RASHTRIYA MADHYAMIK SHIKSHA ABHIYAN, KARNATAKA
SUBJECT TEACHER FORUM – SCIENCE

RESOURCE MATERIAL ON ORGANISMS

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and

UNICEF - Hyderabad

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"This resource material has been put together as a learning document for Karnataka high schools, as a part of the Subject Teacher Forum initiative of the Rashtriya Madhyamik Shiksha Abhiyan, with support from Public Software Centre, IT for Change. This is meant to be used as a teaching learning document by teachers and is, therefore, broader in its scope than a text book on the subject. Many sections of the materials have been compiled from readings of standard textbooks, conversations with subject experts and freely available information on the World Wide Web – http://rmsa.KarnatakaEducation.org.in . Wherever possible and known, we have acknowledged the sources. In the spirit of collaborative creation of digital learning resources by practising teachers, we welcome comments and suggestions, ideas to augment and improve this resource material. Any queries on the resource material can be sent to subjectteacherforum@karnatakaeducation.org.in

Acknowledgements

The following textbooks have been used for reference for Science:

1. Conceptual Physics, Paul Hewitt, 10th Edition
2. Physics for Scientists and Engineers, Douglas C. Giancoli, 3rd Edition
3. Resnick & Halliday with Jearl Walker, 8th Edition
4. LIFE – An Introduction to Biology, William S Beck, Karel F Liem, George Gaylord Simpson, 3rd Edition
5. NCERT textbooks

Publisher - Rashtriya Madhyamik Shiksha Abhiyan, with support from UNICEF

Public Software Centre, IT for Change, has participated in this program with support from UNESCO.

Note from the desk of the State Project Director, SSA, Karnataka.

Rashtriya Madhyamik Shiksha Abhiyaan (RMSA), Karnataka is happy to pilot the innovate Subject Teacher Forums programme for high school teachers. Teachers need a community of peer practitioners for continuous learning and professional development. Providing such an experience only through physical interactions and meetings has its challenges because of the geographical spread and the classroom responsibilities of the teachers. Therefore a digitally enabled community of learners allows for continuous collaboration and networking that makes self and peer learning a reality. This will be a very effective compliment to the physical forums.

The government has provided good hardware infrastructure through the ICT Phase 1 and 2 programmes and is now going to cover all high schools through the ICT Phase 3 programme. By making teachers digitally knowledgeable the computers can be utilised in the most optimal way to enhance teaching learning for the teacher as well as her students.

Excellent computer-aided educational tools that are free to download are available for teachers to enrich their own understanding as well as innovate new methods for teaching difficult concepts. The teachers with their rich experience of the subject and pedagogy are best equipped to use these tools to their full potential. This also enables teachers to create resources in the local context and language to share with new teachers who are entering the system.

Note from the desk of the Director, RMSA, Karnataka

Rashtriya Madhyamik Shiksha Abhiyaan (RMSA), Karnataka in order to improve the quality of teaching-learning in high school classrooms is piloting a new programme that will enable teachers to become digitally knowledgeable. This is to promote the effective use of ICTs provided by the ICT Phase 1 and 2 programmes in the government high schools. Through this programme teachers will start creating open resources that are free to share, and modify thus enabling them to integrate ICTs into the regular curriculum teaching and learning.

A web portal has been created for all teachers to access the created resources and have links to external resources. The vision of this portal is to enable teachers to blog , discuss and share their ideas, resources they create and their concerns to promote deeper understanding of their subject, as well as enable teachers to participate at a systemic level thus enabling decentralisation.

The teachers have also attempted to look at their subject teaching in different ways by engaging extensively with the recommendations of the National Curriculum Framework , 2005 and familiarising themselves with new methodologies that include new skills needed in the information society. The teachers have put together digital resource material in various themes from the above learnings. This is the first draft of the material that they have created.

RMSA, Karnataka is happy to take support from UNICEF as well as Public Software Centre, IT for change (supported by UNESCO) for this programme.

Goals of the Subject Teacher Forum

Our main objective is to strengthen subject matter expertise amongst teachers and increase the range of curricular resources available to teachers for use in their classroom transactions. From our previous research and field work we believe that there are two core areas that need to be addressed to enable deepening of subject knowledge among high school teachers.

Subject Matter Expertise

One, teachers need to be made aware and gain understanding on the usage of many new and innovative resources and tools that are available. A rich variety of teaching-learning as well as informational resources are already available on the internet. Apart from this technology based educational tools are more and more being used in educational institutions world over. These tools enable teachers to create their own lesson plans integrating the local context and the syllabus thus allowing them to innovate different methods for teaching specific topics enriching their own professional expertise. The interactive nature of the tools also help teachers become constructive learners thus enhancing their own subject knowledge. This in turn helps them use constructivist pedagogical practices while teaching children in classrooms, which is the way forward as suggested by the National Curriculum Framework 2005 (NCF 2005). Overall the combination of having knowledge on how to use these tools, combined with the teachers subject knowledge and his/her knowledge of the local context makes these tools very vibrant and powerful resources for the teachers for transacting the curriculum.

Subject Teacher Networks

Two, lately we are seeing that the models of teacher forums that conform only to physical meetings at regular intervals, in the current context of a knowledge and information society are becoming inadequate. There is a requirement in this context to understand education and teaching learning both locally and globally at the same time. The teachers would gain much more benefit if they are able to regularly network to share and exchange ideas, news and issues regarding their work. Fortunately the current digital communication technologies make this possible. With the internet, communication has become faster and easier. For the teacher forums to enable maximum impact, they need to be able to communicate and network with each other in a non-hierarchical manner. Decentralisation is what SSA also believes is the way forward. Non-hierarchical networks, that can be created online via the internet make this a reality. Also the teacher will be better able to participate and provide inputs outside the school walls at a larger systemic level via these networks, providing valuable feedback for educators to enhance current plans and also address future plans and projects in effective ways. In order to make this a reality, teachers require access to a computer, internet connectivity and develop skills to email, blog, use discussion forums, share, and access resources.

Creation/Review Process of Local Digital Resources - IT for Change Note

As one of the objectives of the subject teacher forum indicates, our aim is to enable creating resources by the teachers, as they are most equipped with the knowledge of the subject, local context and their students. In this effort, resources have been created by the teachers based on a template provided. Public Software Centre, IT for change also created four prototypes, two in science , one in social science and one in mathematics covering the following topics : Measurement, Light, Bhakti Movement and Fractions.

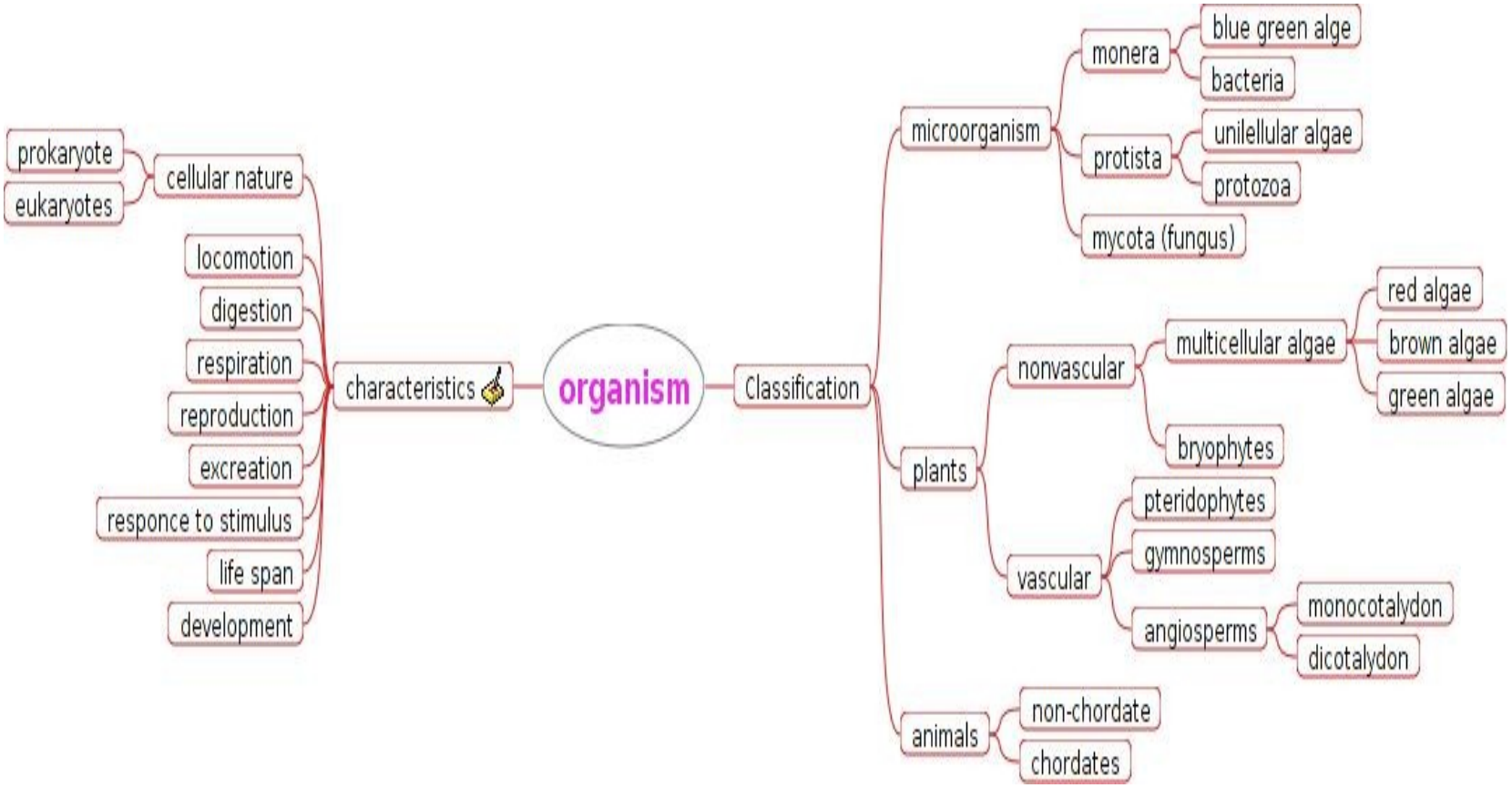
As this was the first time many teachers were exposed to creating digital resources, the quality of these resources may still require refinement and improvement, which will happen in an iterative manner. The teachers need to become much more confident users of technology to produce high quality resources. But what is important to take from these resources is the teachers understanding of the subject and how they envision teaching these topics to their students given their classroom context.

Recognising these resources as documents that are work in progress , IT for Change would like to bring to notice the following aspects while reading these resources

- Resources written in Kannada have not been reviewed by IT for Change
- The background material in the resource books are, in most cases not completely and coherently binding to effectively cover the entire theme.
- A lot of the material sourced from the world wide web, while basically informative of the theme have not been revised to suit the local context - both in terms of language and content.
- IT for Change, in most cases have left the teachers contributions to the background material as-is, if the content was relevant to the theme and only in a few cases re-written some parts.

Table of Contents

Concept Map


organism
characteristics
cellular nature
prokaryote
eukaryotes
locomotion
digestion
respiration
reproduction
excreation
responce to stimulus
life span
development
Classification
microorganism
monera
blue green alge
bacteria
protista
unilellular algae
protozoa
mycota (fungus)
plants
nonvascular
multicellular algae
red algae
brown algae
green algae
bryophytes
vascular
pteridophytes
gymnosperms
angiosperms
monocotalydon
dicotalydon
animals
non-chordate
chordates

Syllabus

Class 6th	7th	8th	9th	10th
Diversity and classification of Living Organisms	-	Types of Classification of Living Organisms	Multicellular Organisms- Characters and Classification -Invertebrates	Classification of Higher plants and animals

Scope of this document

The text books are revised on the basis of National Curriculum Framework (NCF) 2005 at all levels in India. The NCF has prepared five guiding principles for curriculum development:

1. connecting knowledge to life outside the school
2. ensuring that learning shifts away from rote methods;
3. enriching the curriculum so that it goes beyond textbooks;
4. making examinations more flexible and integrating them with classroom life;
5. and nurturing an overriding identity informed by caring concerns within the democratic polity of the country.

NCF 2005 Science Position paper emphasizes on activity -based teaching, Inquiry -based approach, Learning by doing, Project-work, Research , field visits and experiments which helps in experiential learning. Often however there remains a gap between the generally agreed objectives of the curriculum and their actual translation into textbooks and teaching practices.This resource material is an attempt to close this gap as much as possible. Extra knowledge and abstract ideas are focussed along with innovative and child- centered activities.

What does it contain?

This resource book contains the resources helpful for Science teachers of Std 6th to 10th for the topic of organisms. This gives extra informations about Organisms and various methodologies that can be implemented during teaching-learning process. There are links of web sites, videos and audios of

various interesting activities which will be helpful for teachers and students.In this resource material, importance is given to (a) content, (b) methodology and (c) continuous and comprehensive evaluation.

How can teacher use it?

The teachers of any class can go through this resource on Organisms. The students are learning about various organisms from lower classes only. As they proceed to higher classes, the subject content is more deeper and comprehensive. If teacher clicks on the web link given, he/she can collect extra information of his/her desired sub themes of the topic- organisms. This helps in building content knowledge. For each sub theme, many variety of activities (online and offline) are framed. These teaching methodologies help in enhanced learning among students. The teachers also has to prepare for the lessons, activities and for structuring evaluation processes.

Preparation for teachers

Teachers need to prepare at multiple levels for teaching any content. This will include identifying learning objectives, detailing methods of the activity/ lesson and structuring evaluation processes. Teachers have to take trouble of planning the teaching -learning process earlier to the class- room transaction and keep the materials ready for teaching before hand. There are also activities for continuous and comprehensive evaluation (CCE) which guide teachers to assess the students . There are several components to evaluation also - evaluation for a lesson or experience, evaluation of student understanding of the topic and self evaluation for the teachers. Before we get into evaluation, it may be useful to look at some guidelines for teachers while planning a class or an activity.

Planning an activity

1.Identify what are the learning objectives to be met using the activity.

2.Try out each activity for yourself beforehand. Check the working of audio-video aids.

3. Spend some time in the previous lesson explaining what the students are going to do and what material they might need to bring from home.

4. Plan how the class will be organised - at their seats or working in groups; inside or outside the classroom.

5. Before starting on the activity make sure all the students understand what they will be doing, and why. Give the students time to ask questions.

6. (For outdoor activities) Before going outside, explain what the students will do outside,where they should and should not go, and when they should return.
7. Let students work independently as much as possible, while you concentrate your attention on the slower students or those who need encouragement.
8. Keep to certain routines in the classroom so that students know what kinds of things they are expected to do. For example, set up a system whereby students clean up the place after the activity.

Evaluation format

The following is one suggested format for evaluation. Based on the unit, class and activities, teachers can design evaluation formats based on these principles.

Parameters for evaluation

There are several parameters for evaluation including participation in the lesson, understanding of concept and content and the development of skills. The following are some of the pointers that teachers can use for evaluation.

1. **Observation (Ob)** : Teachers should observe the student's participation and involvement in classroom and outdoor activities. That is enthusiasm in doing activities, patience and concentration of the students. And grade can be given.
2. **Understanding** of the concept can be measured by-
   a) Oral work (Or) – Answering to questions and asking questions to other students or to the teacher. This can be through discussion or explanation.
   b) Written work (Wr) : Clarity in reporting observation of activities , project work, discussions, assignment etc. The written work can be extended to include non-textual work and this can include ICTs.
3. **Designing Skills (DS)** : Assessment of design skills should include both the 'planning' and the 'doing' parts of manual activities. These activities include drawing, handling plants and animals as well as tools and equipment, seeing the connection between a material and its uses, constructing, measuring and plotting graphs and charts.
4. **Independent Thinking (IT) :** Is the student able to extend the learning and come up with original ideas?
5. **Co-operation with other students(Co)** Able to consider the ideas of other students

and to work in a group.

6. **Completion of home assignments (HA**) – Is the student able to complete home assignments on time.

Teachers might give grades of A, B, C, D, or E for each assessment box in the Unit,according to the activities done. and then calculate the average for each category. To calculate the average, the number equivalent of the grades can be used (A = 4, B = 3, C = 2, D = 1, E = 0). Write this grade in the box for the category on that page.• After completion of the Unit find the average score on each category over the whole Unit. Write this score in the Unit Assessment Sheet. The grades on all the categories in the four Units can be averaged to give a final grade for the year.

Activity Assessment Sheet

No	Name of Activity	GRADE									
		Ob	Or	Wr	DS	IT	Co	HA	Total	Average	grade
1	Characteristics of Living Organisms. (Gp.Work)	A	C	B	C	C	A	A	4+2+3+2 +2+4+4 =17	17/ 7=2.42	C
	Total Grades										

Notes

This guideline is for assessment of activities done during teaching-learning process . (Ref. Small Science – A Series of Primary Science Class 4 Teacher's Book Dev. By Homi Bhabha Centre for Science Education) . It helps in continuous and comprehensive Evaluation as per NCF 2005 and also for unit test where both practical and theory tests are considered. (NCF2005 recommends practical exam at secondary school level also).

What are living organisms – an introduction

Raksha and Tilak had visited many places with their parents during vacation. During their stay in grandparents house in Ankola, they could visit sea shore, and collected sea shells. They saw variety of fishes, crabs, aquatic plants, mountains nearby with plants of different structures and shapes. They

also saw thick forests on their way to their uncle's place -Dandeli. In another trip to Rajasthan, they came across very less plants and the structure of these plants were different compared to plants in their native place . They traveled on camel on hot sand and collected various cactus plants. They felt very hot in this area. But during their visit to northern part of India, they felt very cold, and found trees with very thin leaves and also the animals here were different . They wondered and discussed about the various living beings they came across during their travel. They were more surprised when they saw small creatures like spider and silver fish between books in their cupboard. Raksha started thinking why so many varieties of living beings are there on this earth? and started collecting information of these living beings. These are called organisms. She found that there are tiny organisms also and all these living creatures are grouped by different scientists on the basis of their habitat (place they are found), their shapes structure and functions. She started to ask more questions about the organisms and discussed with her brother Tilak and also with elders about diversity of living organisms on this earth. Her teacher told her that she cannot understand all the types of organisms, their classification , structure and functions at a stretch and as she proceeds to higher classes she can study in detail about them.

With a narrative like this, the teacher can develop a lesson using the inquiry-based approach. Some of the questions that could guide this inquiry are:

1. There are many living things around us. Are they all alike? Do you find them only on land?
2. Which are the places they grow? What are these living creatures called ?
3. How are they different from non-living things?
4. How do these living things interact with non-living things and each other?
5. What is the behavior of each of these?
6. How do they grow in size? How do they become more or less in number?

Classification of organisms

In this section we will explore the following key concepts:

1. What are the characteristics of organisms?
2. How can we study organisms?
3. What are the similarities and dissimilarities?
4. What are the methods of studying organisms?

Organism and its characteristics

There are common features of organisms:

- All organisms reproduce
- There are patterns of responsiveness and behavior
- There are geographic areas in which organisms live
- Organisms try to maintain order through self regulation

An organism is any contiguous living creature which is capable of breathing, response to stimulus, reproduction, excretion, growth and development and maintenance of homeostatis as a stable whole. An organism may be unicellular (single celled) or multi cellular(many cells). The surrounding where the organisms live is called habitat.

Activity 1: Characteristics of Living Beings

Objectives

1. To observe and record characteristics of living beings (this topic is already introduced in lower classes)
2. To develop skills of observation and classification

Method

1. Group work
2. Materials required: Pen and work sheet (Note book).
3. Time Required: 30 Minutes.

Procedure

Divide the students into 3 groups. Ask group1 to write the characteristics of living organisms, group 2 to discuss similarities between plants and animals and group3 to list differences between plants and animals, by discussing with their group members. Next allow one member from group 1 read loudly what they have written. Let other group members ask questions to group1 related to what is read. They can even add more information .Similar procedure can be followed with group 2 and 3.

Additional web resources

1. To know more visit http://en.wikipedia.org/wiki/Organism
2. http://www.blueplanetbiomes.org/rnfrst_animal_page.htm

Diversity in organisms and their classification

Every organism whether plant or animal is unique in itself. There is a wide diversity in the flora (plants) and fauna (animals) in the world. The diversity we see today is the result of 3.5 billion years of organic evolution. During the course of this evolution several species vanished from the surface of the Earth and became extinct. It is estimated that more than fifty times the existing species have become extinct. With such a vast number of organisms - both living and extinct, it becomes impossible to study every one of them at individual level. This task of studying the diversity of living organisms can be made easier and more effective if the various organisms are arranged in an orderly manner. Classification is one such method of studying living organisms in a systematic manner. By making a comparative study and assorting the similarities and differences amongst the various varieties of species, organisms can be classified into groups or sets. Systematics is the study of the diversity of organisms with their environments.

Diversity of Organisms: The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems. This is also called biodiversity. All living things are identified and categorised on the basis of their body design in form and function. Some characteristics are likely to make more wide-ranging changes in body design than others. Characteristic is a particular form or a particular function.

Activity 2: Diversity in organisms

Objectives

1. Understand about the variety of animal and plant life through direct observation, activities and by using secondary sources like videos, pictures,etc.
2. To develop skills of recording and classification

Method

1. Nature of Activity: pair work

2. Materials required: Pen and work sheet (Note book)
3. Time Required: 30 Minutes.
4. Video-clippings

- http://www.youtube.com/watch?v=90XU0B_ya6g&feature=related
- http://www.youtube.com/watch?v=WuejxJttBqo&feature=related
- http://www.chilika.com/chilika_video_gallery.htm
- www.youtube.com/watch?v=IW23Qhg2v-0

Procedure (part 1):

Teacher tells students to compare their nose , hair, and eye with their friend's and find differences in size and colour. To compare horse with donkey, monkey and gorrilla. What similarities are found between these animals? Which two animals can be grouped as having common characteristics? What is the basis of our identification? In this activity, we had to decide which characteristics were more important in forming the desired category. Now, think of all the different forms in which life occurs on earth. Watch the video-clippings and the various kinds of animals that live there.

Procedure (part 2):

Time required : 30 minutes

Give instruction to students to watch the video/ pictures carefully and to make notes on what they observed and listened. Students must now make a list of animals and plants which have similar structure, shape and size. And their differences. Encourage students to identify unfamiliar plants/ animals or new words while watching video-clippings/ photos/ pictures etc. and raise their hands to ask for meaning, definition etc.

Discussion questions

- What do we mean by an ecosystem? What are the characteristics you saw in the ecosystem? What processes were seen there?
- Will similar processes and characteristics of organisms be found in other systems?
- Are living organisms machines?
- Why do you think there are so many differences? What might have been the processes that caused this diversity

Additional web resources

www.edu.gov.nf.ca/division/stsuppsv/Junhigh/grad9sci.pdf
This is a reference document for planning a unit on diversity of organisms.

Methods of classification

Classification is a grouping of organisms, (plants or animals) in different ranks on the basis of their characters. Systematics is the study of organisms based on the interactions with the environment. **Systematics**(systema - order) - The camparative study of organisms on the basis of morphology, anatomy, ecology, physiology, biochemistry etc. is known as **systematics.** Systematics have three fields (i) Nomenclature (ii) Classification (iii) Taxonomy. **Taxonomy** (Taxis - arrangement, nomous = law / rule) is the branch of biology for the study of classification of organisms following certain rules or principals.

What is the Basis of Classification?

Attempts at classifying living things into groups have been made since time immemorial. Greek thinker Aristotle classified animals according to whether they lived on land, in water or in the air. This is a very simple way of looking at life, but misleading too. For example, animals that live in the sea include corals, whales, octopuses, starfish and sharks. We can immediately see that these are very different from each other in numerous ways. In fact, their habitat is the only point they share in common. This is not an appropriate way of making groups of organisms to study and think about. We therefore need to decide which characteristics to be used as the basis for making the broadest divisions. Then we will have to pick the next set of characteristics for making sub-groups within these divisions. This process of classification within each group can then continue using new characteristics each time.

Taxonomy is a regular branch of science that is involved with the purpose of arranging or grouping organisms.

Importance of classification

- It makes the study of such a wide variety of organisms easy.

- It projects before us a good picture of all life forms at a glance.
- It helps us understand the interrelationship among different groups of organisms.
- It serves as a base for the development of other biological fields such as biogeography .
- Various fields of applied biology such as agriculture, public health and environmental biology depend on classification of pests, disease vectors, pathogens and components of an ecosystem.

History of Classification:

Classification of living organisms is probably as old as human civilization. Organisms have been grouped on different basis at different periods of time. The earliest classification was probably on the basis of utility to man. Plants and animals were classified on different basis such as edible and non-edible ones, useful and harmful ones and so on.

History of systematics

Father of taxonomy -**Carolus Linnaeus**

(Books - Species plantarum & systema naturae) and Philosophica Botanique

Taxonomy term - **de Candolle**

Systematics term - **C. Linnaeus**

Father of Botany - **Theophrastus**.

(He had written the book Historia plantarum and Enquiry into the plants)

Father of Indian Taxonomy -**Santapau**

New Systematics - Or Biosystematics - Classification of organisms on the basis of evolution, genetical & morphological traits. It is the another field of systematics.

New systematics-term by - Julian Huxley

Biosystematics-term by -**Camp & Gilly** **http://www.gocbse.com/posts/show/908735.htm**

Types of Taxonomy

(i) Chemotaxonomy - (Biochemical Systematics) - Classification based on chemicals present in organisms

(ii) Numerical Taxonomy - (or phenetics or Adansonian classification) - Classification based on number of shared characters of various organisms.

(iii) Cytotaxonomy (Alston & Turner) - Classification based on nuclear & chromosomal studies

Activity : Introduction to classification

Objectives

To introduce the method of classification

To observe, record and classify organisms in an environment

Method

1. Nature of Activity: Group /Individual.
2. Materials required: Pen and work sheet (Note book).
3. Books and periodicals in a library

Procedure (part 1)

1. Teacher can develop the concept of importance of classification by illustration through comparing arrangement of books and periodicals in a library.
2. Have the students organize books (reference-text), periodicals (weekly, monthly and yearly) and newspapers (local, outstation). These resources can also be arranged year-wise, subject-wise.
3. Time: 30 minutes

Procedure (part 2)

1. List animals and plants you have seen in your surrounding and you know according to the habitat. Make columns as below and enter .

Animals on land	Animals in water	Amphibians	Plants in forests	Plants in water

2. Time : 30 minutes
3. Video-clippings
    - http://www.wonderwhizkids.com/index.phpy/diversity-of-organisms/biology
    - www.youtube.com/watch?v=-_r2uhvYIyM
4. Questions for discussions
    - Why do we classify organisms?

- Give three examples of the range of variations that you see in life around you.

Systems of Classification

There are three main system of classification

(i) Artificial

(ii) Natural

(iii) Phylogenetic

1. Artificial system of classification

This system is based on few morphological characters. First introduced by Pliny and later on by Aristotle, Theophrastus, Linnaeus, Bauhin, etc. This system has several lacunae.

2. **Natural system of classification**

It is based on a number of characters of organisms that are classified on the basis of Morphology, Anatomy, Cytology, Physiology, Ontogeny, Phylogeny, Biochemistry etc. This was given by Schimper, Eichler, Bentham & Hooker.

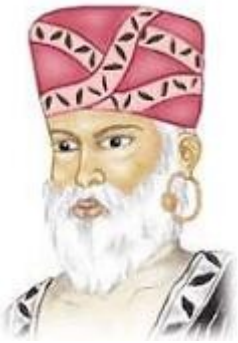
3. **Phylogenetic System of Classification**

This Classification is based on evolutionary interrelationships of organisms. Phylogenetic system is also called cladistics. A Cladogram based on Phenetic is called Dendrogram. This was proposed by Engler & Prantl. Hutchinson, Takhtajan, Dobzhansky & Mayr are modern phylogenetist.

1. Artificial System of Classification --- Contribution of Indians:

(Source: wikipedia)

The earliest attempt towards classification of living organisms is seen in the works of many ancient philosophers in **Greek and India**.



1. Charaka: The information available from many ancient scriptures of our country indicates the attempts made by Indians towards classification of plants and animals. An ancient sage by name **Charaka** who lived in the first century A.D., had listed about 340 plant types and about 200 animals types in his treatise **Charaka Samhitha**.

2. **Parashara:** Another ancient sage by name **Parashara** in his treatise **Vrikshayurveda** had given a vivid description of plants based on the characteristics in flowers. He had divided plants into several "ganas" (families) based on these characters. The description of characters for these ganas, given by Parashara, is very close to the ones given by our modern taxonomists. (Refer – India's Glorius Scientific Traditions Chapter 15 Page no. 148- 155)

3. **Sushruta:** The **Sushruta Samhita** is one of two early texts that form the cornerstone of the Indian medical tradition of Ayurveda (Ayurveda means science of life). The other treatise is called the Charaka Samhita. Like the Charaka Samhita, the Sushruta Samhita made revisions and alterations to an earlier text on which it is based, in this case, the writingsof Divodasa Dhanvantari, the author's teacher. The author, Sushruta, is identified as the son of the Vedic sage Visvamitra. The text is long, running over 1,700 pages in English translation. The exact date of its composition is unknown, but is generally thought to be around 100A.D.

Like the Charaka Samhita, the Sushruta Samhita refers to the eight branches of Ayurvedic medicine. Sushruta is organized similarly to Charaka, but in addition to emphasizing therapeutics, it also discusses surgery, which Charaka barely mentions.

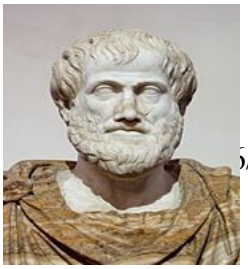
Sushruta details about 650 drugs of animal, plant, and mineral origin. The conquest by Arabs of the Indian province of Sind (now a part of Pakistan)in the eighth century unleashed a scholarly exchange of scientific ideas. The Sushruta samhita was translated into Arabic and later into Persian.These translations, as well as those of Charaka, helped to spread the science of Ayurveda far beyond India.

Additional web resources

1. Sushruta, Information about Sushruta
2. http://www.faqs.org/health/topics/50/Sushruta.html#ixzz22woKO3cr
3. BiologyClassification of Living Organisms

Ancient through medieval times

The famous Greek philosopher (384 to 322 B.C.) had identified different types of plants and animals. Apart from this, he described some organisms under an



intermediate group indicating that such organisms could be placed neither under plants nor under animals. He tried to classify the organisms on the basis of **their form and habitat**. There are many other examples of ancient classification systems that are based mainly on superficial characteristics. Such systems of classification are hence described as **artificial systems of classification**.

Limitations of the artificial system of classification

- The criteria used for classification are superficial and do not reflect the natural relationships.
- The system does not reflect the evolutionary relationship between the organisms.
- Many unrelated organisms are placed in the same group on the basis of their habitats (dwelling place) (For The system does not reflect the evolutionary relationship between the organisms.
- Many unrelated organisms are pla*ced* in the same group on the basis of their habitats (dwelling place) (For example, whales and fishes in the same group).
- Closely related organisms have been placed in different groups because of the differences in their habitat, feeding habits, etc.

2. Natural System of Classification

As science became a part of human life, the classification of living organisms had to undergo a thorough modification. The advent of the microscope in the 17th century opened up a new world of organisms that were hitherto unexplored; the world of micro organisms. It was hard to believe the vast diversity that existed in the microscopic world. Scientists started looking for more and more details about different groups of organisms. Various aspects of life such as mode of reproduction, pattern of development, began to be investigated. As a result, more and more similarities and differences started emerging between the different groups in both plants and animals. This led to a more systematic and scientific approach to classification, which is now known as the **natural system of classification.**

Advantages of natural classification over artificial classification

- It avoids the heterogeneous grouping of unrelated organisms.

- It helps in placing only related groups of organisms together.
- It indicates the natural relationships among organisms.
- It also provides a clear view on the evolutionary relationship between different groups of living organisms.

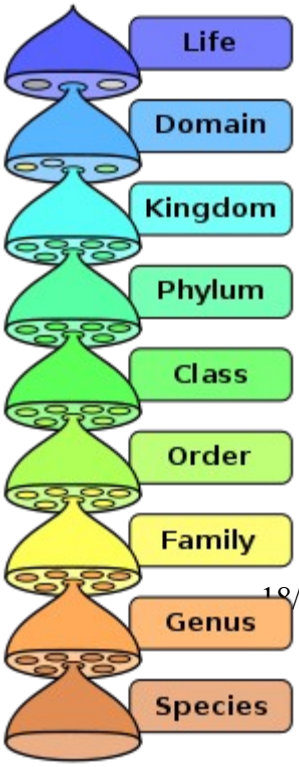
The initial attempt towards a natural system of classification came from an English biologist, John Ray (1627-1705). He identified a large number of plants and animals based on natural relationships among themselves and classified them into specific groups. He was probably the first biologist to have developed the modern concept of a species. He described the species as an assemblage of individuals derived from similar parents and having the ability to pass on their characteristics to the subsequent generations. He published a three-volume compendium - Historia Generalis Plantarum in which he has given a detailed description of over 18,000 types of plants.

Linnaeus Classification

The natural system of classification was placed on a firm footing by the Swedish biologist, **Carolus Linnaeus** (1707-1778). Linnaeus classified living organisms into **two kingdoms the plant kingdom and the animal kingdom.** He recorded nearly 6,000 species of plants in his book Species Plantarum published in 1753. He listed more than 4,300 species of animals. He has given detailed system of his classification in another book **Systema Naturae.** Carolus Linnaeus' great work, the Systema Naturæ (1st ed. 1735), ran through twelve editions during his lifetime. In this work, nature was divided into three kingdoms: mineral, vegetable and animal. Linnaeus used five ranks: class, order, genus, species, and variety.

Linnaeus Taxonomy

Linnaeus is best known for his introduction of the method still used to formulate the scientific name of every species. Before Linnaeus, long many-worded names (composed of a generic name and a differentia specifica) had been used, but as these names gave a description of the species, they were not fixed. In his Philosophia Botanica (1751) Linnaeus took every effort to improve the composition and reduce the length of the many-worded names by abolishing unnecessary rhetorics,



introducing new descriptive terms and defining their meaning with an unprecedented precision. In the late 1740s Linnaeus began to use a parallel system of naming species with nomina trivialia. Nomen triviale, a trivial name, was a single- or two-word epithet placed on the margin of the page next to the many-worded "scientific" name. The only rules Linnaeus applied to them was that the trivial names should be short, unique within a given genus, and that they should not be changed. Linnaeus consistently applied nomina trivialia to the species of plants in Species Plantrum (1st edn. 1753) and to the species of animals in the 10th edition of Systema Naturæ (1758).

Binomial Nomenclature

By consistently using these specific epithets, Linnaeus separated nomenclature from description. Even though the parallel use of nomina trivialia and many-worded descriptive names continued until late in the eighteenth century, it was gradually replaced by the practice of using shorter proper names consisting of the generic name and the trivial name of the species. In the nineteenth century, this new practice was codified in the first Rules and Laws of Nomenclature, and the 1st edition of Species Plantarum and the 10th edn. Of Systema Naturae were chosen as starting points for the Botanical and Zoological Nomenclature respectively. This convention for naming species is referred to as binomial nomenclature. Today, nomenclature is regulated by nomenclature codes, which allows names divided into taxonomic ranks.

How is this done?

The present system of binomial nomenclature identifies each species by a scientific name of two words, Latin in form and usually derived from Greek or Latin roots. The first name (capitalized) is the genus of the organism, the second (not capitalized) is its species. The scientific name of the white oak is *Quercus alba,* while red oak is *Quercus rubra.* The first name applies to all species of the genus—*Quercus* is the name of all oaks—but the entire binomial applies only to a single species. Many scientific names describe some characteristic of the organism (*alba*=white; *rubra*=red); many are derived from the name of the discoverer or the geographic location of the organism. Genus and species

names are always italicized when printed; the names of other taxa (families, etc.) are not. When a species (or several species of the same genus) is mentioned repeatedly, the genus may be abbreviated after its first mention, as in *Q. alba.* Subspecies are indicated by a trinomial; for example, the southern bald eagle is *Haliaeetus leucocephalus leucocephalus,* as distinguished from the northern bald eagle, *H. leucocephalus washingtoniensis.*

The advantages of scientific over common names are that they are accepted by speakers of all languages, that each name applies only to one species, and that each species has only one name. This avoids the confusion that often arises from the use of a common name to designate different things in different places (for example, see elk), or from the existence of several common names for a single species. There are two international organizations for the determination of the rules of nomenclature and the recording of specific names, one for zoology and one for botany. According to the rules they have established, the first name to be published (from the work of Linnaeus on) is the correct name of any organism unless it is reclassified in such a way as to affect that name (for example, if it is moved from one genus to another). In such a case definite rules of priority also apply.

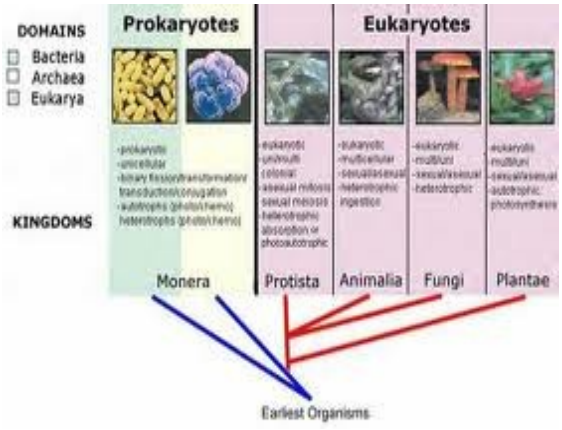
FEW EXAMPLES ARE GIVEN BELOW:

Animals	Plants
Man -Homo Sapiens Cat -Felis Domesticus Dog - Canis familiaris Honeybee - Apis Indica Housefly - Musca domestica Peacock - Pavo cristatus Cobra - Naja naja Hoopoe - Upapa epops House crow - Corvus splendens Jungle crow - Corvus macrorhynchos Silk moth - Bombyx mor	Peepal -Ficus religiosa Mango - Mangifera indica Potato - Solanum tuberosum China rose - Hibiscus rosa-sinensis Lady's finger - Hibiscus esculentus Pineapple - Ananas comosus Pigeon pea - Cajanus cajan Lentil - Lens esculenta Maize - Zea mays

3. Phylogenetic Classification: Modern system

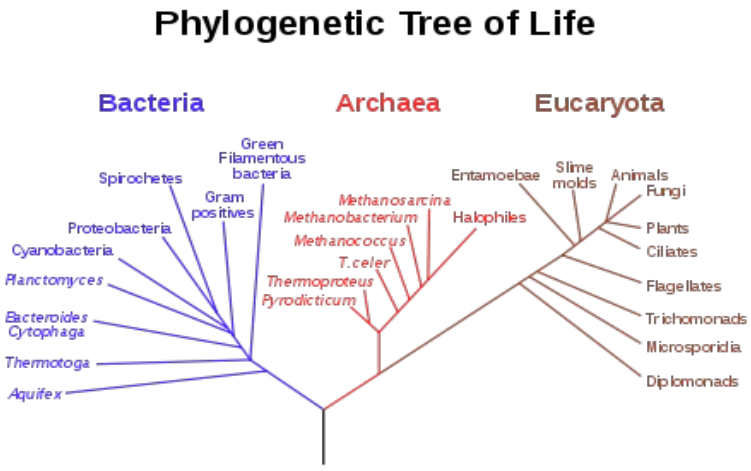
While the earlier systems of classification focused on habitats and characteristics, the current

system of classification is based on evolutionary history, to improve consistency with the Darwinian principle of common descent. With the introduction of the cladistic method in the late 20th century, phylogenetic taxonomy in which organisms are grouped based purely on inferred evolutionary relatedness, ignoring morphological similarity, has become common in some areas of biology.[1] Molecular phylogenetics, which uses DNA sequences as data, has also driven many recent revisions and is likely to continue doing so.



Where as Linnaeus classified for ease of identification, the idea of the Linnaean taxonomy as translating into a sort of dendrogram of the Animal- and Plant Kingdoms was formulated toward the end of the 18th century, well before the Origin of Species was published. Among early works exploring the idea of transmutation of species was Erasmus Darwin's 1796 Zoönomia and Jean-Baptiste Lamarck's Philosophie Zoologique of 1809.

With Darwin's theory, a general acceptance that classification should reflect the Darwinian principle of common descent quickly appeared. Tree of Life representations became popular in scientific works, with known fossil groups incorporated. One of the first modern groups tied to fossil ancestors were birds. Using the then newly discovered fossils of Archaeopteryx and Hesperornis, Thomas Henry Huxley pronounced that they had evolved from dinosaurs, a group formally named by Richard Owen in 1842. The resulting description, that of dinosaurs "giving rise to" or being "the ancestors of" birds, is the essential hallmark of evolutionary taxonomic thinking. As more and more fossil groups were found and recognized in



the late 19th and early 20th century, palaeontologists worked to understand the history of animals through the ages by linking together known groups. With the modern evolutionary synthesis of the early 1940s, an essentially modern understanding of evolution of the major groups was in place. The evolutionary taxonomy being based on Linnaean taxonomic ranks, the two terms are largely interchangeable in modern use.

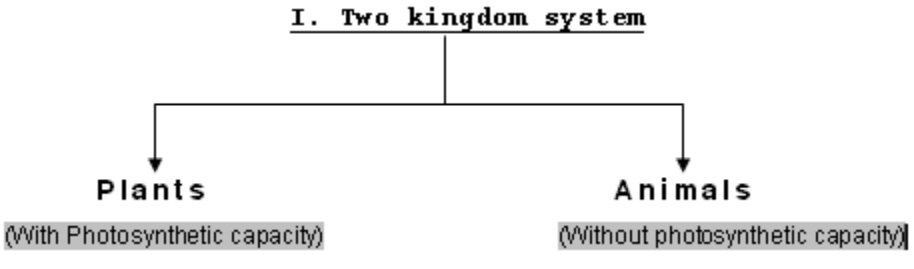
Phylogenetic Nomenclature

Since the 1960s a trend called phylogenetic nomenclature (or cladism) has emerged, inspired by the cladistic method. The salient feature is arranging taxa in a hierarchical evolutionary tree, ignoring ranks. If a taxon includes all the descendants of some ancestral form, it is called monophyletic. Groups that have descendant groups removed from them (e.g. dinosaurs, with birds as offspring group) are termed paraphyletic, while groups representing more than one branch from the tree of life are called polyphyletic. A formal code of nomenclature, the International Code of Phylogenetic Nomenclature, or PhyloCode for short, is currently under development, intended to deal with names of clades. Linnaean ranks will be optional under the PhyloCode, which is intended to coexist with the current, rank-based codes.

Kingdoms and domains

Two Kingdom System

When Linnaeus developed his classification, there were only plants and animals kingdoms. With the microscope came the discovery of many more kingdoms of living organisms.



From well before Linnaeus, plants and animals were considered separate Kingdoms. Linnaeus used this as the top

rank, dividing the physical world into the plant, animal and mineral kingdoms. As advances in microscopy made classification of microorganisms possible, the number of kingdoms increased, five and six-kingdom systems being the most common.

Domains are a relatively new grouping. The three-domain system was first proposed in 1990, but not generally accepted until later. One main characteristic of the three-domain method is the separation of Archaea and Bacteria, previously grouped into the single kingdom Bacteria (a kingdom also sometimes called Monera). Consequently, the three domains of life are conceptualized as Archaea, Bacteria, and Eukaryota (comprising the nuclei-bearing eukaryotes). A small minority of scientists add Archaea as a sixth kingdom, but do not accept the domain method.

Thomas Cavalier-Smith, who has published extensively on the classification of protists, has recently proposed that the Neomura, the clade that groups together the Archaea and Eukarya, would have evolved from Bacteria, more precisely from Actinobacteria. His classification of 2004 treats the archaebacteria as part of a subkingdom of the Kingdom Bacteria, i.e. he rejects the three-domain system entirely.

Limitations of two kingdom system

1 Euglena and other similar unicellular organisms have characters of both animals and plants.

2 Blue green algae (now called *Cyanobactria*) and bacteria having some cytological differences from other organisms also present as difficulty.

3. Fungi, which are usually included in plants, have some characters not common to plants.

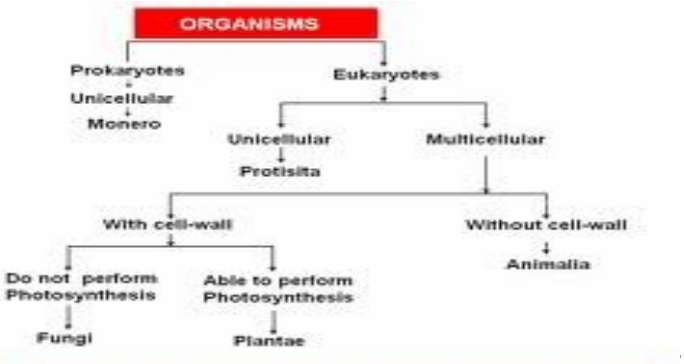
4. Instead of two modes of feeding (ingestion in animals and primarily photosynthesis in plants), now 3 modes are recognized photosynthetic, ingestion & absorption.

Five Kingdom System

This was developed by Whittaker in 1969.

1. Kingdom monera:

(a)Prokaryotic cells lack Nuclear membrane, Plastids, Mitochondria and advanced (9+2)



Classification of Organisms into five Kingdoms

strand flagella.

(b) Reproduction is asexual by fission or budding.

Example - Blue green algae, Bacteria etc.

2.*Kingdom Protista*:

(a) They are unicellular or colonial eukaryotic cells.

(b) Reproduction is asexual and sexual.

Example unicellular Algae, Diatoms etc.

3.*Kingdom plantae*:

(a) Multicellular organisms with cellulose wall and frequently vacuolated, eukaryotic cells.

(b) Nutritive mode is photosynthetic but absorptive.

(c) Reproduction is sexual.

Example - Rhodophyta, Phaeophyta, Gymnosperms, Angiosperms)

4.*Kingdom Fungi*:

(a) Multinucleate organisms with eukaryotic nuclei.

(b) Plastids and photosynthetic pigments lacking.

(c) Reproduction asexual and sexual both. Example - Fungi

5.*Kingdom Animalia*:

(a) Multicellular organisms, eukaryotic cell devoid of cell wall.

(b) Lack plastids and photosynthetic pigments.

(c) Organization and tissue differentiation complex

(d) Reproduction is sexual.

Time line of Classification

***Linnaeus* 1735**	***Haeckel* 1866**	***Chatton* 1925**	***Copeland* 1938**	***Whittaker* 1969**	***Woese et al.***	***Woese et al. 1990***	***Cavalier-Smith* 2004**
2 kingdoms	*3 kingdoms*	*2 empires*	*4 kingdoms*	*5 kingdoms*	*6 kingdoms*	*3 domains*	*6 kingdoms*
(not	*Protista*	*Prokaryota*	*Monera*	*Monera*	*Eubacteria*	*Bacteria*	*Bacteria*

treated)				*Archaebacteria*	*Archaea*		
		Eukaryota	*Protoctista*	*Protista*	*Protista*	*Eukarya*	*Protozoa* *Chromista*
Vegetabilia	*Plantae*		*Plantae*	*Plantae*	*Plantae*		*Plantae*
				Fungi	*Fungi*		*Fungi*
Amnmalia	*Animalia*		*Animalia*	*Animalia*	*Animalia*		*Animalia*

Evaluation

1. Which do you think is a more basic characteristic for classifying organisms?

(a) the place where they live.

(b) the kind of cells they of. Why?

2.What is the primary characteristic on which the first division of organisms is made?

3. Why is Binomial nomenclature famous.? Though cat and tiger belong to same family,why are the species different? Write their systematic position.

Thought provoking question:

1.Why does Polar bear look diffrent from bear in Karnataka? 2. On what bases are plants and animals put into different categories?

Enrichment activity:

1. *Many magazines and newspapers talk about possibility of life outside the Earth. Read these articles and have a discussion in the class about what could be defined as life outside Earth.*

2. *Collect variety of plant leaves, dry and prepare an herbarium. (Diversity -Project work)*
3. *Collect pictures of Charaka , Aristotle and C. Lineus and know their life history.*

Self evaluation of teachers:

Teacher evaluates her transaction in teaching-learning process. She frames the following questions for self evaluation and answers it by reflection on her teaching .

1. Did I plan for the activities before hand?

2. Was I sucessful in implementing these activities?
3. Was the participation of students satisfactory?
4. Did all students actively participate and answer the questions?
5. Was I able to give extra information to students?
6. Did students enjoy using various media for learning?
7. How can I improve my teaching?

Additional Resources

Suggessted Reading:- 1) PUC Text book .(2)NCERT Text books.

(1) Diversity of Living Things www.edu.gov.nf.ca/division/stsuppsv/Junhigh/grad9sci.pdf

(2) **Classification of Organisms**

www.sci.uidaho.edu/.../T2L4P1_**Classification_of_Organisms**.pdf

(3) India'S Glorious Scientific Tradition - Google Books Result

books.google.co.in/books?isbn=818430028X**... By Suresh Soni-2009**

Websites

1. *http://www.youtube.com/watch*
2. *http://library.thinkquest.org.*
3. *http://en.wikipedia.org/wiki/Classification*
4. *www.youtube.com/watch?v=IW23Qhg2v-0* ***(To watch video of diversity of organisms.)***

5. *http://www.ppt2txt.com/r/693f038d/ (for diversity of organisms.)*

External links- 1) http://en.wikipedia.org/wiki/Organism.

Charaka Samhita - Wikipedia, the free encyclopedia

*en.wikipedia.org/wiki/**Charaka**_Samhita*

Subject Teacher Forum (Social Science) - Participating Teachers

Name	District	School
S B Isaraddi	Bagalkote	GHS Teggi, Bilagi Taluk
H G Huddar	Bagalkote	KVVS High School, Katageri, Badami Taluk
I A Doni	Bagalkote	GHS Asangi, Jamkhandi Taluk
Biradar Siddaram	Bagalkote	GHS Janamatti Bilagi Taluk
Mahesh C Sindagi	Bagalkote	GHS Nagaral, Bilagi Taluk
Sanjeevakumar Galagali	Bagalkote	GHS Simikeri Bagalkote Taluk and Dt
Narayana	Bangalore Rural	Govt Junior College, Vijayapura, Devanahalli Taluk
Jagadevi G Hiremath	Bangalore Rural	GGHS Devanahalli Bangalore Rural
Shashikumar BS	Bangalore Rural	GHS Yelekyathanahalli, Nelamangala Taluk
Nagaraja CM	Bangalore South	GHS Kadusonnappanahalli
Vanajakshamma K S	Bangalore South	GHS Kannda Goripalya, Bangalore 26
Jagadeeshappa bannikal	Bellary	GHSKallukamba
Kashinatha shastry N M	Bellary	Govt.composite Junior college Kudligi
K.Nagaraja	Bellary	Govt.Girls High school Kamalapura Hospet Taluk
Pampapathi V	Bellary	GHS Chikkajayiganur, Hospet Taluk
Shivakumar Nelagi	Bidar	GHS Malchapur
Shree GV Hiremath	Bijapur	GHS Arjunagi Bijapur Taluk
G.S.KAMBALE	Bijapur	GHS Hubanur Bijapur Taluk
shri M.A.MOMIN	Bijapur	GHS Managuli Bagewadi Taluk
P.S.Hiremath	Bijapur	GHS Savanahalli Tq/Dt-Bijapur
Siddaraju	Chamaraj nagar	GHS Mangala, Chamarajanagara Taluk
V E Nagalakshmi	Chamaraj nagar	GHS Chikkathuppur, Gundulpet Taluk
Ananda T	Chamarajanagara	Govt. high school, Yanagahalli, Haradanahalli hobali, Chamarajanagara TQ
Archana S	Chamarajanagara	GHS Garaganahalli Gundulpet Taluk
Manjunath.Y.P	Chamarajanagara	GHS, Kolipalya, Mukanapalya Post, Chamarajanagar
Baireareddy	Chikaballapur	GHS Jangamakote, Sidlaghatta Taluk
Srinivas KV	Chikaballapur	GHS Kanagamakalapalli Bagepalli Taluk
Ravindrababu N.V	chikkaballapur	G.H.S Doddabommanahalli.mailandlahalli post.chintamani taluk chikkababallapur district
Hanumantappa .M.H	Chikmagalur	G.J.C.Chowlahiriyur(High school section).Kadure -Taluk.Chickmagalure-Dist.pin-577180
Shivaprasad.S	Chikmagalur	Government Junior College for Boys Tarikere. Chikamagalore District Pin 577228
Venkatesha HN	Chikmagalur	Govt.pu.collage (high school division) mallenahalli chikamagalore 577101
Chandregowda.M.B.	Chikmagalur	G.H.S.Mylimane.Joladal.post. Chikmagalur Taluk
K G Neelakantappa	chikmagalur	govt high school kuruvan ,chikmagalur 577102
Prashantha.S.B	Chikmagalur	B.P.B. G.H.S. Mallandur Chikmagalur 577133

Prashanth M K	chikmagalur	GHS Y Mallapura post Kadur TQ Chikmagalur dist pin-577548
Sunil	Dakshina Kannada	GHS Kokkada
Radhakrishna Baliga	Dakshina Kannada	Sri Sharada High School, Pane
Raghavendra	Dakshina Kannada	GHS Krishnapur 5th Block
Raibagi	Dharwad	GHS Hubli
Anand VK	Gadag	GGHS Bellatti, Shirahatti Taluk
Muttu Garawad	Gadag	GHS Kanvi Taluk
Shyam Danappa Shyavi	Gadag	GS Kotumachagi, Taluk, Dt Gadag
Devindrakumar Aounti	Gulbarga	GHS Dugnoor, Sedam Taluk
Girish S Sajjaner	Gulbarga	GHS Kardal, Chittapur Taluk
Satyakumar Bhagodi	Gulbarga	GHS Batagera(B), Sedam Taluk
Somashekhar Hiremath	Gulbarga	Government Girls High School, Kamalapur
Vijaykumar B Melkar	Gulbarga	GHS Satnoor, Chittapur Taluk
Prasanna Kumar NB	Hassan	GHS, Jodigubbi, Holenarsipur Taluk
Chaluvanarayanaswamy	Hassan	GHS Kantharajapura, Channarayapatna Taluk
Kantharaju KC	Hassan	GHS Kallusadarahalli, Arsikere Taluk
Manjunatha KS	Hassan	DIET Hassan
Sathisha BK	Hassan	GPUC Shravanabelagola, Channarayapatna
Girish KS	Hassan	GHS Bettahalli Alur Taluk
Kiran GS	Hassan	GGPUC Belur, Belur Taluk
Joachim Dsouza	Hassan	GHS Mallipattana, Arakalgud Taluk
Basavaraj Mamadapur	Haveri	GHS Kannada Kanavalli Taluk
Veeresh M Gadda Devarmath	Haveri	GHS Havanur Taluk
Harish BE	Kodagu	Govt PU College, Shirangala, Somwarpete Taluk
Nandakumar K C	Kolar	GHS Doddachinnahalli(v&p), k.g.f.(range)
Ananda Babu A R	Kolar	BRP, BRC Srinivaspur
Ashoka.V	Kolar	Govt High school Gonamakanahalli
Nagesh TS	Kolar	GHS Alangur Cross, Mulbagal Taluk
Manjunath KS	Mandya	Govt PU College, VC Farm
Mallikarjun Aradhya	Mandya	Govt PU College , Ballenahalli, KR Pet Taluk
DM Venugopal	Mandya	Govt PU College, Bukanakere
Nanjaraju C L	Mandya	GHS B Hosur, Mandya North
Vasanthkumar	Mandya	Tech Assistant, RMSA Mandya
Basavaraju Y S	Mandya	Govt PU College, Chandupura, Maddur Taluk
Basavegowda U S	Mandya	Govt high school Thattahalli Nagamangala
Hareeshkumar K	Mandya	GHS Huskuru, Malavalli Taluk
Mohan KR	Mandya	GHS Hiremarali. Pandavapura Taluk
Putta swami gowda M.L	Mandya	GHS Mudaganduru Mandya Taluk
Gayithri J	Mandya	Govt Girls High School, Srirangapatna
Harish KS	Mandya	GHS Sunahahally, Mandya Taluk
Dinesh Kumar	mysore	GHS D Salundi
Prabha	Mysore	DIET Vasantha Mahal, Nazarbad
Pushpalatha	Mysore	Govt PU College, Hemmeragala, Nanjangud Taluk
H L Shailaja	Mysore	GHS Megalapura, Mysore Taluk
Rajesh Y N	Mysore	GHS Mallupura, Nanjangud Taluk
ShivaShanker RN	Raichur	GHS Navalkal

H Peerbasha	Raichur	GHS Madlapur, Manvi Taluk
Valibabu	Raichur	Govt Boys High School Manvi Dist :- Raichur
Vaishampayan K Joshi	Raichur	GGHS Manvi Taluk
Raghavendra chary.M	Ramanagar	Govt High School , Harokoppa ,Sogala post, Channapatna Tq
Sandhya	Ramanagara	GHS Harthigate, Magadi Taluk
Anusuya	Ramanagara	GHS Sripatihalli, Magadi Taluk
Krishna.B.A	shimoga	G.H.S.Yadur Hosanagara Taluk
Franky Francis.	Shimoga	GHS Masur, Sagur Taluk
Ramesha K.V	Shivamogga	G.H.S. Heddaripura Hosanagar taluk
Madhu	Tumkur	Govt PU College for boys, Tiptur
Prasanna Kumar Shetty	Udupi	GHS Bidarur, Arkalgud Taluk
Venkatesh	Udupi	Viveka PUC
Rathnakara Shetty	Udupi	GHS Uppoor, Kolalagiri Post, Uppoor Village
Shripathi Aithal	Udupi	GPUC Haladi, Kundapura Taluk
Guruprasad H	Udupi	GPUC Hosangadi, Kundapura Taluk
Girish Kumar	Udupi	GPUC Sanoor, Karkala Taluk

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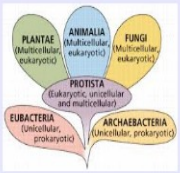
Organisms and Their Classification



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