrates.
- List out the economically important animals among annelida, arthropoda and mollusca etc.
-

Consolidation

- Porifera (sponges) are with the cellular grade of organization, water canal system - ostia, spongocoel, osculum - choanocytes, skeletal structures like spicules. Exhibit asexual and sexual reproduction, hermaphrodites and development is direct.
- Coelenterates (Cnidaria) are animals with tissue grade of organization, diploblastic. Coelenteron as gastrovascular cavity, special cnidoblast cells. Exhibits polymorphism and alternation of generation (metagenesis). Development indirect.
- Ctenophores are exclusively marine with comb plates and are bioluminescent.
- Aschelminthes are round worms, freelifving (aquatic and terrestrial) or parasitic in plants and animals. bilaterally symmetrical, triploblastic and pseudocoelomate. Possess muscular pharynx. Sexes separate, Females larger than males. Fertilisation is

internal , development may be direct or indirect.

- Platyhelminthes are animals with the organ grade of organization, triploblastic, acoelomates, bilaterally symmetrical with flame cells for excretion, hermaphrodite with parasitic adaptation.
- Annelids are true coelomates, with metamerism, excretory organs are nephridia, parapodia freelifing and parasitic forms and are economically important.
- Arthropods (largest phylum) have jointed appendages, chitinous exoskeleton with body divisions, respiration by gills, book gills, book lungs or tracheal system, open type of circulation, excretion with malpighian tubules. Economically important. **Examples** include insects, vectors, pests, living fossils
- Mollusca is the second largest phylum, aquatic or amphibious mode of life, body with head, visceral mass and foot, possess external calcareous shell, possess mantle cavity and rasping organ - radula.
- Echinodermates are exclusively marine, radially symmetrical adult, possess watervascular system which helps in locomotion, capture of prey and transport of blood, development indirect with bilaterally symmetrical larvae.
- Hemichordates are marine worm - like organisms with cylindrical body having proboscis, collar and trunk, circulation is open type, respiration through gills, excretion by proboscis gland, development direct.
-

Activity log containing salient features of non chordates, list of harmful and beneficial animals, and list of animals with parasitic adaptations.

Assigned activity

Prepare a picture album containing animals coming under non - chordata

CONCEPT : Classification of Chordata

- Urochordata
- Cephalochordata
- Vertebrata
 - Agnatha
 - Class cyclostomata
 - Gnathostomata
- Superclass Pisces



- Class Chondrichthyes
- Class Osteichthyes
- Superclass Tetrapoda
 - Class Amphibia
 - Class Reptilia
 - Class Aves
 - Class Mammals

Suggested activity : General discussion

A general discussion is conducted using a slide presentation, videoclips, charts and pictures.

Discussion points

- What are the salient features of chordates?
- How can we classify chordata?
- Which are the classes and subclasses of vertebrata?
- How are pisces adapted for their aquatic life
- Why are amphibians, reptiles, aves and mammals called tetrapods?
- Tetrapods have various characters for their mode of life. List out the characters of different classes of tetrapods.
-

Consolidation

- Chordates are animals with notochord, dorsal tubular nerve cord, Paired pharyngeal gill slits, Post anal tail and ventral heart.
- Phylum Chordata is subdivided into 3 subphyla - Urochordata, Cephalochordata and Vertebrata based on notochord.
- Vertebrates are divided into 2 groups Agnatha and Gnathostomata.
- Agnatha are jawless vertebrates eg. Petromyzon, Myxine.
- Gnathostomata are divided into Superclass Pisces and Superclass Tetrapoda
- Superclass pisces are divided into Class Chondrichthyes and Class Osteichthyes. They have streamlined body, 2 chambered heart, Poikilotherms and sexually dimorphic.
- Chondrichthyes are exclusively marine with persistent notochord, Possess ventral mouth, gill slits without operculum, placoid scales and heterocercal caudal fin present. Without airbladder

- Osteichthyes have bony exoskeleton, four pairs of gills with operculum, cycloid and ctenoid scales, airbladder present and exhibit external fertilization.
- Tetrapods are chordates with 2 pairs of limbs - Amphibia, Reptilia, Aves and Mammals.
- Amphibians - body divided into head and trunk, skin moist. Tympanum exposed, cloaca present. Respiration by skin, gills and lungs. Heart 3 chambered. Fertilization external, indirect development.
- Reptiles are terrestrial poikilotherms. Heart usually 3 chambered (in crocodile it is 4 chambered.) Scales/ scutes present. Tympanum exposed, Fertilization internal, Oviparous, Direct development. Eg Lizards, Snakes, Turtles, Tortoises, Crocodiles etc.
- Aves - homeothermic with flight adaptations, Crop and gizzard present. Air chamber is present along with lungs, Completely four chambered heart present, Fertilization internal, oviparous.
- Mammals are cosmopolitan in distribution with mammary glands. Body covered by hair, Ear pinnae present Different types of teeth are seen. Eg. Ornithorhynchus, Macropus, Pteropus, Felis, Elephas, Equus, Panthera etc.

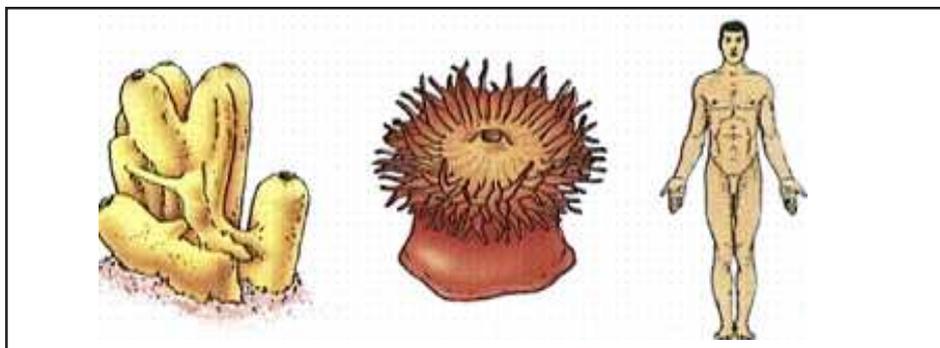
• Activity log containing consolidation of Phylum Chordata, branching chart showing the classification of chordata.

Assigned activity

1. Prepare a picture album showing various examples of Phylum Chordata.
2. Prepare a table showing salient features of different phyla in the animal kingdom.

**Questions**

1



Identify the types of symmetry in the above animals.

2. Following are the unique features of some phyla/ class. Identify the phyla/class.
 - a) Body divided into head, thorax and abdomen.
 - b) Body divided into head collar and trunk with proboscis and proboscis gland
 - c) Body divided into head and trunk.
3. Match columns A, B and C

A	B	C
Feature	example	Product / use
1 Presence of nephridia	Scoliodon	Silk
2 Calcareous shell	Bombyx	Pearl
3 Joint footed	Pinctada	Vermicompost
4 Streamlined body	Pheretima	Edible

4. Which among the following is the correct pair ?
 - a) *Pteropus* - Rat
 - b) *Macropus* - Monkey
 - c) *Balaenoptera* - Blue whale
 - d) *Ornithorynchus* - Dolphin
5. Select the wrong statements.
 - a) Flat worms are triploblastic and pseudocoelomates.
 - b) Amphibians are homeotherms without scales.
 - c) Echinoderms are exclusively marine with water vascular system.

- d) Hemichordata are marine with open type of circulation.
A) a only B) a and d C) a and b D) c and d
6. Read the following features of organisms, categorise them under appropriate headings.
(3 chambered heart, presence of ear pinnae, moist skin, 2 chambered heart, wings, pneumatic bones, body hair, completely aquatic, body with head and trunk)
7. Pick out the wrong pair .
- Porifera - Spicules
 - Coelentrata - metameric segments
 - Annelida - Nephridia
 - Arthropoda - Malpighian tubules
8. Which of the following is not an amphibian?
- Salamander
 - Tortoise
 - Toad
 - Frog
9. In which of the following phyla did true coelom appear first in the course of evolution.
- Echinodermata
 - Annelida
 - Chordata
 - Aschelminthes
10. Absence of excretory organs, great power of regeneration and exclusively marine are characters of the phylum
- Mollusca
 - Echinodermata
 - Fishes
 - Arthropoda
11. Distinguish poikilotherms from homeotherms with examples.
12. List five different excretory organs present among animals.
13. *Pila globosa*, Fresh water mussel, Earthworm, Man, *Petromyzon* *Balanoglossus*. Categorise them according to the type of circulation
14. With regard to the evolutionary significance adult echinoderms are primitive than their larval forms. Give reason?



SCORING KEY

Q. No	Value Points	Split score	Total score
1.	a. Can't be divided into two equal halves in any plane b. Can divide into two equal halves in only one plane c. Can cut through the axis at any point (makes two equal halves)	1 1 1	3
2.	a. Arthropoda b. Hemichordata c. Amphibia	½ ½ ½	1½
3.	1-4-3 2-3-2 3-2-1 4-1-4	1 1 1 1	4
4.	c. Balenoptera-Blue whale	½	½
5.	A&B	½	½
6.	Class Pisces-2chambered heart, completely aquatic Class Amphibia-3 chambered heart, moist skin, body with head and trunk Class Aves-pneumatic bones, wings Class Mammalia-presence of ear pinnae, body hair	1 1 1 1	4
7.	b. Coelenterata-metameric segmentation	½	½
8.	b. Tortoise	½	½
9.	b. Annelida	½	½
10.	b. Echinodermata	½	½
11.	Poikilotherms: Cold blooded animals whose body temperature varies according to the surrounding temperature. eg. Pisces, Amphibians, Reptiles Homeotherms: Warm blooded animals with constant body temperature. eg. Birds, Mammals	1½ 1½	3
12.	Nephridia (Earthworm), Green glands (Prawn), Proboscis gland (Balanoglossus), Malpighian tubules (Cockroach), Kidney (vertebrates including man)	½ ½ ½ ½ ½	2½
13.	Open circulatory system: Pilaglobossa, fresh water mussel, Balanoglossus Close circulatory system: Earthworm, Petromyzon, Man		
14.	<i>Open text question</i>		