Synopsis of Phylum Chordata

Identifying Characteristics of the Phylum
- most advanced phylum of animal kingdom
- includes fish, amphibian, reptiles, birds and mammals; some of the largest or most massive animals
- Notochord; flexible rodlike structure; extends the length of the body; in larva and/or adult
- Dorsal tubular nerve cord; (in invert ; nerve cord is ventral & paired)
- Pharyngeal (gill) slits; first evolved as a filter feeding apparatus
- endostyle or thyroid gland; specific kind of tissue found only in chordates
- Post-anal tail; in aquatic chordates it provides motility in terrestrial chordates it is used for balance
- ventral heart (inverts have dorsal heart)
- endoskeleton; most members have an internal skeleton of cartilage and/or bone

Subphylum Urochordata (tunicates, sea squirts)
- all marine; widely distributed in all marine waters
- most are bag-like sessile suspension feeders as adults, often colonial
- tadpole-like larva has typical chordata features
- adults have tough, nonliving, tunic covering body; secreted by mantle; forms 2 siphons
- filter feeders: incurrent siphon → pharynx (branchial sac) → slits → atrium → excurrent siphon
- pharynx also serves as a respiratory organ
- simple open circulatory system with small ventral heart and 2 major blood vessels
- nerve with ganglia and plexus of nerve fibers
- all tunicates are hermaphrodites with single ovary and testis; free-swimming larva
- Human Impacts of Tunicates: antiviral, antitumor

Subphylum Cephalochordata (lancelets)
- closest living relatives to vertebrates
- slender, translucent, laterally compressed, fishlike or eel-like body
- instead of tunic, outer body is covered by soft epithelium; 2 folds of skin = metapleural folds
- springy notochord for support supports body while swimming or burrowing
- with well developed “V” myotomes (=myomeres)
- are filter feeders: mouth surrounded by oral hood with tentacles (=oral cirri) an a wheel organ
- pharynx strains food from water; water passes through pharynx into atrium and out the atrio pore
- all are dioecious with males and females

Subphylum Vertebrata
- internal jointed skeleton of bone or cartilage
- complex skin; multilayered: epidermis, dermis
- digestive system uses muscular contractions rather than cilia to move food through
- increasingly efficient closed circulatory system with pumping heart (2,3, or 4 chambered)
- most complex and best developed nervous system of all animals; more emphasis on brain & senses
- Improved efficiency of excretory system; paired kidneys (most cephalochordates had none)
- almost all are dioecious and reproduce only sexually

Vertebrates: The Fish Classes
- fish are the most diverse, most abundant and successful group of living vertebrates
- all fish are aquatic & and highly adapted for aquatic life
- skin: epidermis usually secretes slimy mucus; dermis produces scales in most fish
- highly flexible “backbone” of cartilage or bone is the main support for swimming muscles
most of a fish’s body mass is myomeres (=myotomes)
most fish have gills for getting O_2 from water; some fish can also breath through their skin; a few fish can breath air
-circulation is tied to gas exchange through gills; 2 chambered heart and a single circuit of bloodstream
-brains are relatively small and simple; cerebrum (higher centers) very small; cerebellum (coordination of movement) relatively large; brain stem (automatic activities) relatively large
-probably the most important sense in fish is lateral line system = “distance touch”
-sound is an important means of communication in fish, especially deepwater fish
-kidneys remove wastes (Nitrogen wastes); gills also play role in excretion and osmoregulation
-most fish are dioecious; most with external fertilization (oviparous); a few bear live young

Class: Agnatha (Jawless Fish)
-oldest known vertebrates; most ancient & primitive vertebrate group
-not technically “vertebrates” since they have no vertebrae – just a cartilage rod for support
-only living vertebrate group with no jaws; also lack paired fins
-three main groups of agnatha: ostracoderms - all extinct; hagfish; lampreys
-Human Impacts: bane to some commercial fishermen using gill or set nets; collected for “leather” to make golf bags and boots; in 1950’s lampreys destroyed great lakes fisheries

Class: Chondrichthyes (Sharks and Rays)
evolution of jaws was one of the major events in the history of vertebrates
-Body Form; either fusiform (spindle shaped) or flattened
-skin is very tough & leathery→ muscles of shark pull on skin rather than pulling on the skeleton
-bony scales reduced to small, hard, knife-like (placoid) dermal scales embedded in skin
-all members of the group have a skeleton made mostly of cartilage
-paired appendages: pectoral and pelvic fins; but pectoral fins are rigid, not flexible
-most sharks are predators with powerful jaws; the teeth and (dermal) scales of sharks identical
-digestive system has new structures eg. liver, gall bladder, pancreas; spiral valve to improve absorption
-gills are inside 5 pairs of gill slits similar to agnatha; a pair of spiracles behind the eyes
-sharks retain urea to help maintain internal fluids isosmotic to sea water; rectal gland assists kidney
-most sharks, but only a few kinds of other fish possess a cloaca
-all chondrichthyes have internal fertilization; many bear live young
-Human Impacts: shark attacks. shark fishing, medicinal/pharmaceuticals

Class Osteichthyes (Bony Fish)
-most successful vertebrate class; more species than all other kinds of vertebrates combined
-most bony fish are designed for active swimming but with an amazing diversity of body form
-most bony fish have thin, overlapping dermal scales in dermis that grow throughout life
-most bony fish can control their color to some degree due to chromatophores
-freely moveable pectoral and pelvic fins for better maneuvering
-most bony fish today have swim bladder to control buoyancy
-most modern fish are carnivores; small, numerous, sharp teeth are used to seize prey
-much more efficient gills; often have “gill rakers”; covered by operculum
-most bony fish with external fertilization; a few bear live young (eg. guppies)
-A few fish make nests and show fairly elaborate mating behaviors and parental care
-some fish migrate between fresh and saltwater for spawning
-Human Impacts: pets, research, food

Class Amphibia
-modern amphibians still retain a unique blend of aquatic and terrestrial characteristics

This is NOT “what’s on the test”; this is a summary of the major points from lab and lectures; the lecture & lab notes are the sources of exam questions
-most with thin moist, glandular skin without scales; often with many glands
-stronger, skeleton, mostly of bone, with toes; supports body weight & movement on land
-most amphibians are predators (carnivores); eat mostly insects
-most have long flexible tongues for capturing prey
-some amphibians have teeth to hold prey; food swallowed whole, not chewed
-amphibians can take in oxygen in four ways: lungs, through skin, mouth, gills
-circulatory system has 3 chambered heart & two complete circuits of blood flow
-amphibian brain is about same size as fish relative to body size

-Senses: lateral line; vision is dominant sense in many amphibians; smell has also become more important; hearing – amphibians have both middle and inner ear
-skin and kidneys are the main way salts and water are gained or lost
-all amphibians have poison glands in their skin; some toxins are lethal
-dioecious; no sexual dimorphism; mating is controlled by season; external fertilization
-most frogs undergo metamorphosis into adult in a year or less
-during winter most temperate frogs hibernate in mud at bottoms of pools and streams

-Ecology: Frogs are critical links between predators and the bottom of the food chain
-Human Interactions: food, education, research, poisonings, as environmental indicators

Class Reptilia
-reptiles include lizards, snakes, turtles
-reptiles were the 1st vertebrates no longer tied to water, even for reproduction
-complete independence from water due to development of amniotic egg
-another major innovation of reptiles is a thick, tough, dry, waterproof skin; the skin of reptiles contains scales but unlike fish scales → reptile scales are in the epidermis, not under the epidermis → also reptile scales are made of keratin, a waxy protein, not enamel and dentin
-more powerful muscles than amphibians; limbs are stronger and more flexible for walking
-most reptiles are carnivores
-tongue is muscular and mobile; in some tongue serves as touch receptor
-most reptiles have teeth
-in some salivary glands are modified into poison glands
-stomach often has pebbles to help grind food (=gastroliths) → common find at dinosaur sites
-lungs are more efficient, more folding, more surface area; air is sucked into lungs, not gulped
-like amphibians, most with three chambered hearts; but partial septum separates the ventricle
-some reptiles in past were warmblooded
-nervous system similar to mammals in basic structure, only smaller
-vision is most important sense organ eyes usually with 2 moveable eyelids
-also have well developed sense of smell; Jakobson’s organ assists in sense of smell/taste
-some snakes have IR sensors
-more efficient (metanephric) kidneys
-venomous snakes use their poisonous fangs for protection as well as for subduing prey
-dioecious; copulatory organs; all reptiles have internal fertilization
-almost all reptiles go through early development within an amniotic egg
-many reptiles have well developed abilities to regenerate missing body parts
-Humans Impacts: snakebites, medical research, pharmaceuticals, farmed reptiles – semi-domesticated, reptiles as food, world trade in live reptiles, invasive species

Class: Aves (Birds)
-birds clearly evolved from dinosaurs
-in spite of the great diversity of birds they are amazingly similar in structure; entire anatomy is designed around flight

This is NOT “what’s on the test”; this is a summary of the major points from lab and lectures; the lecture & lab notes are the sources of exam questions
-bird **skin** is thin, light and flexible, most of body is covered by feathers
-wings and body covered by **feathers**; light & strong and tough, feathers are **molting** regularly
-**chromatophores** impart colored pigments during feather development
-the skeleton is exceptionally **light and delicate** yet sturdy
-since birds lose the use of their forelimbs their **beaks** are used as tools; **neck** is extremely flexible
-breast muscles are the **flight muscles**
-**beaks** of birds are highly adapted for their feeding type
-birds are voracious feeders due to **high metabolic rate**
-**crop** stores food to provide a continuous supply of energy during flight
-modern birds have no teeth, grinding is done in **gizzard**; some birds “eat” pebbles to aid this process
-some birds of prey form **pellets** of undigested material (bones and fur) and regurgitate them
-birds & mammals are **warm blooded** (homeothermic)

-bird lungs are relatively small; instead of microscopic **sacs** bird lungs contain **air capillaries** & system of
-**air sacs** in body; these air sacs also serve as an **air conditioning system**
-most birds have a **larynx** but use **syrinx** to generate sounds
-have **4 chambered heart** & 2 completely separate **circuits**: pulmonary & systemic
-**brain** is same relative size as mammals
-predatory birds have eyes in front of head; other birds have eyes that look out to sides
-some of the most obvious and characteristic features of birds are the **nests** they make

-Bird Ecology: pollination, disperse seeds, pest control

-Human Interactions: meat and eggs, introduced pests, domestication, bird watching, hunting, bycatch, research, wildlife photography, art

**Class Mammalia**

today, is one of most successful group of vertebrates
-most massive of **all** animals today or that ever existed is a mammal; blue whale
-**skin** is thicker and more complex; many different glands; sensory structures
-body covered with complex layer of skin with **hair** (fur); is periodically molted
-other **keratinized** (horny) structures of mammals: **bristles**, spines, **vibrissae**, horns
-mammals have a great variety of **skin glands**: sweat, scent, oil, mammary, wax
-great variation in structure of **skeleton** based on method of locomotion and lifestyle
-mammals are **warmblooded** and much more active than reptiles

-**teeth** represent the greatest evolutionary diversification of the mammalian skeleton
-the **digestive system** may also be modified in various ways determined by their diet
-all mammals have very efficient **lungs** and breath air
-mammals have **4 chambered heart** with 2 completely separate **circuits** of blood flow
-relatively large, highly developed **brain** \(\rightarrow\) disproportionately larger per body wt

-vision and hearing well developed in most mammals

-dioecious, **internal fertilization**, all but one small group of mammals are **viviparous**
-nurse young with milk \(\rightarrow\) **mammary glands**

-3 patterns of reproduction: egg laying, marsupials, placental mammals

-Mammal Ecology: pollination & plant dispersal

-Human Impacts: domestication, pets, service animals, hunting, fur & game farming, zoos education, research, food and crop loss, sickness & disease, illegal trade in mammal products, bycatch, pollution, tourism, wildlife photography, art, entertainment

---

This is NOT “what’s on the test”; this is a summary of the major points from lab and lectures; the lecture & lab notes are the sources of exam questions