

Bio101

Introduction to biology

Important short notes

From 28 – 45 lessons

Prepared by Esha Anjum

Phylum Echinodermata

Echinoderms include common seashore animals such as sea stars (also known as "starfish"), sand dollars and sea urchins, along with hundreds of more exotic forms. An echinoderm is any member of the phylum Echinodermata of marine animals. The adults are recognizable by their radial symmetry, and include starfish, sea urchins, sand dollars, and sea cucumbers, as well as the sea lilies or "stone lilies".

Phylum Chordata

The Phylum Chordata includes the well-known vertebrates (fishes, amphibians, reptiles, birds, mammals). A chordate is an animal of the phylum Chordata. All chordates possess 5 synapomorphies, or primary characteristics, at some point during their larval or adulthood stages that distinguish them from all other.

What are the three main characteristics of chordates?

1) Chordata is most advanced animal phylum. 2) Notochord, a solid unjointed rod, is present in chordates at some stages of life. 3) A dorsal hollow nerve cord develops in embryo which usually persist throughout life in most chordates. 4) **Gill slits r present at some stages of life.**

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Characteristics of Urochordata:

- Possesses a Notochord, a hollow nerve cord and a post anal tail.
- Body has more than two cell layers and includes tissues and organs.
- Has a U-shaped gut.
- Body has no coelomic body cavity.
- Body wholly enclosed in a 'tunic' of secreted protein and cellulose-like material.

What is chordate metamerism?

In chordates the metamerism **evolved independently for locomotion**. Metamerism allowed the tail muscles to be arranged segmentally for the undulatory movement of the body.

What animals belong to the subphylum Cephalochordates?

What are examples of Cephalochordates?

These 5 synapomorphies include a notochord, **dorsal hollow nerve cord**, endostyle, pharyngeal slits, and a post-anal tail (see chordate for descriptions of each). The fine structure of the cephalochordate notochord is best known for the Bahamas lancelet, *Asymmetron lucayanum*.

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Sub-phylum Vertebrata General Characteristics

Diversity of vertebrates: animals with backbones: The subphylum Vertebrata contains **all animals that possess backbones, gills, and a central nervous system in at least one phase of development**. Vertebrates include amphibians, reptiles, mammals, and birds, as well as the jawless fishes, bony fishes, sharks, and rays.

What does Gymnosperm mean?

Medical Definition of gymnosperm

: **any of a class or subdivision (Gymnospermae)** of woody vascular seed plants (as conifers or cycads) that produce naked seeds not enclosed in an ovary and that in some instances have motile spermatozoids — compare angiosperm.

Angiosperms Definition. ...

An angiosperm is **a plant that produces flowers**. The angiosperms, also identified as the flowering plants, belong to one of the vital groups of plants having seeds.

Definition of monocot

: **a chiefly herbaceous angiospermous plant** (such as a grass, lily, or palm) having an embryo with a single cotyledon, usually parallel-veined leaves, and floral organs arranged in multiples of three: monocotyledon Monocots account for a quarter of all flowering plants.

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Dicots

Dicotyledon, byname dicot, any member of the flowering plants, or angiosperms, that **has a pair of leaves**, or cotyledons, in the embryo of the seed.

Sexual Reproduction in Plants

Flowering plants reproduce sexually through a process called **pollination**. The flowers contain male sex organs called stamens and female sex organs called pistils. The anther is the part of the stamen that contains pollen. ... Self-pollination happens when a plant's own pollen fertilizes its own ovules.

Development of the ovule and female gamete

The **female gametophyte** develops within the ovule and generally consists of three antipodal cells, one central cell, two synergid cells, and one egg cell (Figures 1A and 1B). The female gametophyte is also commonly called the embryo sac or megagametophyte. ... The Arabidopsis female gametophyte. (A) Ovule.

Evolution of gymnosperms

Gymnosperms were the **first seed plants to have evolved**. The earliest seedlike bodies are found in rocks of the Upper Devonian Series (about 382.7 million to 358.9 million years ago). During the course of the evolution of the seed habit, a number of morphological modifications were necessary.

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Life Cycle of Gymnosperms

The life cycle of a gymnosperm involves **alternation of generations**, with a dominant sporophyte in which reduced male and female gametophytes reside. All gymnosperms are heterosporous. ... Male and female spores develop in different strobili, with small male cones and larger female cones.

Cycads

Cycads (order Cycadales) are an **ancient group of palmlike gymnosperms** with about 300 extant species across three families. The plants are distinguished by crowns of large pinnately compound leaves and by large cones. Several species are grown as ornamentals.

ginkgo biloba

Ginkgo biloba, commonly known as ginkgo or gingko also known as the maidenhair tree, is a species of tree native to China. It is the only living species in the order Ginkgoes, which first appeared over 290 million years ago.

Evolutionary History of Angiosperms

Angiosperms evolved **during the late Cretaceous Period, about 125-100 million years ago**. ... As angiosperms evolved in the Cretaceous period, many modern groups of insects also appeared, including pollinating insects that drove the evolution of angiosperms; in many instances, flowers and their pollinators have coevolved.

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Life Cycle of Angiosperm

The adult, or sporophyte, phase is the main phase of an angiosperm's life cycle. As with gymnosperms, angiosperms are heterosporous. Therefore, they generate microspores, which will produce pollen grains as the male gametophytes, and megaspores, which will form an ovule that contains female gametophytes.

Monocotyledon vs Dicotyledon

Monocotyledon	Dicotyledon
The monocot embryos have a single cotyledon	The dicot embryos have a pair of cotyledons
They have a fibrous root system	They have a tap root system
Leaves in monocots have parallel venation	Leaves in dicots have reticulate or net venation
In monocot flowers, the count of parts of the flower is a multiple of three or equal to three	The count of parts in a dicot flower is a multiple of four or five or equal to four or five
The roots and stems of Monocotyledons do not possess a cambium and cannot increase in diameter	The roots and stems of Dicotyledons possess a cambium and have the ability to increase in diameter
A few examples of monocotyledons are garlic, onions, wheat, corn and grass	A few examples of dicots are beans, cauliflower, apples and pear

Biotechnology

Biotechnology is **technology that utilizes biological systems, living organisms or parts of this to develop or create different products**. Brewing and baking bread are examples of processes that fall within the concept of biotechnology (use of yeast (= living organism) to produce the desired product).

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Recombinant DNA Technology

Recombinant DNA technology comprises **altering genetic material outside an organism** to obtain enhanced and desired characteristics in living organisms or as their products. This technology involves the insertion of DNA fragments from a variety of sources, having a desirable gene sequence via appropriate vector [12].

What is meant by DNA cloning?

By definition, the general term “cloning” means obtaining multiples copies of something, let it be individuals of an animal species, or molecules. DNA cloning is a Molecular Biology technique that **allows us to get multiple copies of identical sequence-specific double-stranded DNA fragments**, for various purposes.

Transformation

Genetic modification of a cell by the uptake and incorporation of exogenous DNA is called transformation.

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Gene Cloning in a Bacterial Plasmid

In a typical cloning experiment, a target gene is **inserted into a circular piece of DNA** called a plasmid. The plasmid is introduced into bacteria via a process called transformation, and bacteria carrying the plasmid are selected using antibiotics.

Preparing Genomic Libraries

In order to construct a genomic library, **the organism's DNA is extracted from cells and then digested with a restriction enzyme** to cut the DNA into fragments of a specific size. The fragments are then inserted into the vector using DNA ligase.

Making complementary DNA

In genetics, complementary DNA (cDNA) is **DNA synthesized from a single-stranded RNA** (e.g., messenger RNA (mRNA) or microRNA (miRNA)) template in a reaction catalyzed by the enzyme reverse transcriptase. cDNA is often used to clone eukaryotic genes in prokaryotes.

Screening a Library

Traditionally, libraries are screened with different **probes to isolate target genes or sequences**. These probes can be a particular sequence such as a cDNA, a polymerase chain reaction (PCR) product, or a genomic fragment (1).

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Polymerase Chain Reaction

The polymerase chain reaction (PCR) can produce many copies of a specific target segment of DNA. A three step cycle heating, cooling, and replication brings about a chain reaction that produces an exponentially growing population of identical DNA molecules. The key to PCR is an unusual, heat-stable DNA polymerase called Taq-polymerase.

DNA Sequencing

DNA sequencing is **a laboratory technique used to determine the exact sequence of bases (A, C, G, and T) in a DNA molecule.** The DNA base sequence carries the information a cell needs to assemble protein and RNA molecules. DNA sequence information is important to scientists investigating the functions of genes.

Sanger sequencing

Sanger sequencing, also known as the “chain termination method”, is **a method for determining the nucleotide sequence of DNA.** The method was developed by two-time Nobel Laureate Frederick Sanger and his colleagues in 1977, hence the name the Sanger Sequence.

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What is diagnosis and treatment of disease?

Medical diagnosis (abbreviated Dx, D_x, or D_s) is **the process of determining which disease or condition explains a person's symptoms and signs**. It is most often referred to as diagnosis with the medical context being implicit.

Forensic Evidence and Genetic Profiles

DNA profiling is a **forensic technique in criminal investigations**, comparing criminal suspects' profiles to DNA evidence so as to assess the likelihood of their involvement in the crime. It is also used in parentage testing, to establish immigration eligibility, and in genealogical and medical research.

Short Tandem Repeats

Short tandem repeats (STRs), which are sometimes referred to as microsatellites or simple sequence repeats (SSRs), are **accordion-like stretches of DNA containing core repeat units of between two and seven nucleotides in length** that are tandemly repeated from approximately a half dozen to several dozen times (1).

Transgenic Animals

Transgenic animals are **animals (most commonly mice) that have had a foreign gene deliberately inserted into their genome**. Such animals are most commonly created by the microinjection of DNA into the pronuclei of a fertilized egg which is subsequently implanted into the oviduct of a pseudo pregnant surrogate mother.

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What are transgenic techniques?

Transgenics describes **the process of introducing foreign deoxyribonucleic acid (DNA) into a host organism's genome**. The foreign DNA, or "transgene," that is transferred to the recipient can be from other individuals of the same species or even from unrelated species.

What are the applications of transgenic plants and animals?

(i) therapeutics, (ii) diagnostics, **(iii) genetically modified crops for agriculture**, (iv) processed food, (v) bioremediation, (vi) waste treatment and (vii) energy production.

Genetic Engineering

Genetic engineering is **the process of using recombinant DNA (rDNA) technology to alter the genetic makeup of an organism**. ... Genetic engineering involves the direct manipulation of one or more genes. Most often, a gene from another species is added to an organism's genome to give it a desired phenotype.

Benefits of Transgenic Animals

Practical applications of transgenics in livestock production include **enhanced prolificacy and reproductive performance, increased feed utilization and growth rate, improved carcass composition, improved milk production and/or composition** (Figure 1), modification of hair or fiber, and increased disease resistance.

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Agricultural Applications of Transgenic Animal

Practical applications of transgenics in livestock production include **enhanced prolificacy and reproductive performance, increased feed utilization and growth rate, improved carcass composition, improved milk production and/or composition** (Figure 1), modification of hair or fiber, and increased disease resistance.

TRANSGENIC ANIMALS AND THEIR APPLICATION IN MEDICINE

Transgenic animals are animals that are genetically altered to have traits that mimic symptoms of specific human pathologies. They **provide genetic models of various human diseases** which are important in understanding disease and developing new targets.

Xenotransplantation

Xenotransplantation is any **procedure that involves the transplantation, implantation or infusion into a human recipient** of either (a) live cells, tissues, or organs from a nonhuman animal source, or (b) human body fluids, cells, tissues or organs that have had ex vivo contact with live nonhuman animal cells, tissues.

What is human gene therapy?

Human gene therapy seeks **to modify or manipulate the expression of a gene or to alter the biological properties of living cells for therapeutic use** 1. Gene therapy is a technique that modifies a person's genes to treat or cure disease.

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Industrial Applications of Transgenic Animals

Transgenic animals produced with the purpose of **producing better and good quality breed, increased in milk yield, as well as to produce organs to meet the demand for organ transplantation.**

Genetically modified animals are proving ever more vital in the development of new treatments and cures for many serious diseases.

Tools in Molecular Biology

- Quantitative Polymerase Chain Reaction (qPCR)
- Stable Isotope Probing (SIP)
- Compound Specific Isotope Analysis (CSIA)
- Metagenomics (Next Generation DNA Sequencing)
- Microarrays.

Gel electrophoresis

Gel electrophoresis is **a laboratory method used to separate mixtures of DNA, RNA, or proteins according to molecular size.** In gel electrophoresis, the molecules to be separated are pushed by an electrical field through a gel that contains small pores.

Polymerase chain reaction (PCR)

Polymerase chain reaction, or PCR, is **a technique to make many copies of a specific DNA region in vitro** (in a test tube rather than an organism). PCR relies on a thermostable DNA polymerase, Taq polymerase, and requires DNA primers designed specifically for the DNA region of interest.

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Applications of PCR

PCR has many research and practical applications. It is routinely used in DNA cloning, medical diagnostics, and forensic analysis of DNA.

Southern blotting

A Southern blot is **a laboratory method used to detect specific DNA molecules from among many other DNA molecules**. The technique was named after its inventor, Edward Southern.

Northern blotting

A northern blot is **a laboratory method used to detect specific RNA molecules among a mixture of RNA**. Northern blotting can be used to analyze a sample of RNA from a particular tissue or cell type in order to measure the RNA expression of particular genes.

Western blotting

A western blot is **a laboratory method used to detect specific protein molecules from among a mixture of proteins**. This mixture can include all of the proteins associated with a particular tissue or cell type. ... Following separation, the proteins are transferred from the gel onto a blotting membrane.

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Principles of DNA Isolation and Purification

Sources of DNA include

- Blood
- Buccal cells
- Cultured cells (plant and animal)
- Bacteria
- Biopsies
- Forensic samples i.e., body fluids, hair follicles bone and teeth roots.

The three basic steps of DNA extraction are

- 1) lysis,
- 2) precipitation, and
- 3) purification. In this step, the cell and the nucleus are broken open to release the DNA inside and there are two ways to do this. First, mechanical disruption breaks open the cells.

What is a simple definition of an allele?

An allele is **one of two or more versions of a gene**. An individual inherits two alleles for each gene, one from each parent. If the two alleles are the same, the individual is homozygous for that gene. If the alleles are different, the individual is heterozygous.

homozygous

The presence of two identical alleles at a particular gene locus. A homozygous genotype may include two normal alleles or two alleles that have the same variant.

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Heterozygous

The presence of two different alleles at a particular gene locus. A heterozygous genotype may include one normal allele and one mutated allele or two different mutated alleles (compound heterozygote).

The principle of segregation

The Principle of Segregation describes **how pairs of gene variants are separated into reproductive cells.** ... This meant that the pair of alleles encoding the traits in each parental plant had separated or segregated from one another during the formation of the reproductive cells.

The principle of independent assortment

The Principle of Independent Assortment describes **how different genes independently separate from one another when reproductive cells develop.** ... During meiosis, the pairs of homologous chromosomes are divided in half to form haploid cells, and this separation, or assortment, of homologous chromosomes is random.

Albino Trait

Albinism is an inherited condition that **leads to someone having very light skin, hair, and eyes**. It happens because they have less melanin than usual in their body. Melanin gives skin, hair, and eyes their color. Except for vision problems, most people with albinism are just as healthy as anyone else.

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Monohybrid Cross

A monohybrid cross is **a cross between two organisms with different variations at one genetic locus of interest**. ... To carry out such a cross, each parent is chosen to be homozygous or true breeding for a given trait (locus).

Punnett Square with one Trait

The Punnett square is a tabular summary of possible combinations of maternal alleles with paternal alleles. These tables can be used to examine the genotypical outcome probabilities of the offspring of a single trait (allele), or when crossing multiple traits from the parents.

Dihybrid Cross Genotypes

Dihybrid cross is a cross between two different lines (varieties, strains) that differ in two observed traits.

What is apitherapy used for?

Apitherapy is a type of alternative therapy that uses products that come directly from honeybees. It's used to treat illnesses and their symptoms as well as pain from acute and chronic injuries. Illnesses that apitherapy may treat include: **multiple sclerosis**.

maggot debridement therapy

Maggot therapy is the controlled, therapeutic use of live blow fly larvae ("maggots") to treat skin and soft tissue wounds. Maggot Debridement Therapy is used to treat for removing dead tissue from wound, preventing infection and speeding healing process.

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Beetle Juice Therapies

The most commonly used treatment is **Cantharidin**, also referred to as “beetle juice”. Cantharidin is a chemical found naturally in members of the beetle family hence the nickname “beetle juice”. It is a liquid that is painlessly applied to the bumps on the skin in the office and washed off at home a few hours later.

Cantharidin

Cantharidin is **a substance derived from the blister beetle Cantharis vesicatory**. The Chinese have used this ancient medicine for thousands of years for a number of maladies. In the 1950's it was used in the US and other westernized countries to treat warts.

Examples of Plant Medicines

- 1 Anesthetics
- 2 Analgesics
- 3 Heart medicines

4 Laxatives

5 Muscle relaxants

What is Chaulmoogra oil used for?

Chaulmoogra is an herb. People use the seed to make medicine. Despite serious safety concerns, people put chaulmoogra powder, oil, emulsion, or ointment on the skin to treat **skin problems including psoriasis and eczema**. Chaulmoogra is given intravenously (by IV) for leprosy.

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Does cinchona treat malaria?

Cinchona bark contains quinine, which is a **medicine used to treat malaria**. It also contains quinidine which is a medicine used to treat heart palpitations (arrhythmias).

Pharmacology

Pharmacology is **a branch of science that deals with the study of drugs and their actions on living systems** - that is, the study of how drugs work in the body (sometimes referred to as 'drug actions'). ... This module will focus on psycho-pharmacology which concerns the action of mind-altering or psycho-active drugs.

pharmacokinetics and pharmacodynamics

pharmacokinetics (PK) **is defined as the movement of drugs through the body**, whereas pharmacodynamics (PD) is defined as the body's biological response to drugs.

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What is the life cycle of drug?

The four phases of the life cycle of drugs and products of other industries include **introduction, growth, maturity, and decline**

Depot Binding

Binding of a drug with various tissues of the body or with proteins in the blood; causes drugs to not reach their site of action.

half-life of a drug

The half-life of a drug is **the time it takes for the amount of a drug's active substance in your body to reduce by half**. This depends on how the body processes and gets rid of the drug. It can vary from a few hours to a few days, or sometimes weeks.

Potency

Potency is **an expression of the activity of a drug in terms of the concentration or amount of the drug required to produce a defined effect**, whereas clinical efficacy judges the therapeutic effectiveness of the drug in humans.

Modes of Action

1. Agonism

A compound that does the job of a natural substance. Does not affect the rate of an enzyme catalyzed reaction.

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2. Antagonism

A compound inhibits an enzyme from doing its job. Slows down an enzymatically catalyzed reaction.

What is the meaning behind the tree of life?

Immortality and Rebirth: The Tree of Life is a symbol for rebirth as trees lose their leaves and seem to be dead during winter, but then new buds appear and new, fresh leaves unfurl during the spring. This represents the beginning of a new life and a fresh start.

What is theory and fact?

Definition. Fact is **something that has occurred or that which is true or something that has been proven right**. The theory is a carefully thought scientific explanation for observations in the natural world and which brings together many facts and hypothesis.

Transmutation

Jean-Baptiste Lamarck proposed a theory on the transmutation of species in *Philosophie Zoologies* (1809). Lamarck did not believe that all living things shared a common ancestor.

Rather he believed that simple forms of life were created continuously by spontaneous generation.

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Type of Stamen

1. Monadelphous stamen 2. Diadelphous stamen 3. Didynamous stamen 4. Tetradynamous stamen 5. Polyadelphous stamen 6. Syngenesious stamen

Type of Flower

Complete flower

A flower having all four floral parts: sepals, petals, stamens, and carpels.

Incomplete flower

A flower without one or more of the normal parts, as carpels, sepals, petals, pistils, or stamens

Floral formula

A Floral formula is **a notation for representing the structure of particular types of flowers**. Such notations use numbers, letters and various symbols to convey significant information in a compact form.

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