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 motilityin 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

Suphylum 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 **atriopore**
-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
-<u>all</u> 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 bloodflow
-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 posess 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

-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

-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 **molted** 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
-some with elaborate courtship, nesting, mating, and parental behavior
-**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** → 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 → **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