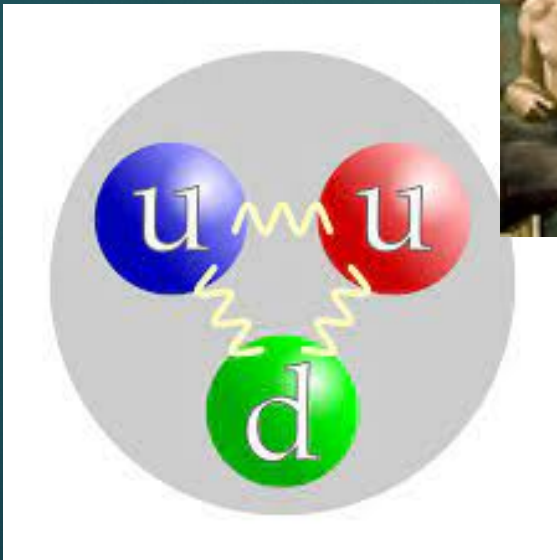


Quarks to Quasars

Or science for creationists

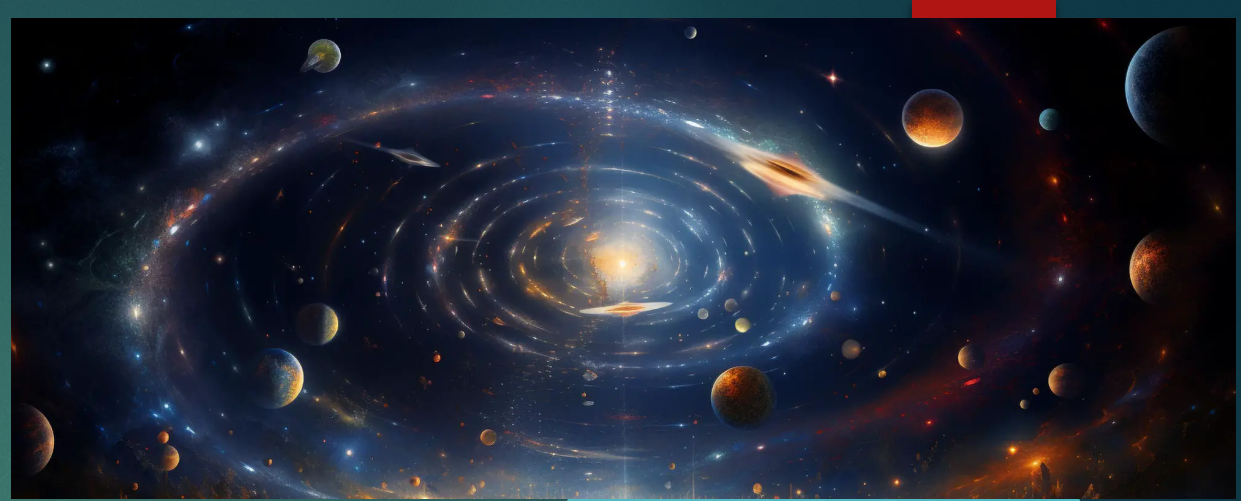
IX. Human Body



Outline/Review

- ▶ I. Introduction – importance, improbability, theory flaws
- ▶ II. Quarks and Atoms – Big Bang, string theory, atoms, relativity
- ▶ III. Molecules and Cells – many complex systems but great order
- ▶ IV. Cells=Life – abiogenesis/cell formed, division, genetics, embryogenesis
- ▶ V. Life to Man- short history coincidences, path to man, fossil lack
- ▶ VI. Other creeping things – many special design ; complex and improbable
- ▶ VII. Earth and Geology- dating problems, age appearance, Flood, design
- ▶ VIII. Heavens – gamut of celestial bodies; many inconsistencies w Big Bang
- ▶ IX. Human body
 - ▶ Organs, tissues, systems
 - ▶ Many integrated, complex metabolic, developmental, regulation pathways
 - ▶ Design vs evolution

Purpose: God made for Man



- ▶ Remember the “small stuff”?: atoms, molecules, organic molecules, complex/integrated systems, cells, **complexity yet order** in life
- ▶ Remember the BIG STUFF?: the earth/universe to **demonstrate His glory**
- ▶ Sea, flying, and land creatures (“**Journey to Man**”)- Man’s dominion
- ▶ The human body is the climax of His creation! (day 6) – His image, likeness; very good!
 - ▶ Survey the breadth of what the human body entails
 - ▶ Demonstrates amazing **design** of the processes and capabilities
 - ▶ too many adaptations to have occurred by trial and error.
- ▶ **Psalm 139:14**
 - ▶ **I will praise thee; for I am fearfully and wonderfully made: Marvellous are thy works; And that my soul knoweth right well**

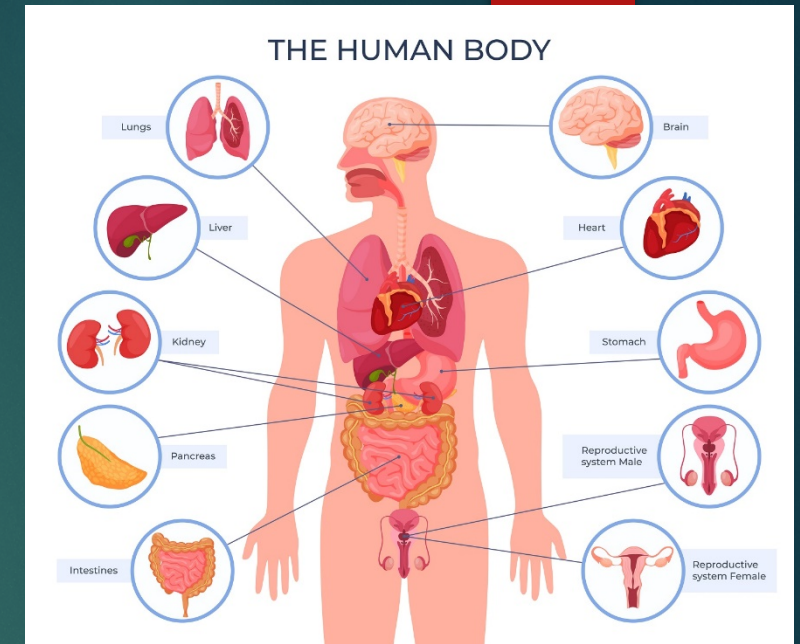


Recurring “proof” themes (evaluate these throughout)

- ▶ Mathematical improbabilities
- ▶ Violations/misapplications of logic and scientific principles
- ▶ Supernatural design (vs results of natural selection)
- ▶ Contradictions of Scripture/theological bases

The Human Body

- ▶ Unfathomable design
 - ▶ Complexities; order and efficiencies
 - ▶ Irreducible complexity – a recurring theme
 - ▶ Healing capabilities; adaptations
 - ▶ “lower” animals, etc have formidably complex components
- ▶ Multiplicity of organs, tissues, systems – all directed by innumerable processes from differentiation to formation to function to regulation
- ▶ Basic unit frequently underlies the larger organ
- ▶ 1Cor 12:12 - For as the body is one, and hath many members, and all the members of that one body, being many, are one body: so also is Christ.

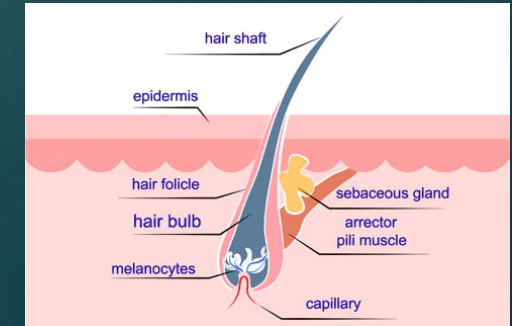
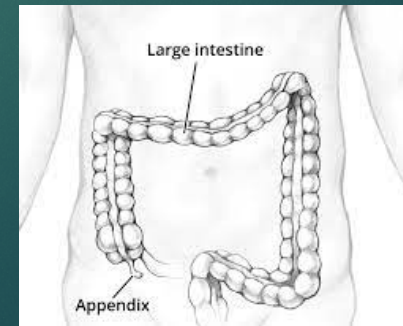
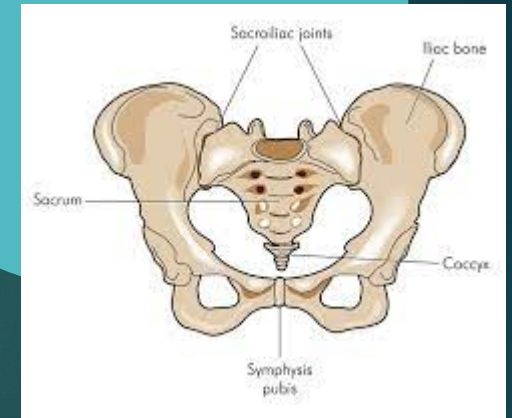
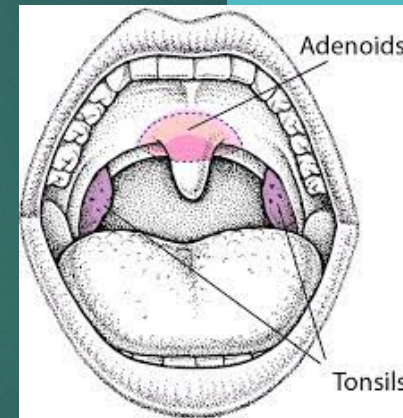
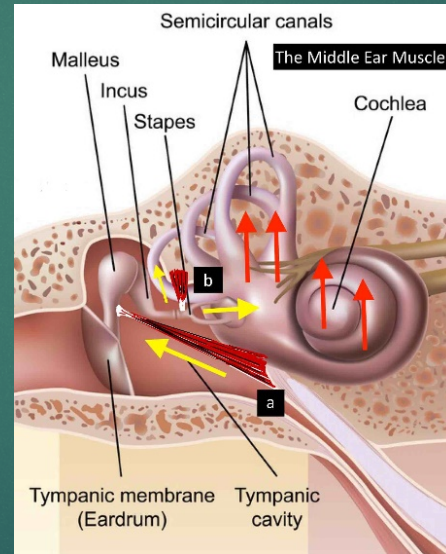
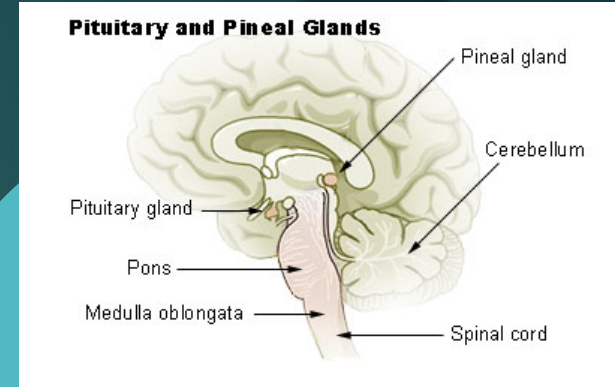
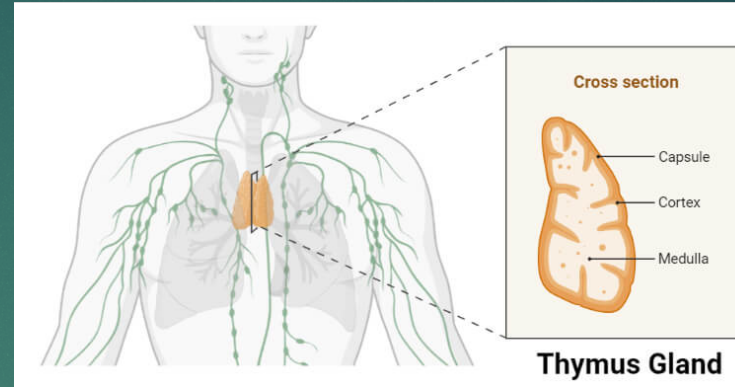


First, let's dispense with what it is NOT...

Vestigial Organs (recapitulation theory)

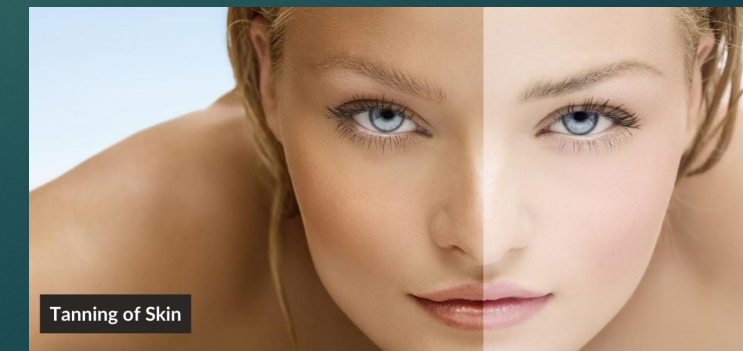
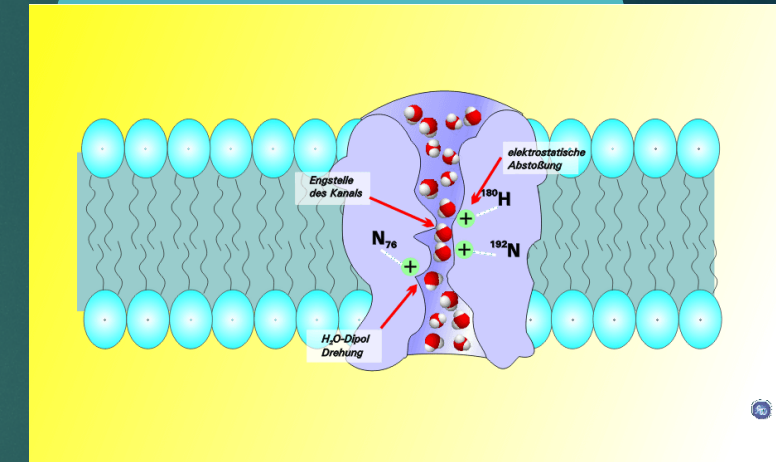
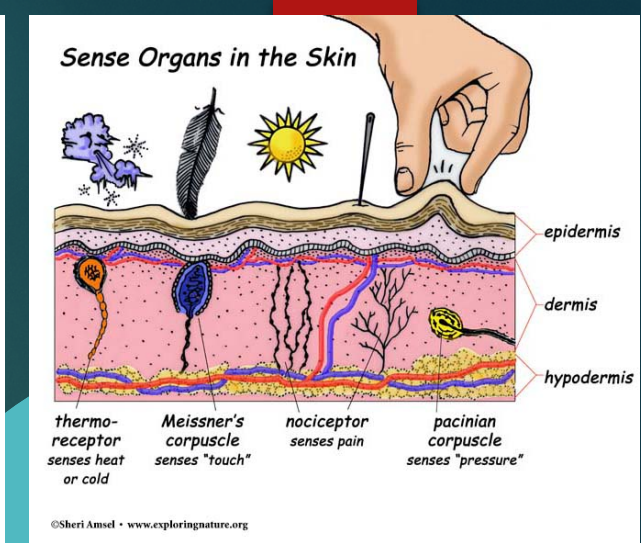
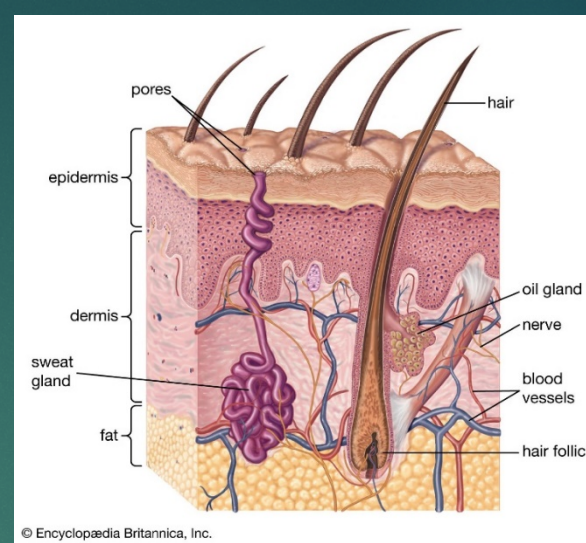
- ▶ Darwin listed 12 (in *Descent of Man*, 1871)
 - ▶ 1893 anatomist Wiedersheim 86; others 100
- ▶ Function now ID'd for most; "top ten":
 - ▶ Thymus- immune system (T cells)
 - ▶ Pineal gland- endocrine (melatonin)
 - ▶ Pituitary – controls many endocrine functions
 - ▶ Ear muscle – protection of eardrum/etc
 - ▶ Tonsils/adenoids - lymphoid
 - ▶ Coccyx- 6 muscles anchored, pelvic floor
 - ▶ 3rd molars ("wisdom teeth")
 - ▶ Appendix – lymphoid
 - ▶ Goose bump muscles – heat
 - ▶ Babinski and Grasp reflex – programmed, **not remnant**

▶ Why not just presume we have not yet found the function for others?



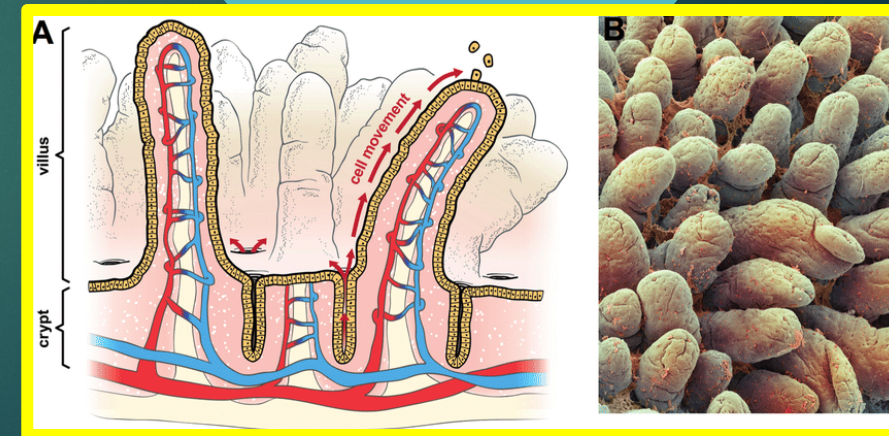
Skin...not just skin deep

- ▶ Largest organ (essential for life)
- ▶ Glands
 - ▶ Sebaceous – body oils
 - ▶ Eccrine – most sweat glands
 - ▶ Apocrine – specialized areas – axilla, ear canal, perineal, etc
- ▶ More complex than might be thought
 - ▶ Aquaporins (Agre, Nobel 2003) – specialized water channels with a family of proteins that allows water transfer, including sweating (implications for deodorants!)
- ▶ Sensory receptors – fine touch, temperature, pain, vibration
- ▶ Adaptable
 - ▶ thicker (eg work hands, soles of feet)
 - ▶ Melanin production increased 2/2 UV radiation
- ▶ Unique fingerprints



Gastrointestinal/Digestive system

- ▶ Teeth/chewing muscles/tongue
- ▶ Swallowing mechanism is fairly complex (50 pairs of muscles)
- ▶ Esophagus – same top path as respiratory; epiglottis as gate
- ▶ Stomach – flexible volume; pH ~2; acid hydrolysis/amylase (lining protected by goblet cells); receptors to regulate
- ▶ Gall bladder adds necessary ingredients for fat solubilization
- ▶ Pancreas – juice digestive enzymes; neutralizes acid; control glucose
- ▶ **Small intestine** – influx water to solubilize, enzyme systems activated, 22' long, villi multiply surface area (2700 ft²), nutrients absorbed to liver, etc
 - ▶ Network of blood vessels to collect and distribute (mesentery)
 - ▶ Selectivity in absorbing useful nutrients
- ▶ Colon – reabsorption of water
- ▶ Rectum – elimination of wastes
- ▶ Mucosal lining – includes IgA antibodies as defence; ~75% of body's immune cells are in gut

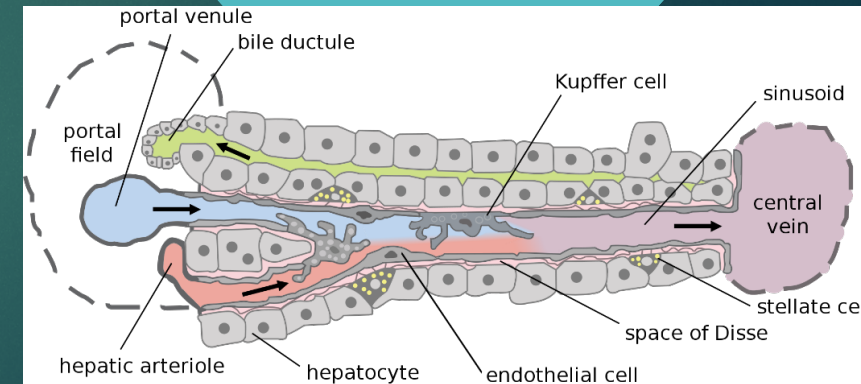
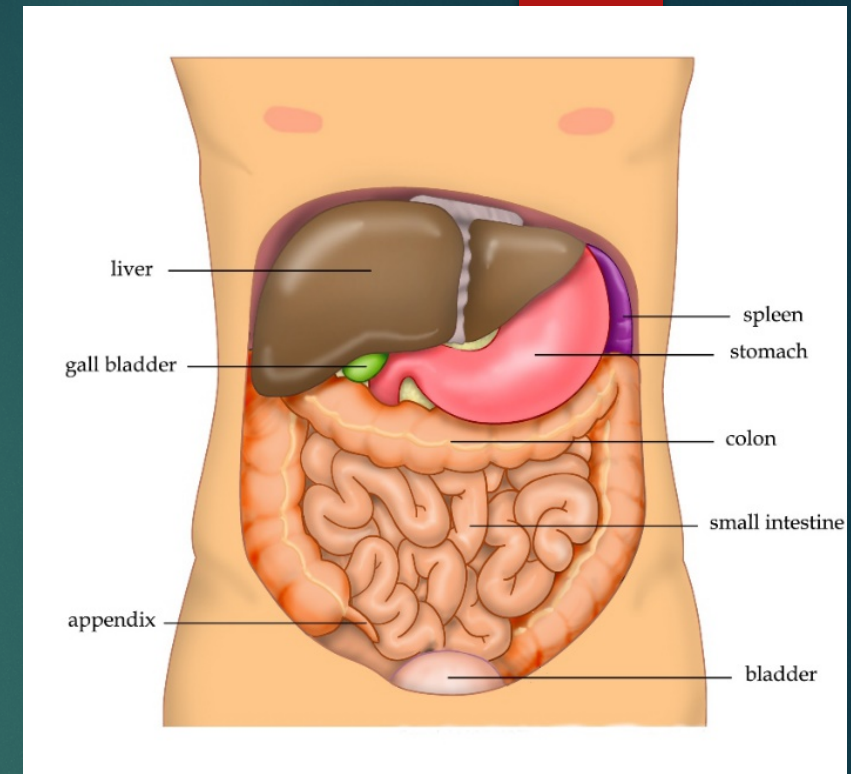


Each of these have complex, orderly functioning that is vital to health

Liver

- ▶ Largest solid, isolated organ - size varies widely
- ▶ Can regenerate (only organ that can do that)
- ▶ 60% of protein coding genes are expressed in the liver
- ▶ ~500 functions – (portal vein from GI tract)
 - ▶ Detoxifies (eg H-peroxide) and many drugs and toxins
 - ▶ Removes “spent” RBCs (bilirubin)
 - ▶ produce clotting factors (including regulatory of platelets)
 - ▶ Vitamin/mineral storage (B12, A, D, K, Fe Cu, Zn, Co)
 - ▶ Works in concert with gall bladder for fat metabolism – synthesizes most of body’s lipoproteins
 - ▶ Store glucose as glycogen; many AAs stored in fat deposits

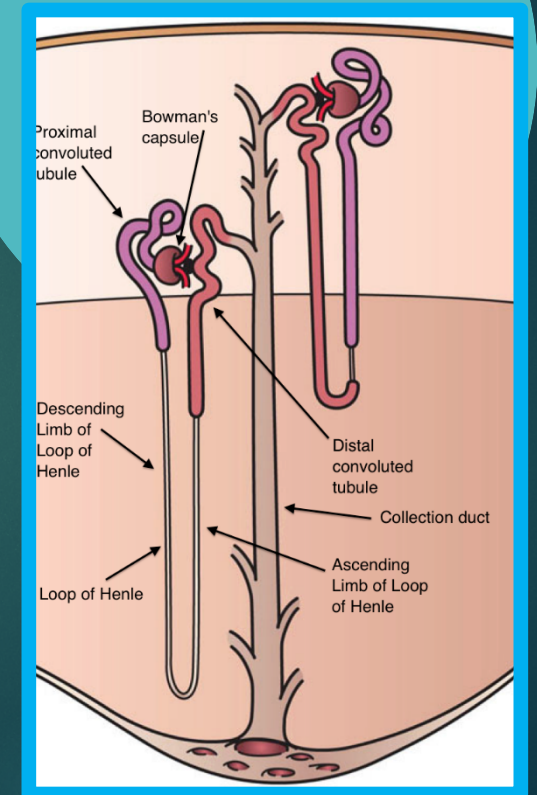
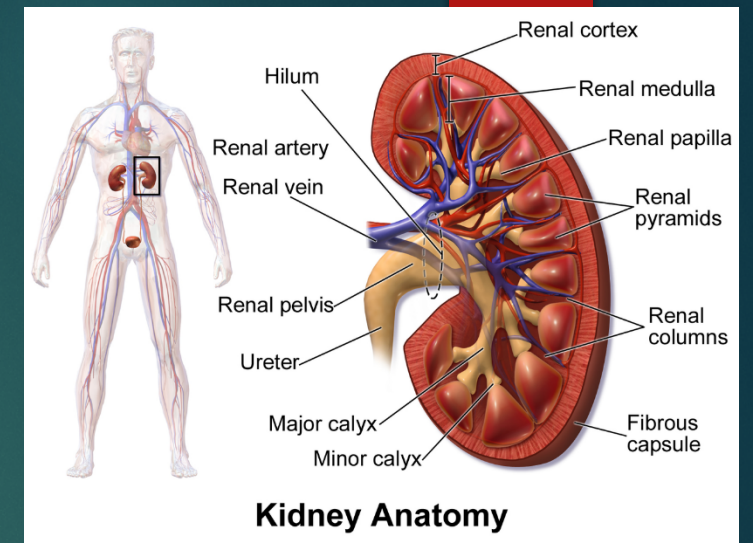
Consider efficiency of so many vital functions; the complexities – how could that evolve?



Hepatic lobule

Kidneys

- ▶ Consists of ~1M **nephrons/glomerulus** (functional unit)
- ▶ Control of body fluids (urine, hydration)
- ▶ Acid-base balance
- ▶ Osmolality (hypothalamus/post pituitary)- diuresis (eg salt, coffee)
 - ▶ Blood pressure control implications
- ▶ Other electrolyte balances (Na, K, etc)
- ▶ Reabsorption: water, bicarb, glucose, AAs
- ▶ Secretion: H, NH₃, K, uric acid and many drugs, etc
- ▶ Metabolic roles: activates vit D, erythropoietin (RBCs), renin (BP)
- ▶ **Again, imagine the control of the many specialized cells, the organization, and the complex pathways that had to work from the start or else the organism would DIE!**



Circulatory system

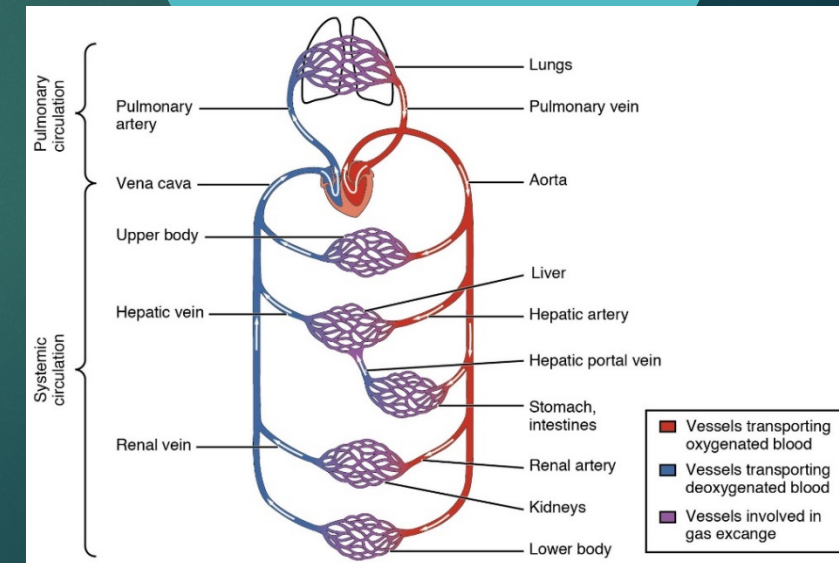
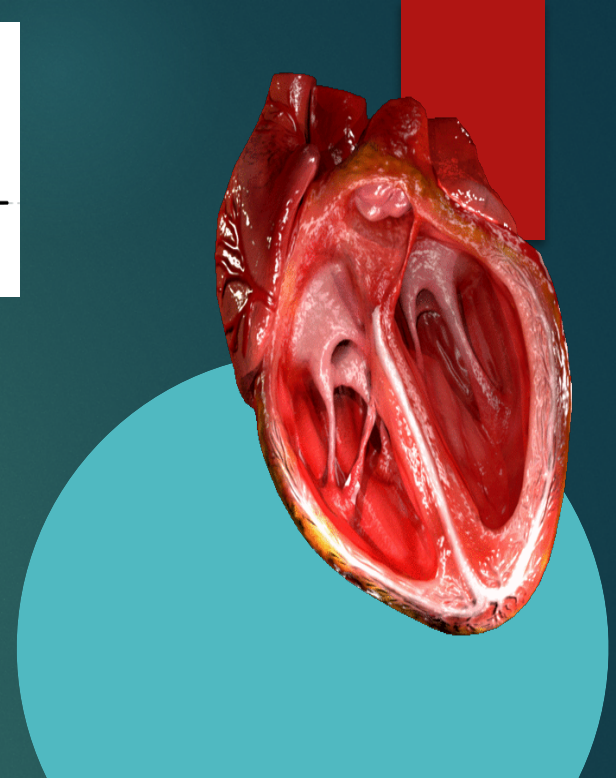
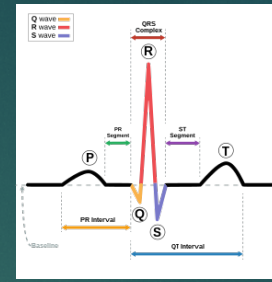
- ▶ Wm Harvey (1578-1657) – discovered; previously Galen (~130-200) philosophized began intestines, pores in heart and “vital spirits” added; no body dissection; dominated until Harvey
- ▶ Heart (with its coronary arteries) – 5.25 L/min; ~70 bpm; (total is 5 L)
 - ▶ Electrophysiology; “ticker” SA node
 - ▶ 4 chambers with valves with specific structures, timing
 - ▶ Wrapped in pericardium (likely site of Jesus’ being pierced)
 - ▶ Some neural input (Vagal nerve - parasympathetic)
 - ▶ A big muscle with complex, enzyme control by Troponin/Ca contraction; K repolarization (and blood vessel supply – coronaries!)

Vessels

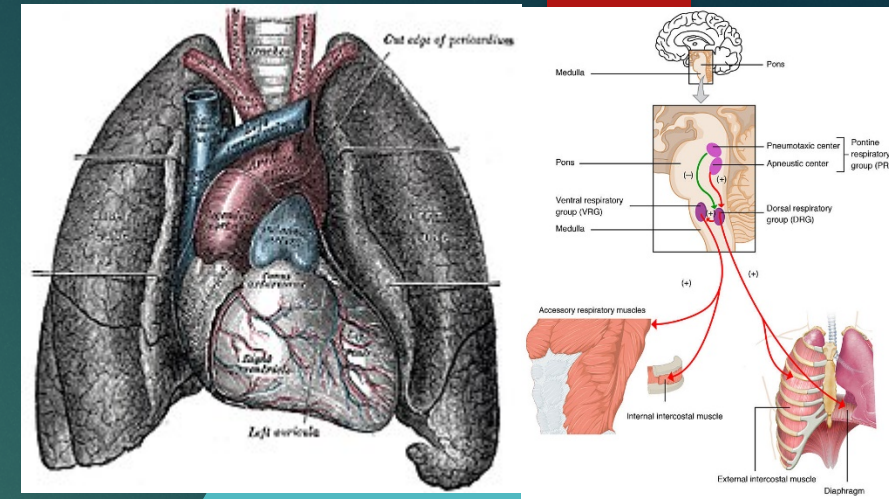
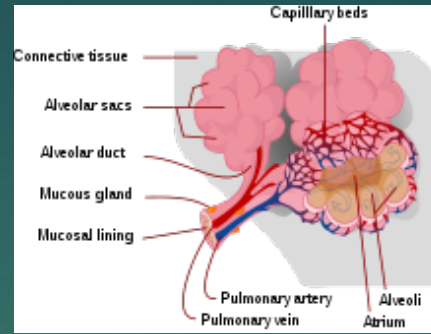
- ▶ Arteries, Veins, Capillaries, Lymphatics
- ▶ Blood pressure control – carotid sinus baroreceptors (stretch) controls several homeostatic mechanisms – **can't work part way!**
- ▶ Blood – hemoglobin, different cell types, immune response

▶ **Blood vessels actually have a slight helical twist which gives better flow (DESIGN!)**

▶ (New Scientist 158(2134);19, May 16, 1998

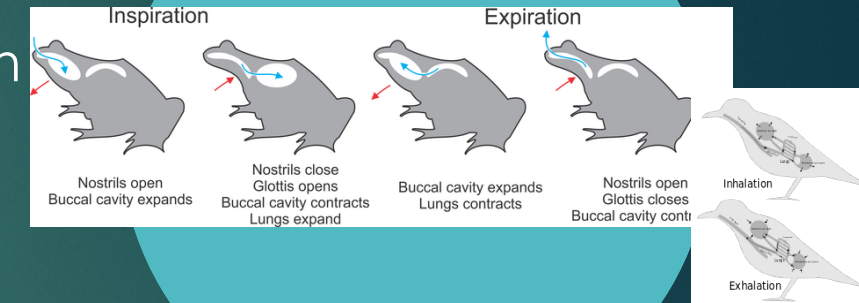


Lungs



▶ Mechanical –

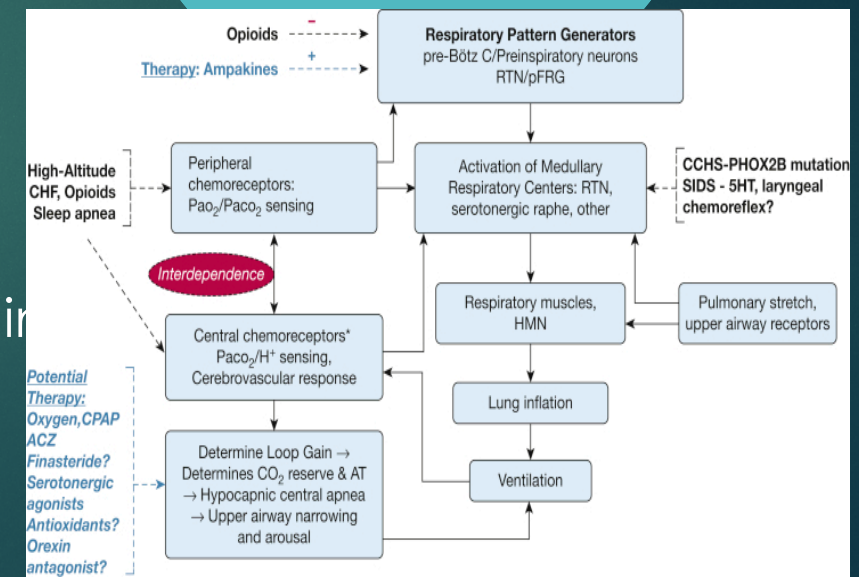
- ▶ muscles of respiration (cf pharyngeal/buccal pumping in amphibians and “circulatory” in birds; no “in between”)
- ▶ alveoli -inflation with precise surfactant mix - surface tension
 - ▶ increases surface area (1400ft²) for exchange with capillaries
 - ▶ Control of ventilation – brainstem; complex mechanisms



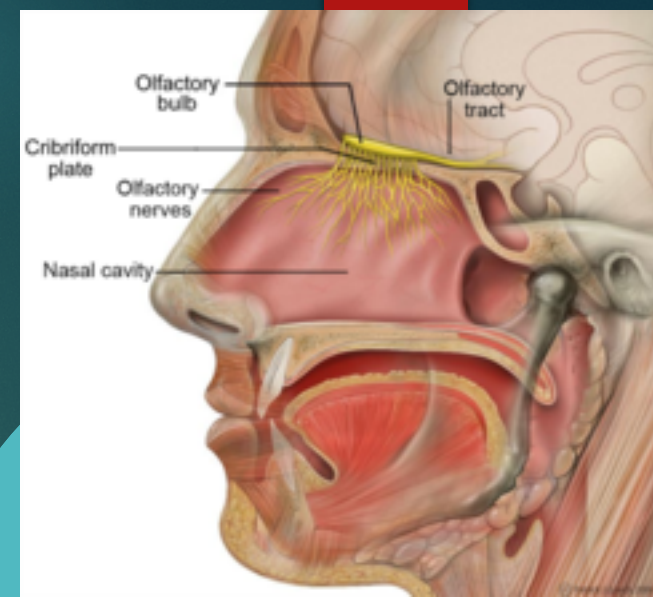
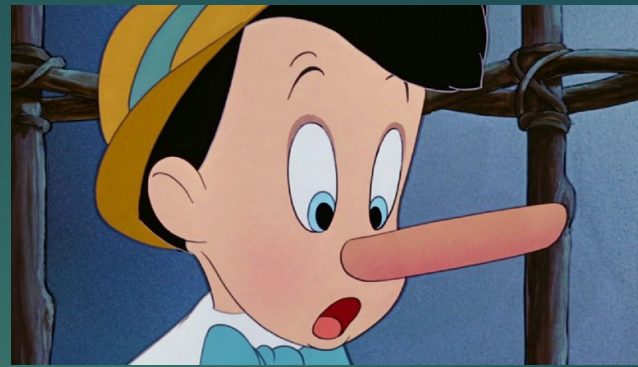
▶ Biochemical - O₂ in and CO₂ out

- ▶ O₂ solubility would require 1050 bpm
 - ▶ hemoglobin makes it work; 99% bound, facilitatively >> CO₂
- ▶ Blood flow – linked to heart; 25 B RBCs per minute; only .75s in the alveoli; 1 gal/min pumped

Such a vital function; no room for partial, or errors in development!



Nose/Smell

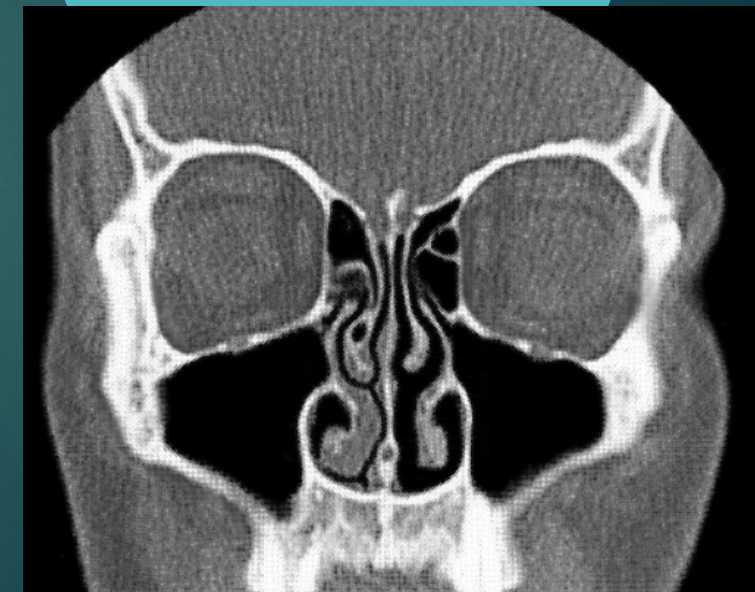
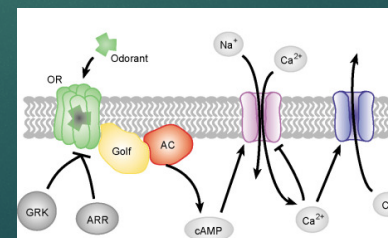
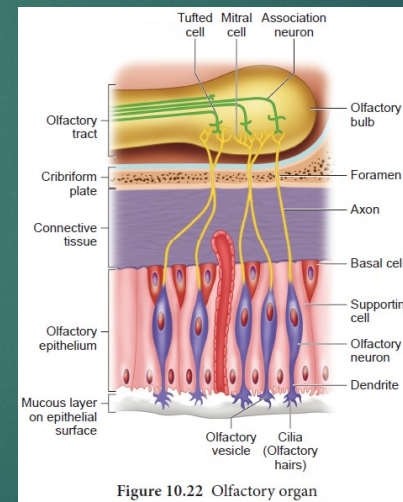


- ▶ 20K liters air/day; 220K rhinoplasties/yr in US
- ▶ One nostril usually dominates at a time in breathing, but other cycles around - regulated by autonomic NS by stiffening effect; pranayama, a kind of yoga tries to control

- ▶ https://en.wikipedia.org/wiki/Nasal_cycle

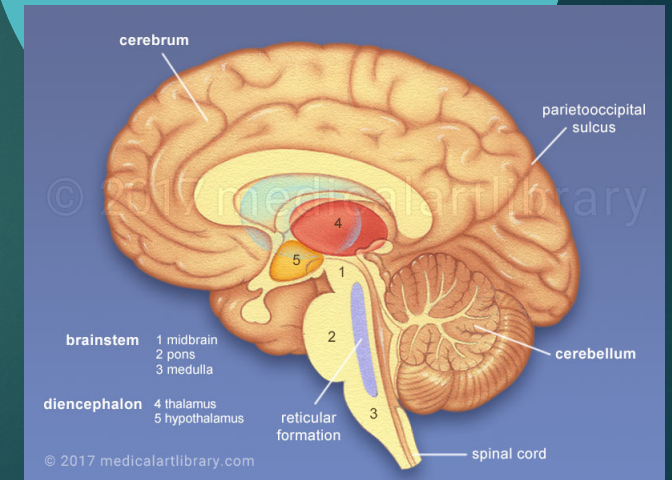
- ▶ Other functions

- ▶ Olfactory cells: can smell up to 1T odors
 - ▶ Nose can trap harmful debris
 - ▶ Warms, humidifies air before entering lungs
 - ▶ Voice intonation/sinuses



Brain

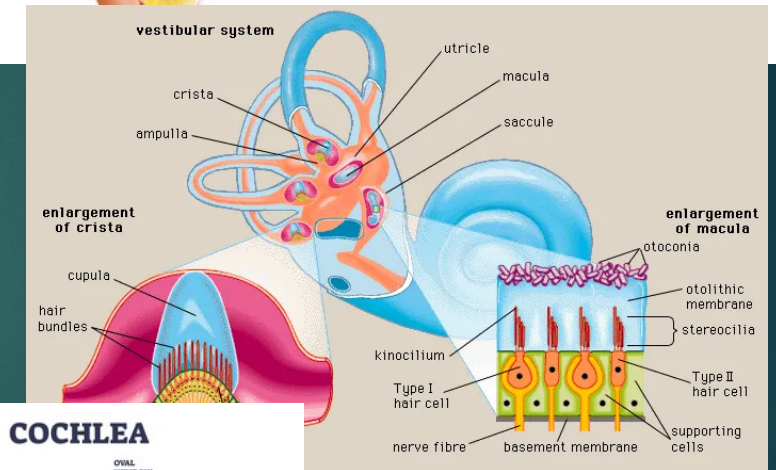
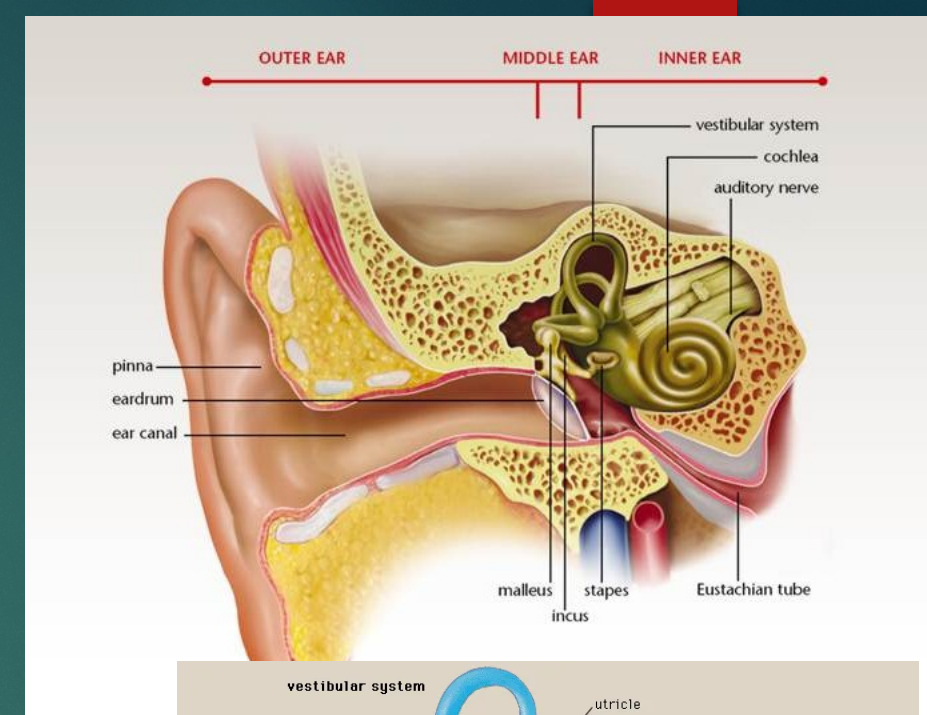
- ▶ Amazing hardware: 1350gm; power of 1000 supercomputers; 200B neurons w 100T connections; length of connections – 100K mi!; 10^{15} signals/s
 - ▶ Recently found to be 10x more active than thought (petabyte levels of storage)
 - ▶ 20% of total energy budget in an organism (2% of mass)
- ▶ Organization
 - ▶ **Cerebral cortex** – (right vs left features); multiple lobes/purposes
 - ▶ White matter – inner, mostly nerves with higher fat content (myelin)
 - ▶ Gray matter – outer, sensory/motor activities
 - ▶ Lobes: frontal, parietal, temporal, motor, Premotor cortex – motor memory, occipital
 - ▶ **Cerebellum** – more surface area than previously recognized- very tightly packed folds with much more than other apes (80% to 30%) of the cerebrum; even larger in some animals (eg momyrid fishes –"elephantfish"); **does not fit evolution scheme**
 - ▶ in general control - motor coordination/learning/posture
 - ▶ but also cognitive functions, mathematical
- ▶ special components – hypothalamus, thalamus, pituitary, pineal gland, amygdala, ventricles, corpus callosum, and more; brainstem... Breathing, reflexes
- ▶ Apoptosis – 25K neurons formed/min in womb; then about 50% programmed death few mos after birth
- ▶ Blood supply (strokes), etc



And all has to work together; eg. no brainstem = no breathing;

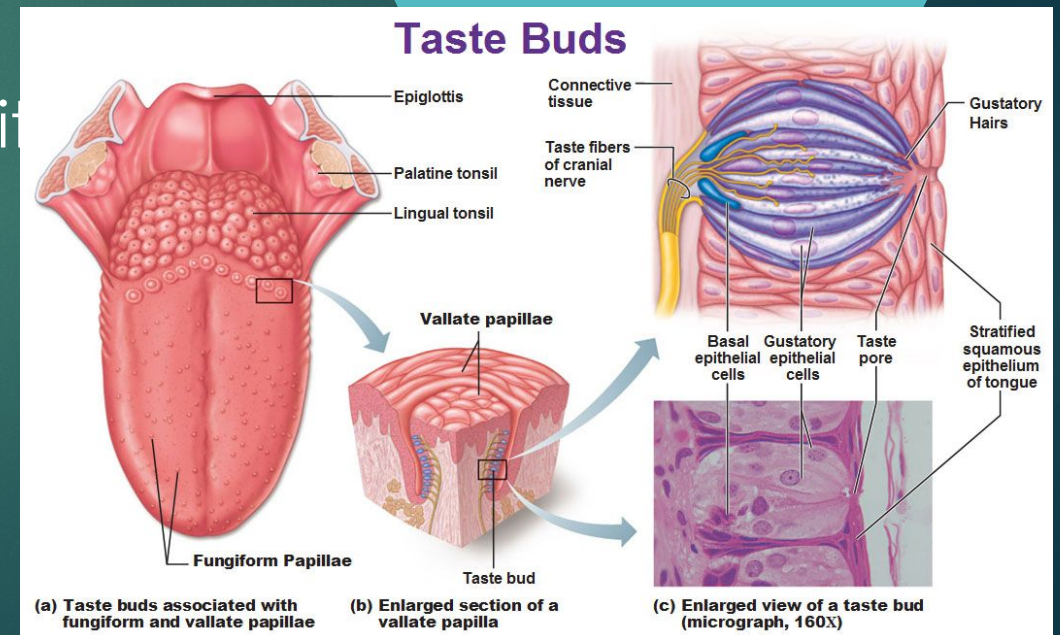
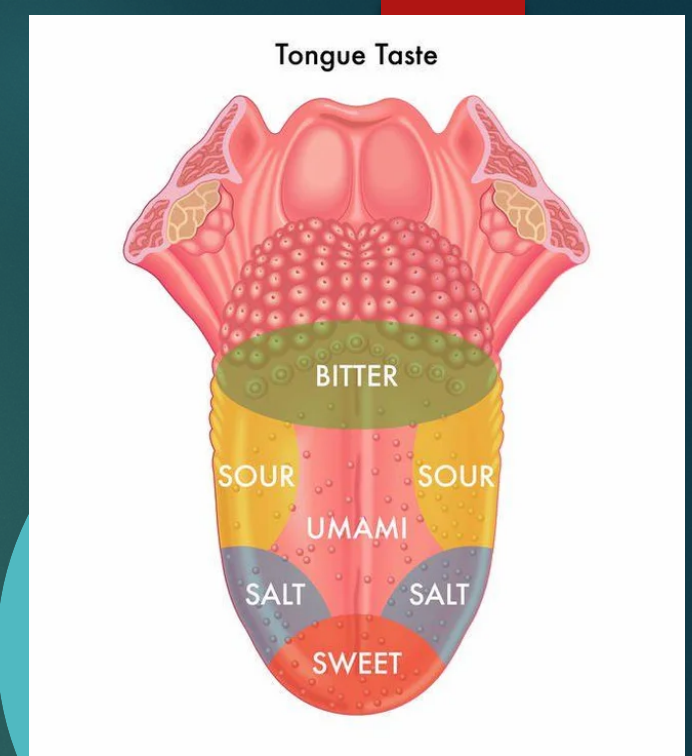
Ears – hearing and balance

- ▶ External ear, bones, muscles – separated for sound localization, gathers, tempers
 - ▶ Cochlea – hearing; 25K nerve endings, “tuned” to different frequencies; 20 to 20K Hz (other animals wider)
- ▶ But much more than “just” hearing...
 - ▶ Sacculle and utricular – stationary balance
 - ▶ Semilunar canals – sensation of body position, acceleration, dynamic balance
- ▶ Neural interface with brain- input from other senses- eye tracking, body coordination, perception, etc



Taste (tongue)

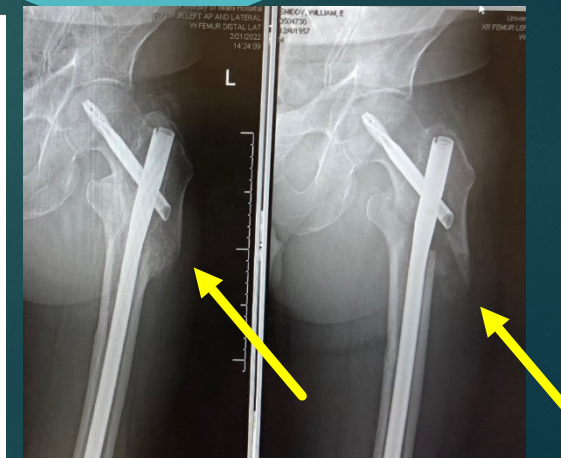
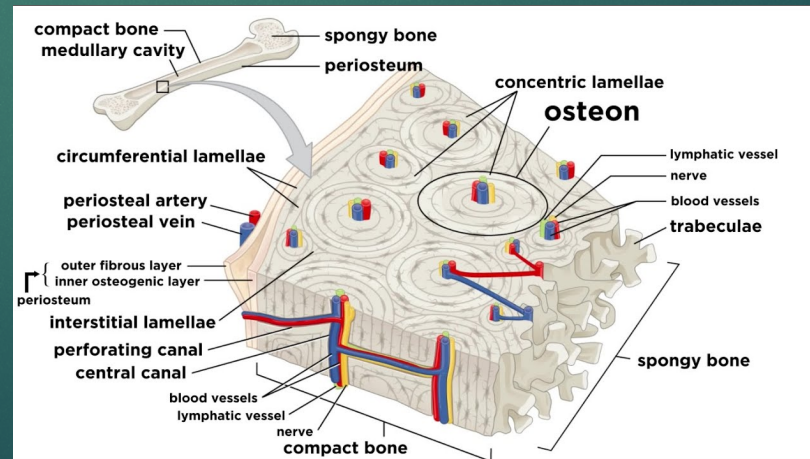
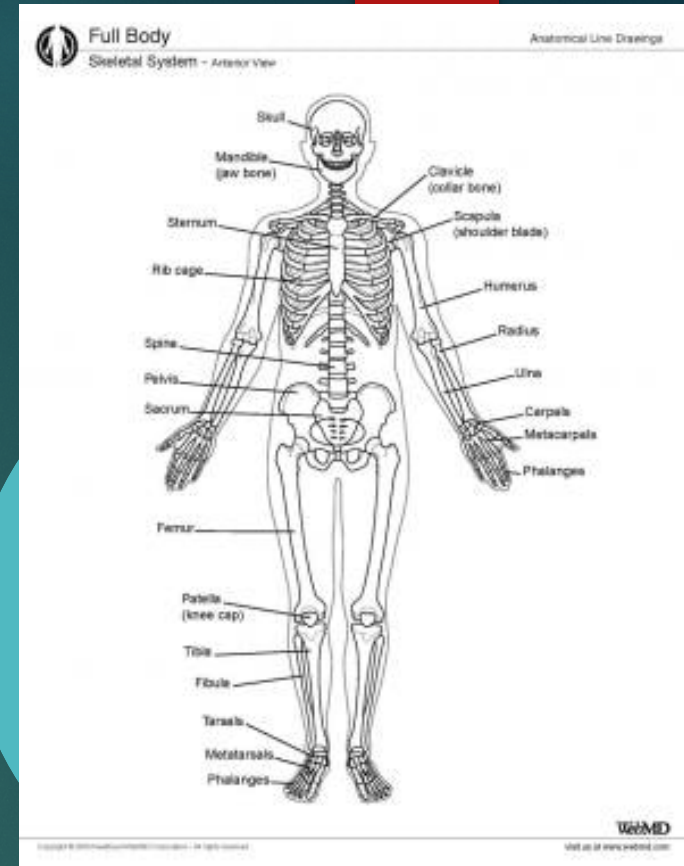
- ▶ 5 sensors: sweet, salty, sour, bitter, umami (meaty, savory, deep flavor; via a receptor to allow seeking out high protein food)
- ▶ Specialized cells to sense taste, processing centrally
- ▶ Each person has a unique “tongue print”
- ▶ Necessary for speech, processing food bits
- ▶ Man has “lost” some taste function compared to other animals



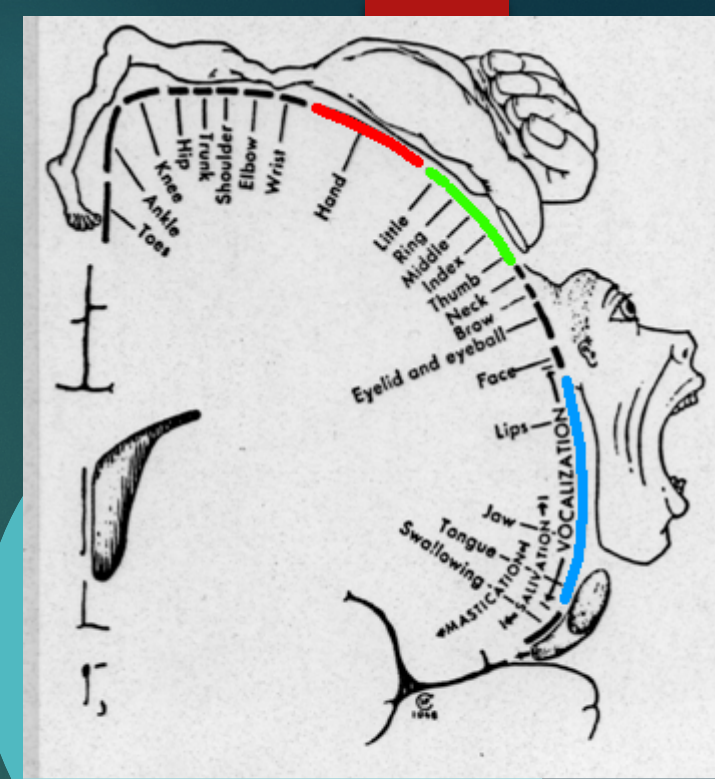
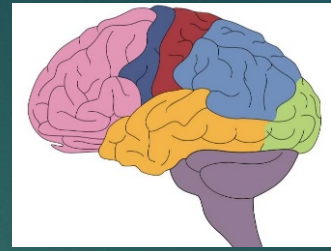
Skeletal system

- ▶ 206 bones in human; much symmetry and homology
- ▶ Collagen “rebar”, apatite “cement”; spongy internal allows better reinforcement, and marrow
- ▶ Osteon: can regenerate/remodel through cells in periosteum
 - ▶ Routinely used by thoracic/reconstruction surgeons
 - ▶ Adam’s rib? Bone, rib will regrow if periosteum is preserved)
 - ▶ Gen 2:21 - And the Lord God caused a deep sleep to fall upon Adam, and he slept: and he took one of his ribs, and closed up the flesh instead thereof;
- ▶ Many examples of excellent design
 - ▶ Ankle, cranium
 - ▶ Knee
 - ▶ Ranges of motion/joints
 - ▶ Growth plates
 - ▶ Protection, structure, function

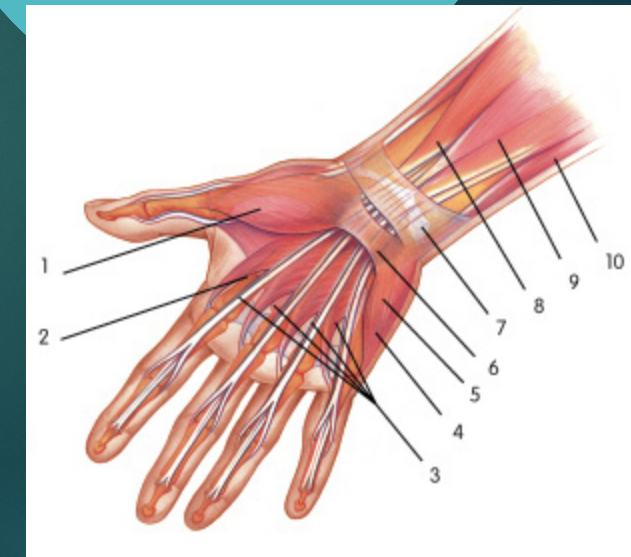
We do not find some parts “ahead” of others in development



Hand design (just one example in skeletal system)



- ▶ Incredible range: avg grip 100 lbs, finger-thumb as low as 0.07 oz
- ▶ Disproportionate representation of hand (and mouth) in motor cortex (“homunculus”)
- ▶ Speed range: 40ms piano notes (anticipatory); Coordination of many hand muscles
- ▶ Opposable thumb (27 bones; etc working together!)
- ▶ Integration with visual, auditory, sensory systems
- ▶ God's hand in Scripture (122 verses!)
 - ▶ Right hand of Father – Acts 5:31; Rom 8:34; Col 3:1; Heb 1:3; 1Pet 3:22
 - ▶ Made things by His hand - Acts 7:50 – made all these things
 - ▶ Protection -Job 12:10 – life given
 - ▶ Justice/deliverance – Deut 32:41 – takes hold on justice
 - ▶ Direction – Ruth 1:13 – hand of the Lord



Summary – the organs

- ▶ Complexity yet order
- ▶ Necessary functions
- ▶ Note how all had to work from the start or else lethal
 - ▶ No changes have been observed
- ▶ But there is more!
- ▶ Remember, each organ has special/differentiated cells/tissues
 - ▶ Consider that each must be specially expressed
 - ▶ Each must have been directed to form in the right place (during embryonic development), at the right time, connected to its right complement
 - ▶ The sheer number of systems on an organ, tissue, biochemical level is unfathomable!

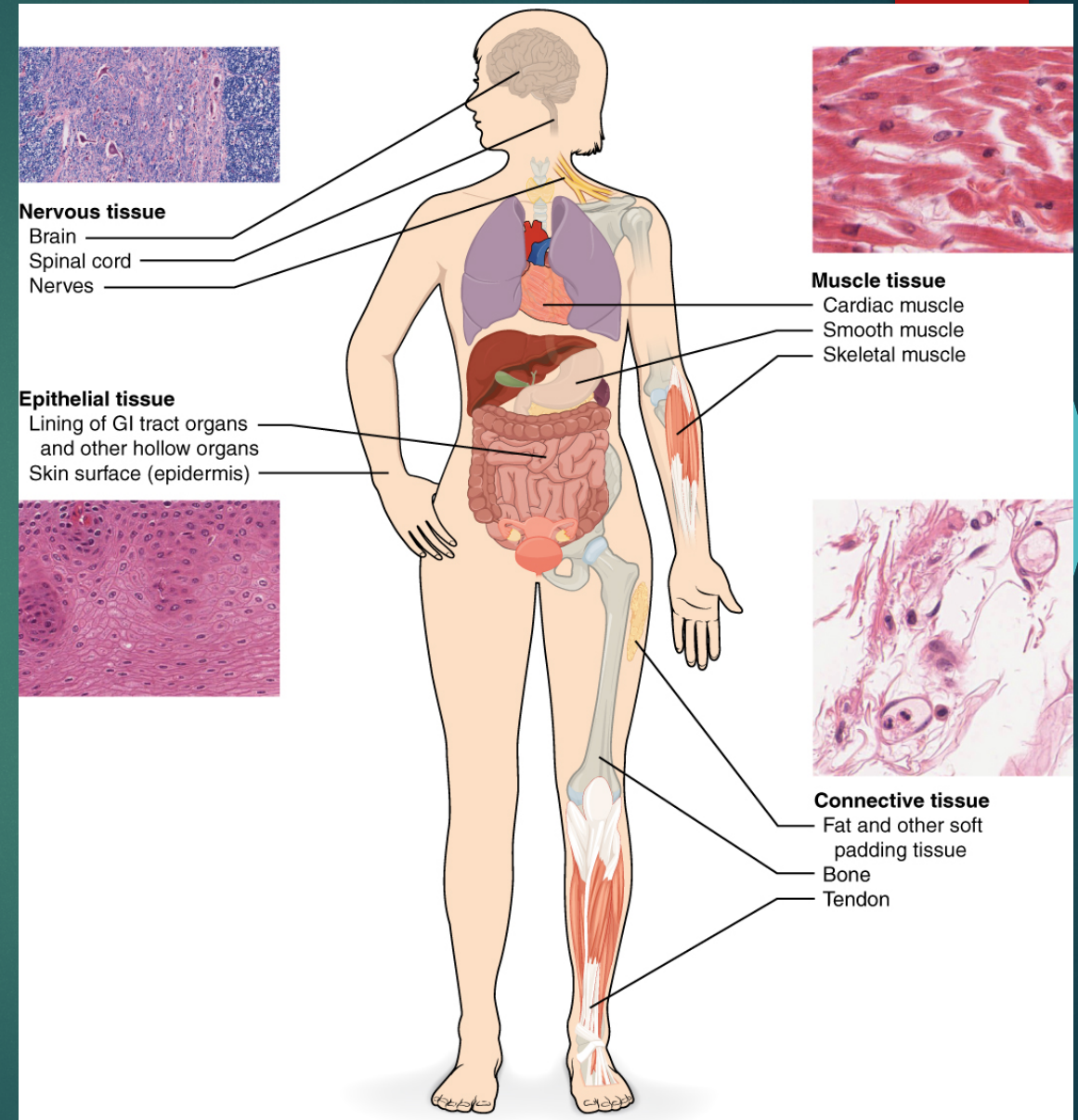
Irreducible Complexity

How can this be anything but design?

Drill down just a bit...

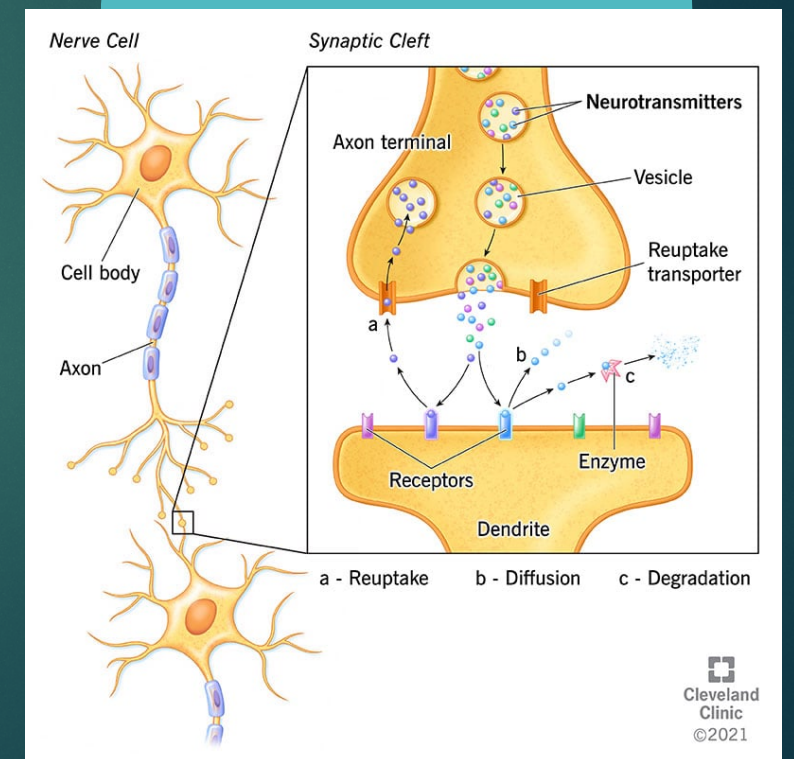
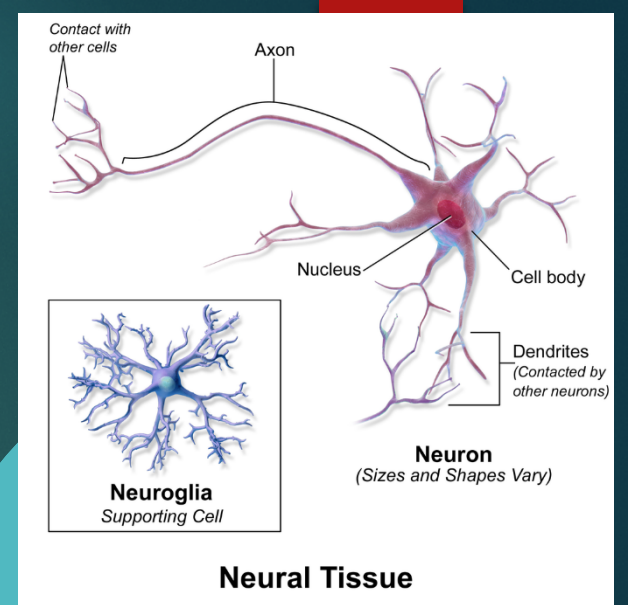
Tissues

- ▶ 4 main types
 - ▶ Epithelial
 - ▶ Nervous
 - ▶ Muscle
 - ▶ Connective
- ▶ Not to mention subtypes!
- ▶ Each has the exact same DNA! Complex regulation/signaling/ epigenetics



Nervous tissue

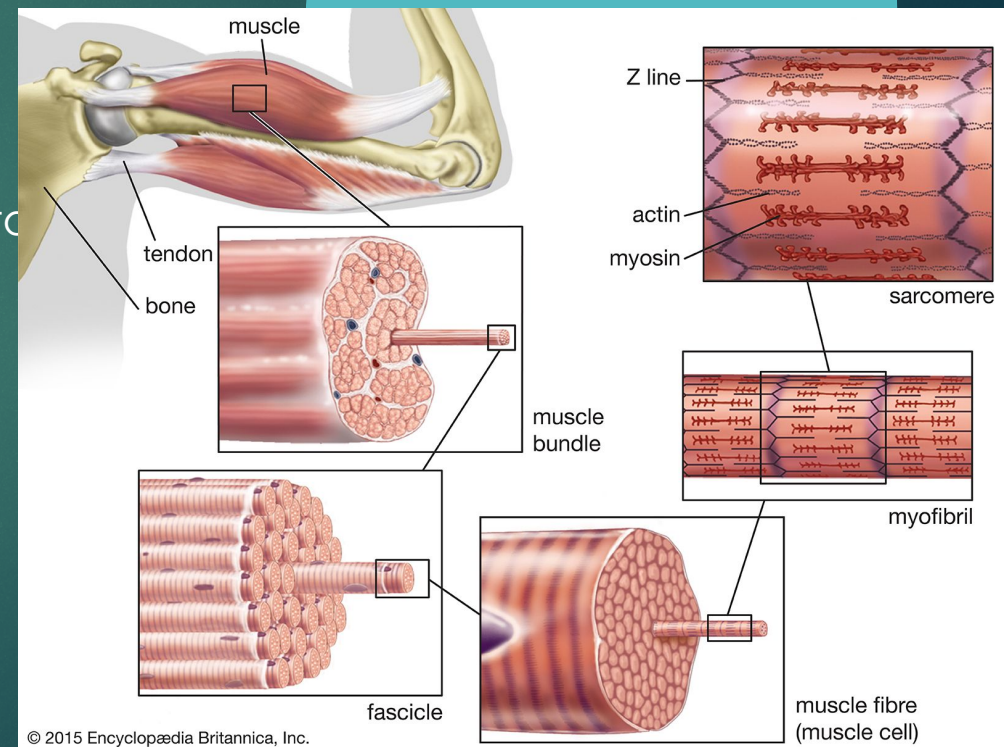
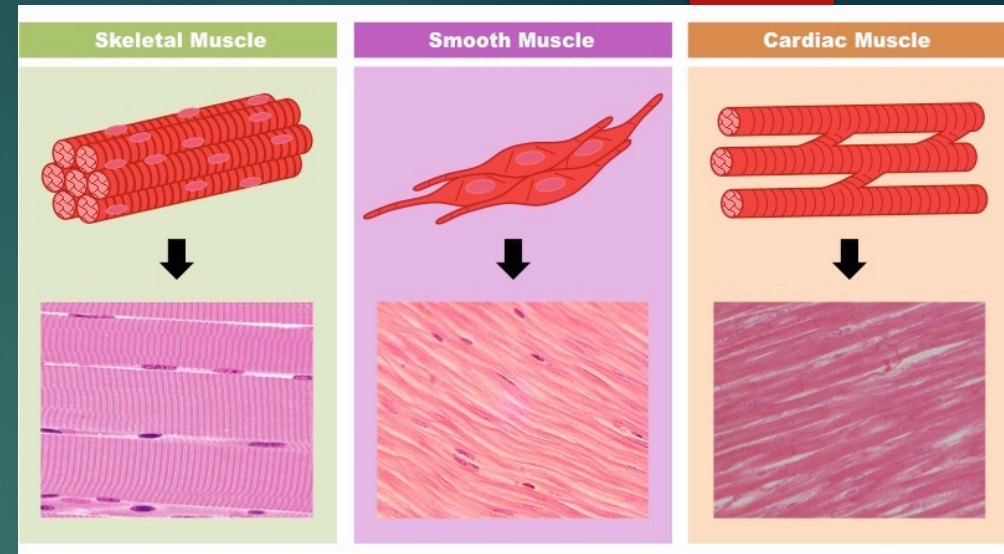
- ▶ Central nervous system (cannot regenerate; maybe?)
 - ▶ Brain, Spinal cord
- ▶ Peripheral nervous system (axons can regenerate)
- ▶ Neurons (cell body but variable length axons; sensory, motor) (about 10^{11} in body)
 - ▶ Electrical “action potentials” is manner of action
 - ▶ Neurotransmitters (varied, complex regulation) at synaptic cleft (Cajal, Nobel 1906) (about 10^{15} synapses in body)
 - ▶ Might synapse with several (10^4) other neurons/target tissues
- ▶ Supporting cells (glial), astrocytes (larger, metabolic support), oligodendrocytes/Schwann cells (produce myelin sheath)
- ▶ Notice how many different cell types this takes!



Muscles



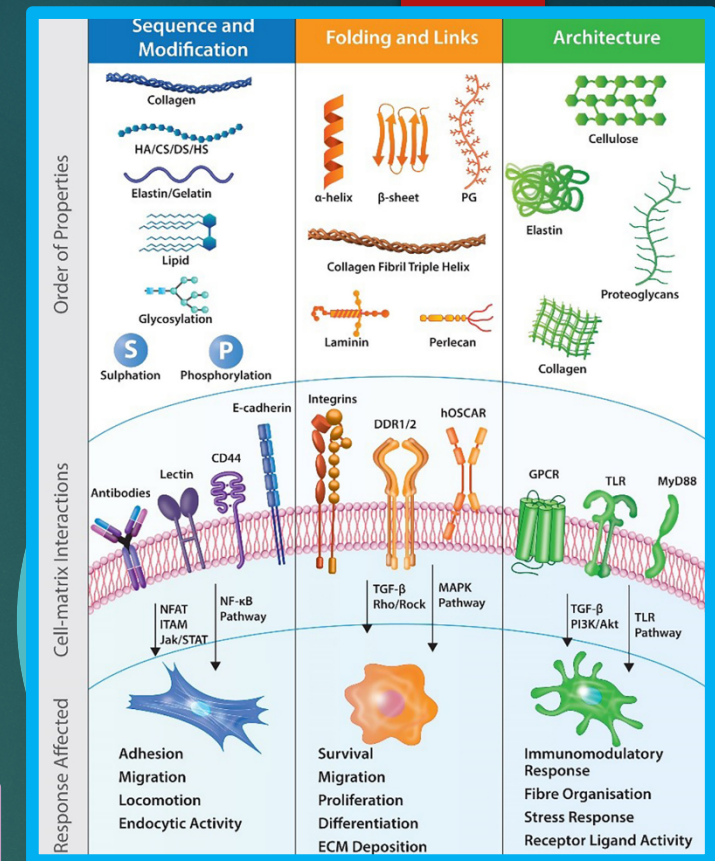
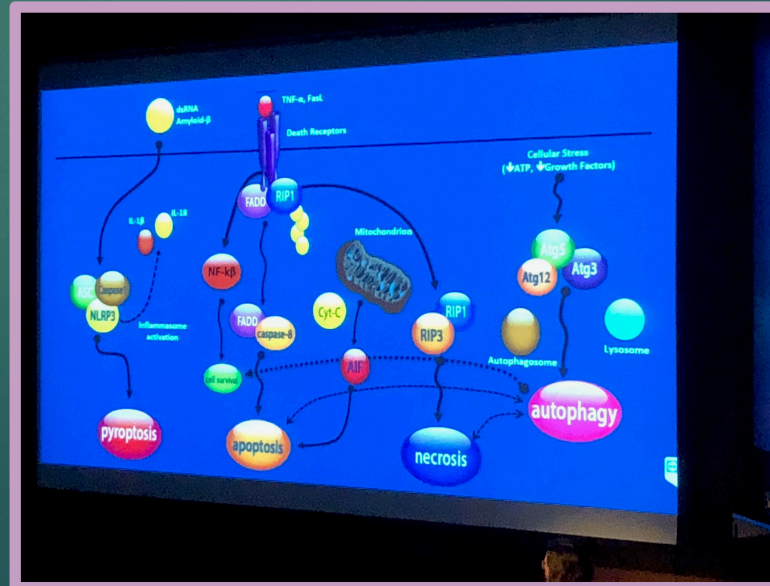
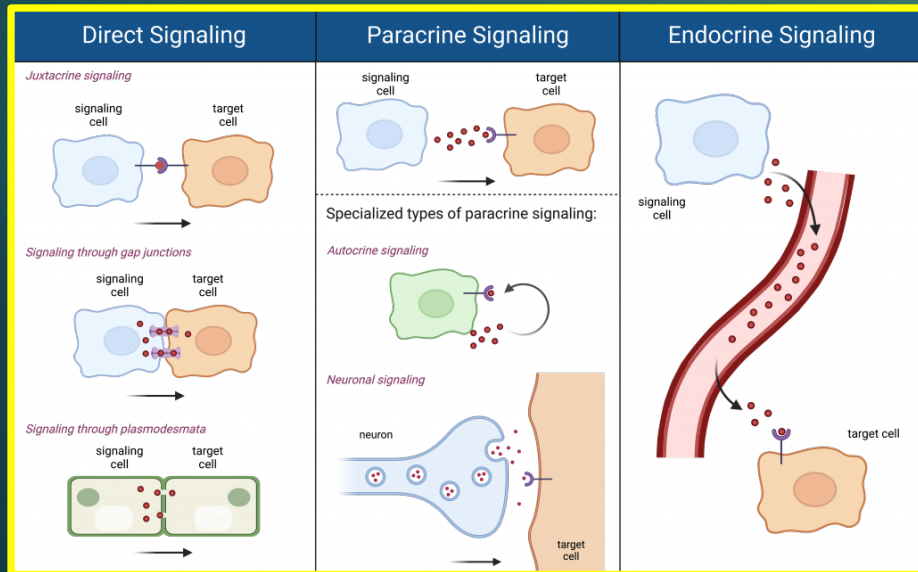
- ▶ 3 general types: skeletal (motion, voluntary), smooth (organs, involuntary), cardiac
- ▶ Can hypertrophy/atrophy (adapt)
- ▶ Skeletal (density > water)
 - ▶ Type I: “dark” (stored myoglobin/storage of O₂) for “slow-twitch” (aerobic); rich in mitochondria and capillaries
 - ▶ Type II: “white” for “fast-twitch” (anaerobic); in situ glucose; lactic acid build up; (also: IIB – fast oxidative)
- ▶ Complex but amazing mechanism of contraction; calcium flux to control actin/myosin contraction and relaxation (**sarcomere – unit of function**)
 - ▶ Influence of nervous system/neurotransmitters
- ▶ Connected to bones via tendons
- ▶ Even (low) insects have muscles!
- ▶ Yet another example of very specialized and complex system that is little different across species (no “transitions”) – DESIGN!



And many components underlie the functions...

Systems

- ▶ Too many to count! (not just Krebs' cycle, etc)
- ▶ Had to work from the start; **no new systems seen to develop!**
- ▶ Interaction with organs, tissues, but mostly **biochemical** systems/cascades
 - ▶ Many "moving parts", gene and epigenic expression/control (apoptosis, autophagy) (eg photoreceptors)
 - ▶ Larger: endocrine, clotting, immune, **cell signaling**
 - ▶ Smaller: innumerable – formation, control of regulatory systems

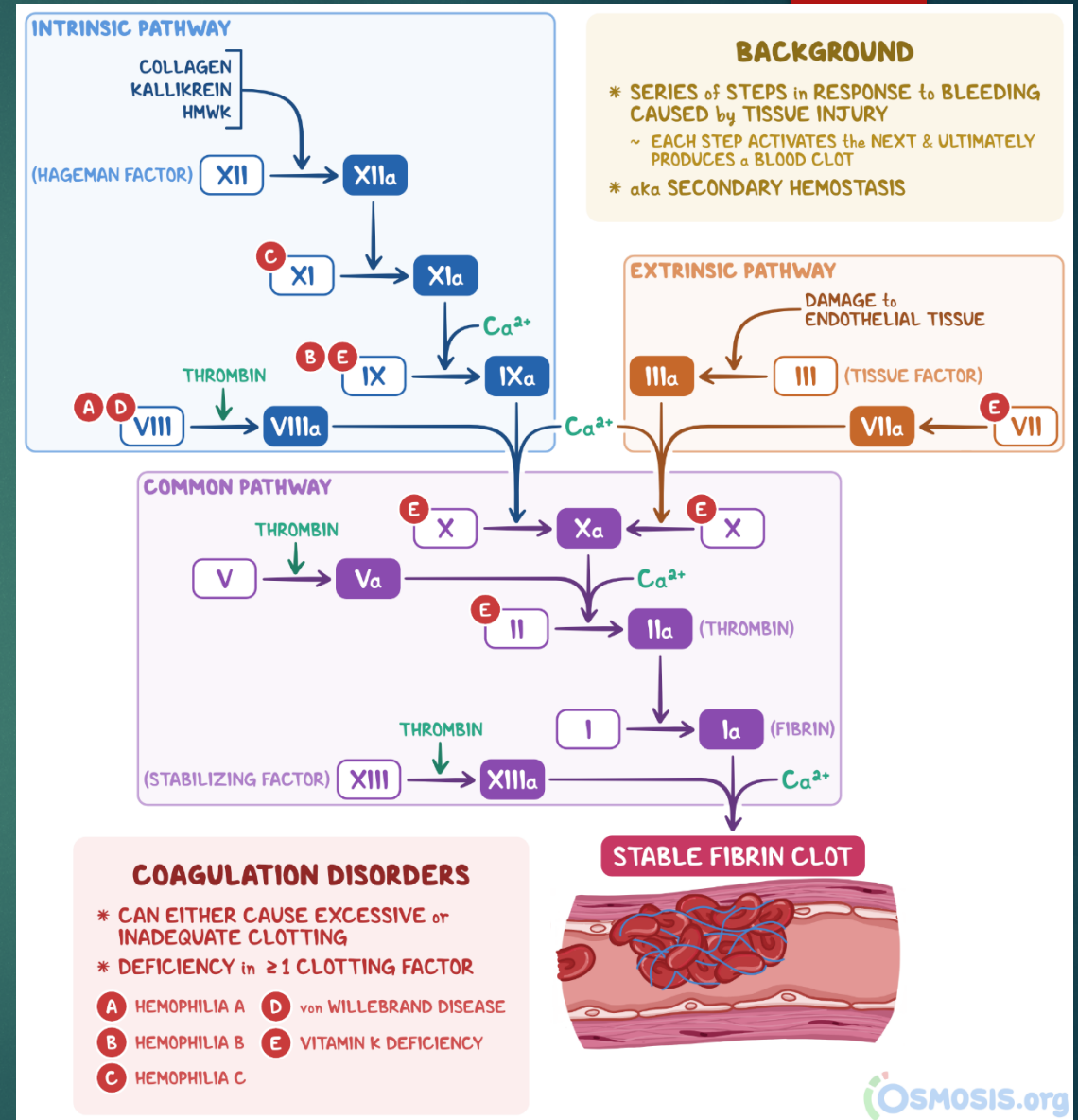


TOO MANY SYSTEMS to have just evolved step by step!!!

Consider just one...

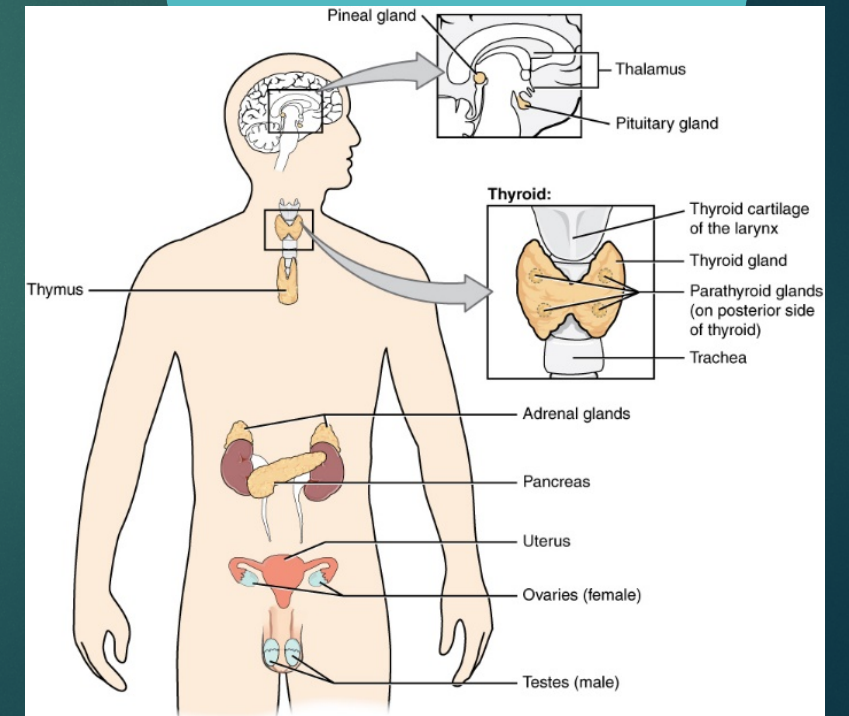
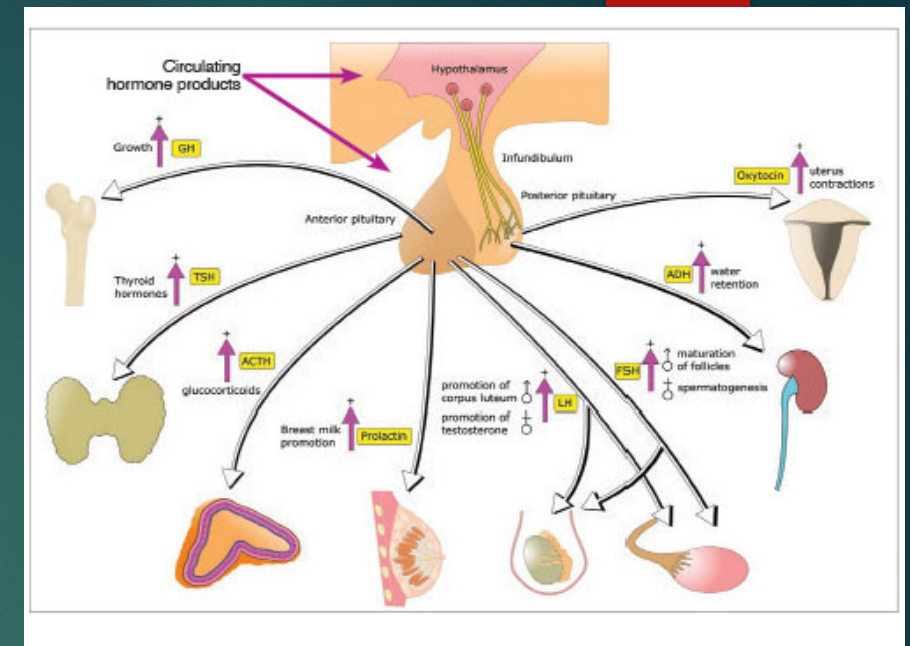
Clotting system

- ▶ Platelets (initiates clot)
 - ▶ Only in mammals (nothing transitional)
 - ▶ No nucleus (cell fragments)
 - ▶ Adhesion, activation, aggregate- stimulate cascade
- ▶ Humoral factors – about 30 components
 - ▶ Closely linked to immune system (eg fibrin clot around bacteria)
- ▶ Note complexities – requires the whole system to function correctly; control to avoid excessive bleeding or clotting (DIC, shock; eg hemophilia)



Endocrine system – Consider just the hypothalamus

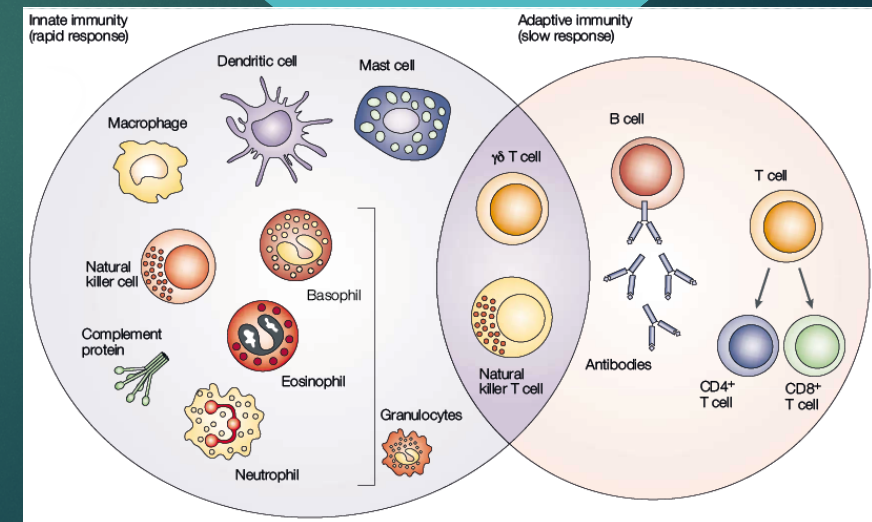
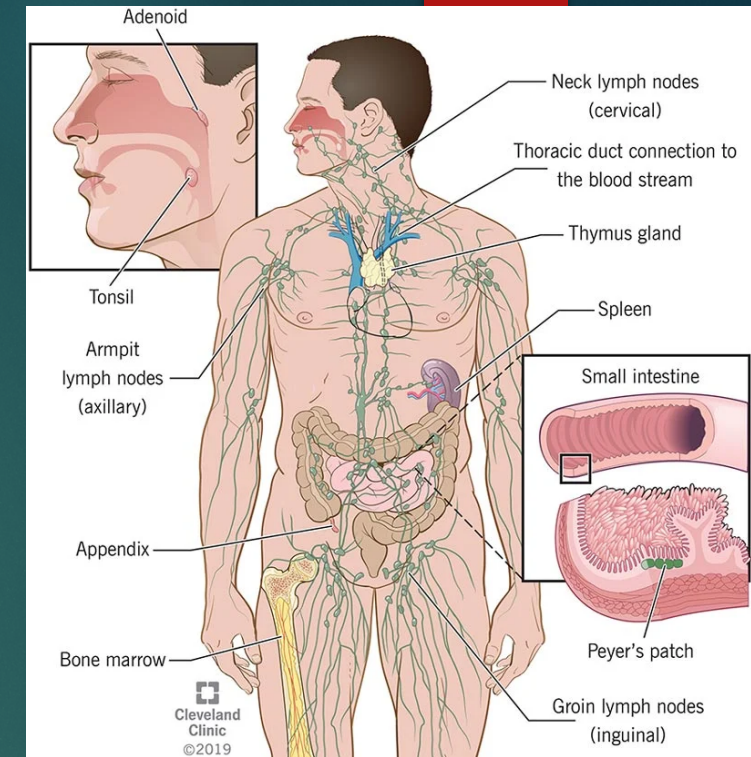
- ▶ Hypothalamus – regulates many: “command center”
 - ▶ Pancreas- glucose metabolism
 - ▶ Thymus- regulation of immune/blood system
 - ▶ Thalamus – relays motor signals
 - ▶ Pituitary- many different cell types
 - ▶ lactation, growth hormone, oxytocin, BP regulation, salt concentration
 - ▶ **Adrenals – steroid, growth**
 - ▶ Thyroid – metabolic rate, protein synthesis
 - ▶ Sex glands- testosterone, estrogen
- ▶ each has a detailed structure, cell types, multiple proteins with complex mechanisms of action and control



Many can be fatal if deficient

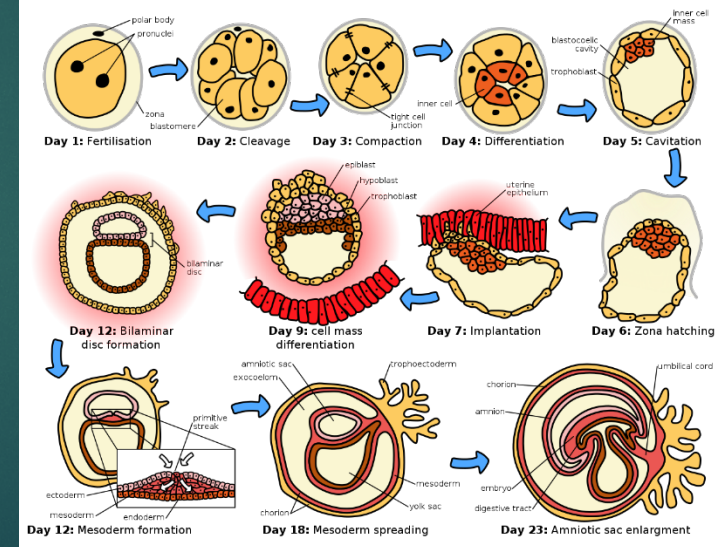
Immune System

- ▶ Markers distinguish “self” and “non-self” (cf friend or foe in military)
- ▶ Neutrophils (1st responder)
 - ▶ Specific conditions: Eosinophils, basophils, macrophages, mast cells
- ▶ Lymphocytes
 - ▶ Cellular (T cells) (mature in thymus) – multiple types
 - ▶ cytotoxic, helper Ag presentation cells– to “supervise” response
 - ▶ Natural Killer(CD3-CD56+) – directly against cancer or virus-infected cells
 - ▶ Humoral (B cells) (mature in spleen; bursa of Fabricus in birds) make antibodies (multiple types)
 - ▶ The immunoglobins/antibodies are essentially “preformed”; single cell cloned
- ▶ Immune cells have as many as 200K receptors (collectively 1 B) that can trigger a reaction; “naïve” cells reside in lymph nodes
 - ▶ MANY subtypes/systems to regulate (>20 different molecules) – cytokines, etc
 - ▶ Primary vs secondary response (memory)(basis of vaccines)
- ▶ Complement system – 3 arms; ~45 proteins; opsonizes antigens (facilitates attack)
- ▶ **MAJOR regulation – basis for much autoimmune dz; checkpoint inhibitors**



Reproduction

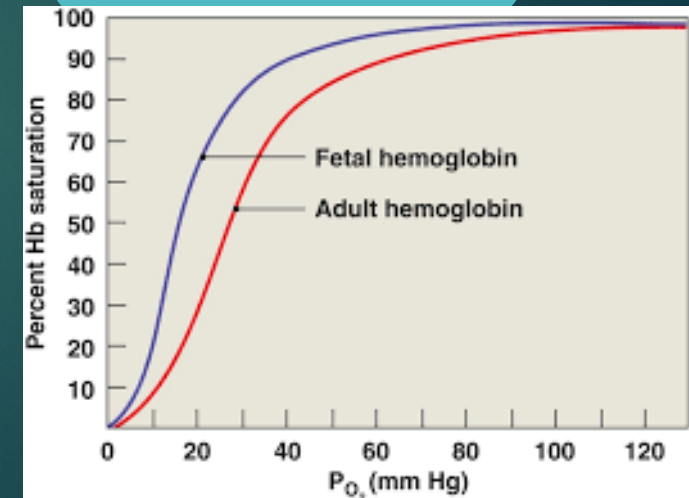
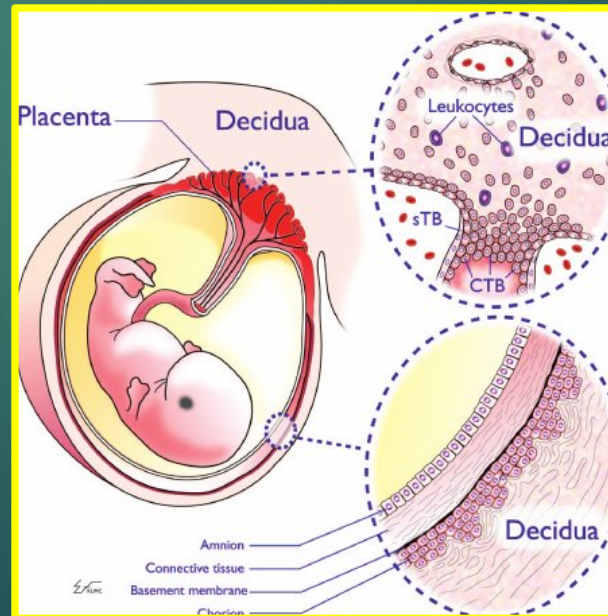
- ▶ Complex, specialized organs
- ▶ remember Chromosomes, meiosis, etc
- ▶ Spermatogenesis/oocytes form in specialized organs
- ▶ Fertilization - acid neutralization; antibacterial qualities; sperm activated by uterine “capacitation” to remove glycoproteins; once one egg is fertilized, no more
- ▶ Implantation, placenta, gestation, miscarriages - MANY factors govern ; embryogenesis
- ▶ Enormous hormonal action/control; eg. provision for lactation (source of key Ab) ideal composition
 - ▶ Birth process – eg Pubis bone joint stretches; oxytocin to contract (mother)
 - ▶ Placenta separation at just the right time



▶ All had to work from the first “mutation”

Design features of pregnancy

- ▶ Fetal hemoglobin – prevents CO₂ accumulation
- ▶ **Placenta** – theory that its egg-layer lost the *vtg* gene for necessary proteins and placentas evolved
 - ▶ based on a very weak finding - 62% homology of a gene sequence with chicks; more likely a regulatory gene
- ▶ Nutritional changes
- ▶ Cardiac output, warmth
- ▶ Postnatal
 - ▶ Mammary glands

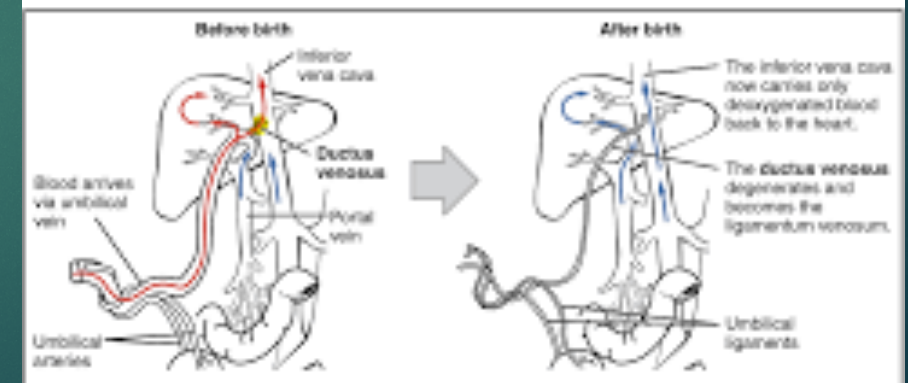
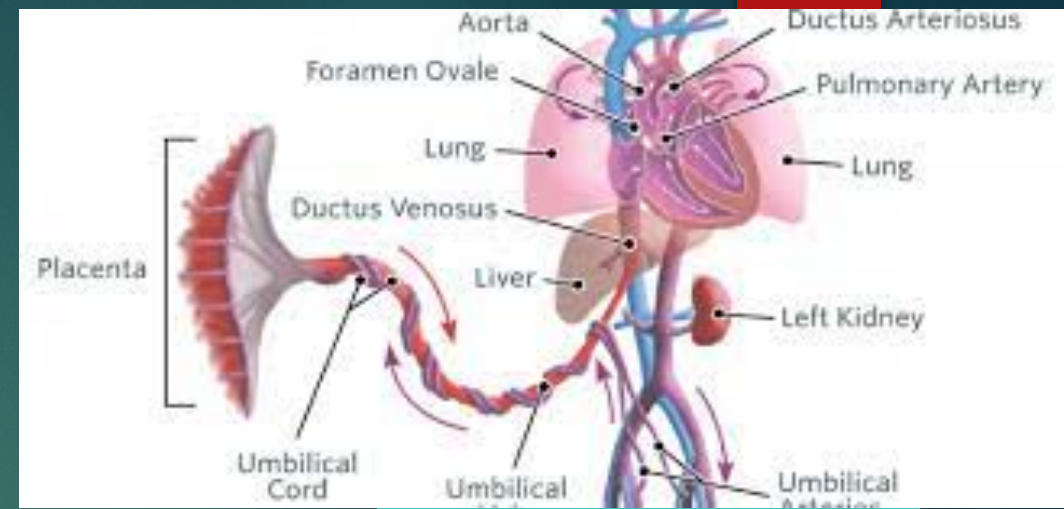


Again, had to work from the start!

But that is not all (baby's perspective)...

Cataclysmic Changes at Birth


- ▶ In utero
 - ▶ Umbilical cord provides blood – bypasses lungs via foramen ovale (atria) ductus arteriosus (PA to desc aorta)
 - ▶ Venous blood bypasses liver/kidney (placenta)
- ▶ At birth
 - ▶ Foramen ovale/ductus arteriosus close
 - ▶ Heart – L side now higher pressure, oxygenated
 - ▶ Portal vein (liver) opens
 - ▶ Lungs inflate
 - ▶ Kidneys start to work
 - ▶ Other homeostasis systems (eg glucose)
 - ▶ Start transition: fetal to adult Hgb (takes about 6 mos)
 - ▶ Placenta releases
 - ▶ Clotting factors (peak at day 8; Gen 17:10-12)



All of this had to work the first time or else death of species!

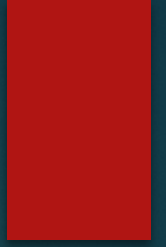
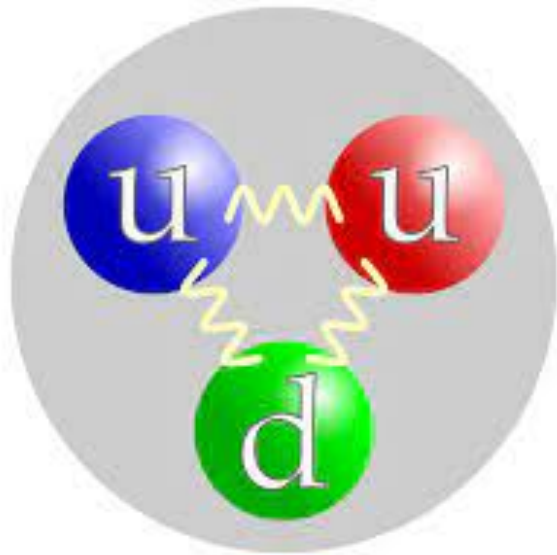
Human Body - summary



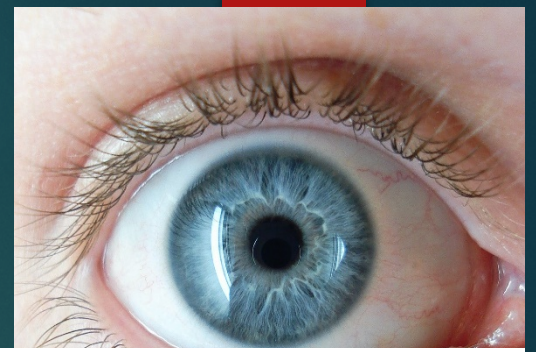
- ▶ There are
 - ▶ thousands of systems, features, tissues, organs
 - ▶ must work together, from the start
 - ▶ have so many “moving parts”
 - ▶ And there have “only” been a few million years for it to occur
 - ▶ It challenges my imagination, at least, to think chance, even with the “miracles” that neoDarwinism theory hypothesizes
- 

But we are not done! We will go into more depth on JUST ONE of these organs in next segment – EYES!

Quarks to Quasars
Or science for creationists
X. Eyes by Design



Purpose of this section



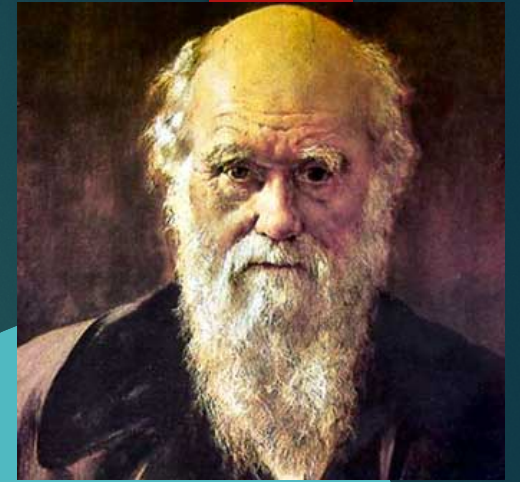
- ▶ Evaluate/drill down on the eye
 - ▶ **JUST ONE ORGAN** for a deeper c
 - ▶ Review some complexities, interco
 - ▶ Some perspectives of nonhuman
 - ▶ Question the possibility of step by equilibrium to explain developm

▶ **DESIGN!!!**

- ▶ **Prov 20:12 - The hearing ear, and the seeing eye, the LORD hath made even both of them.**



Another famous Darwin quotation...

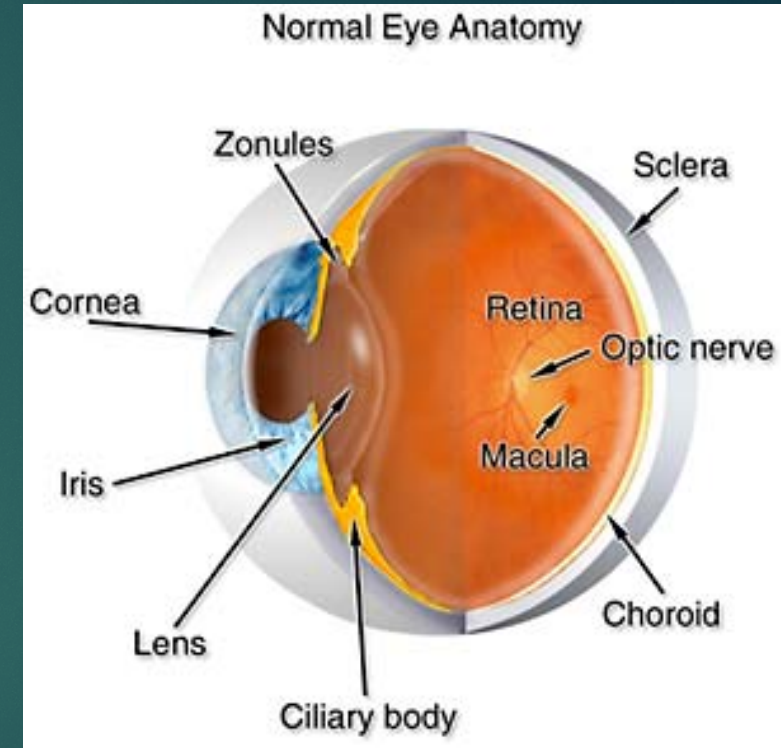
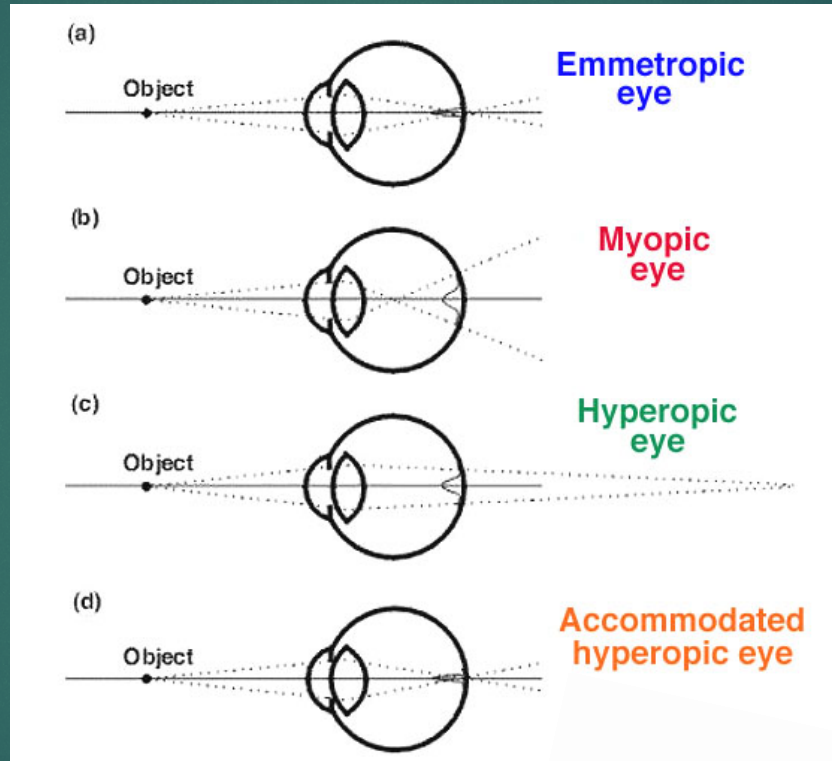
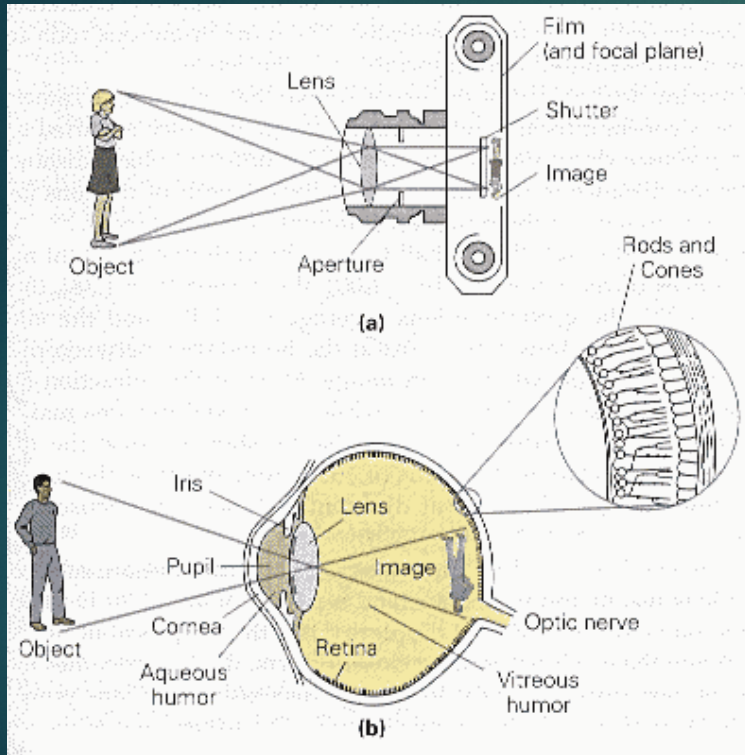


- ▶ Complexity of eye (just the refractive, focusing aspects!)- “To suppose that the eye, with all its inimitable contrivances for adjusting the focus to different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree” Origin of the Species, 1859 (6th edition 1872), p 133.
- ▶ “the thought of it gives me a cold shudder” – letter to Asa Gray

And he was just thinking about the optics!

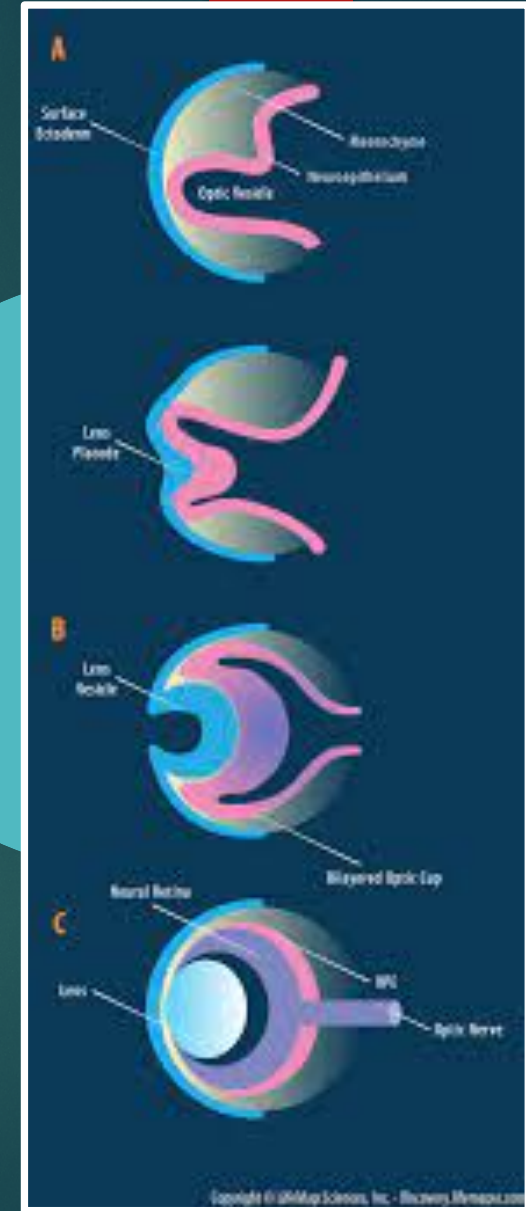
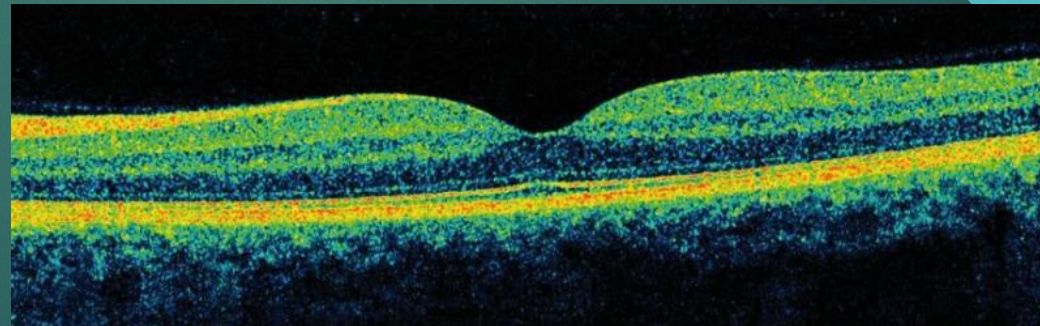
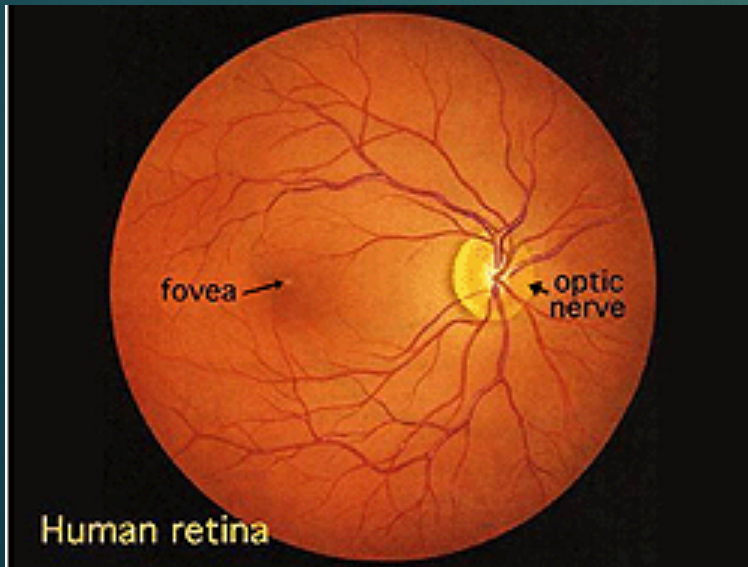
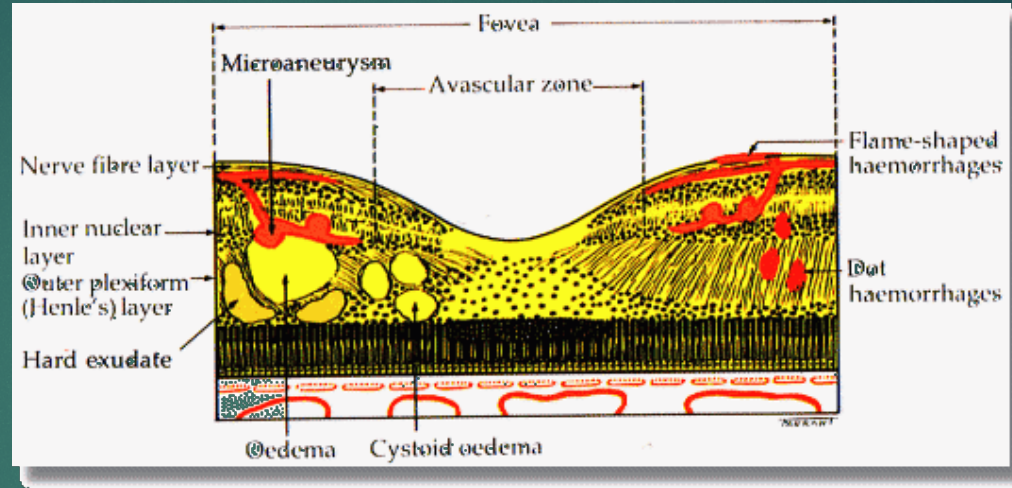
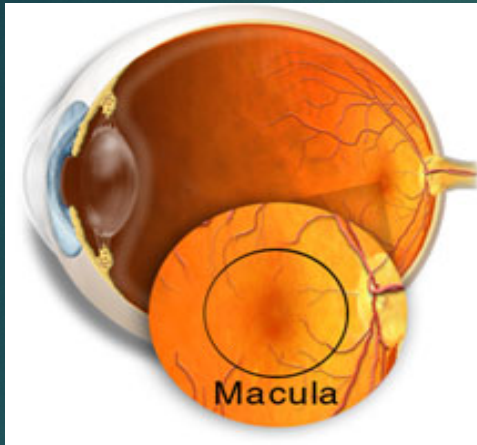
Darwin's Cold Shudder, the Eye...

-more than a refractive organ (sorry LASIK surgeons!)



Retina, macula, fovea

– and it is way more than that!



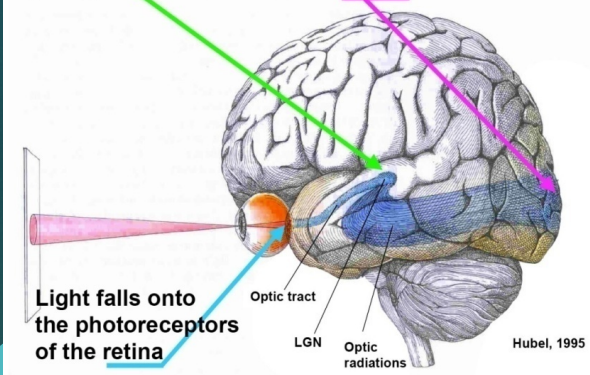
10 cell layers in the retina, interconnected; 18 different types of RGC alone!

But that is just the beginning of the many interdependent vision systems

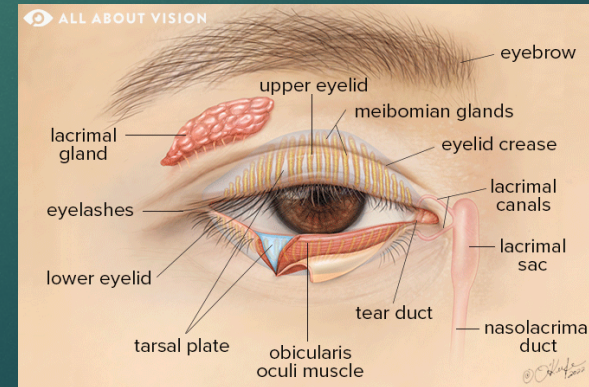
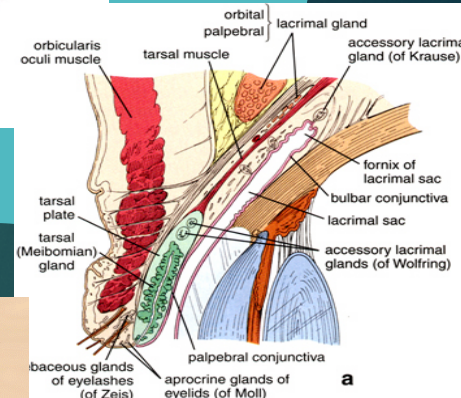
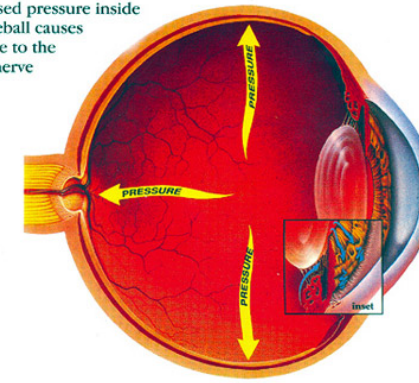
- ▶ Retina, cornea, eye muscles, gaze centers, lid reflexes
 - ▶ Intraocular pressure control, sensitivity
 - ▶ Lids (fastest of 650 muscles)/lacrimal glands
 - ▶ iris/accommodation, color vision/visual pigments, rods/cones, radiations to back of brain/brainstem, **decussation/chiasm**
 - ▶ multiple processing centers, dependence on higher order functions (taste, smell, etc), stereopsis, kinetic/static vision, complex functions of RPE, etc.

▶ So many of these we take for granted! ...No time to cover connections tonight

Thalamus (LGN) serves strategic role in gating of information flow to cortex



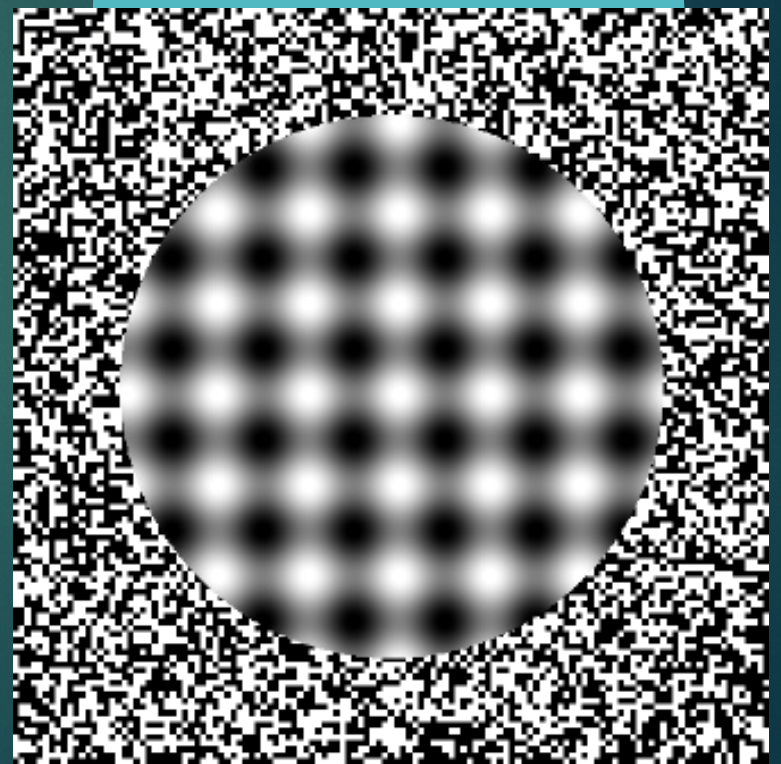
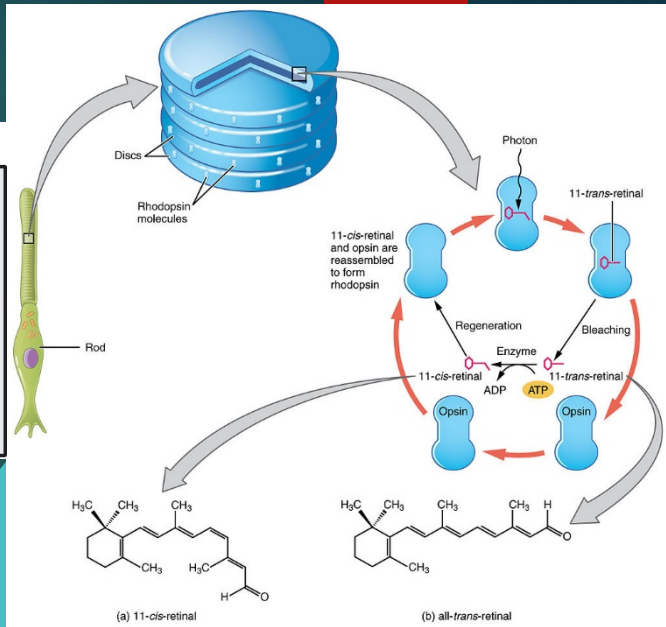
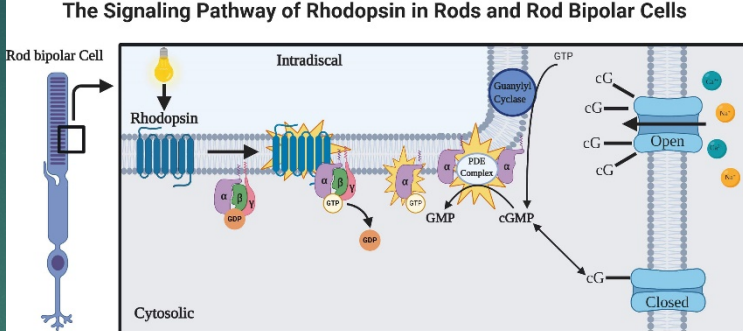
Increased pressure inside the eyeball causes damage to the optic nerve



One example you might not have thought about...

Complexity- "An eye for detail"

- ▶ Visual signaling is molecular and regenerative - too much, "Blinded by the Light"
- ▶ Eye "jitter" during fixation
 - ▶ Like a screen saver
- ▶ Discovered in 1950s; negating with mirrors made object disappear into a featureless gray
- ▶ Now- computer tracking technology: 16% reduction VA if negated
 - ▶ Rucci (Nature 447:582;2007)
- ▶ "vision isn't just a camera"!



Evolution and the Eye

The Darwin Bicentennial and the Sesquicentennial of the Origin of Species

Ronald S. Fishman, MD

- ▶ Rhodopsin- family of 300 molecules, in low forms (Pax6 gene); early variation, but **well preserved for 100s million yrs**
- ▶ Panoply of Eyes- evidence of Darwin's hypothesized intermediate forms- **varied, but not intermediate!**
- ▶ Compound eyes existed in Trilobites, 540my ago- "PreCambrian Explosion"- **not too much has changed among Crustaceans!**
- ▶ Nilsson-Pelger model (1994)- 2000 1% steps from optic pit to an eye in a million years- **drawings; homology frequently does not match function** (a la Lamarck) **much less DNA**
- ▶ Eye has evolved 40-60 times- **just once would be unbelievable!**

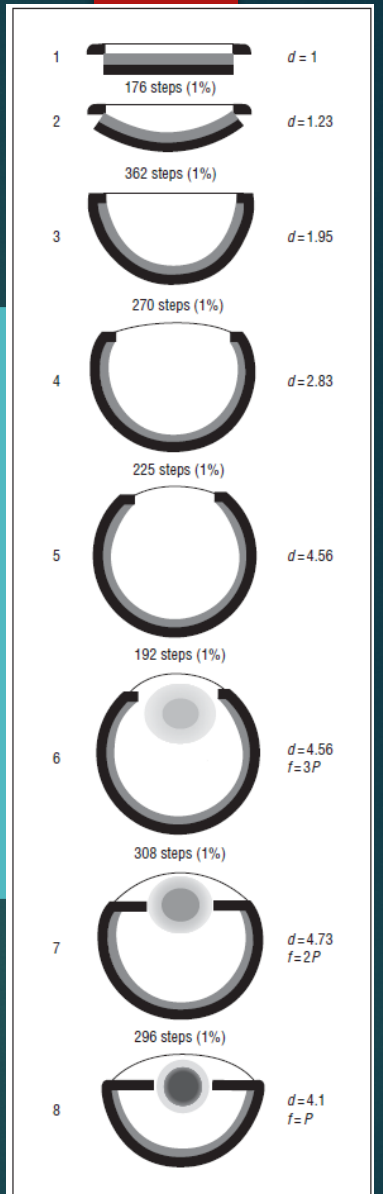


Figure 3. The Nilsson-Pelger model shows how a single-chambered complex eye may readily evolve from a flat patch of photoreceptors by a series of about 2000 steps of 1% tissue deformations. Reprinted with permission from Nilsson and Pelger.²⁰

Fishman: Darwin's **misquoted quote** in *Origins*: That just the refractive components could have evolved by natural selection is absurd...but that with each step "multiplied by the million" and preserved, altered on "millions of individuals" for "millions on millions" of years, "natural selection will pick out with unerring skill"

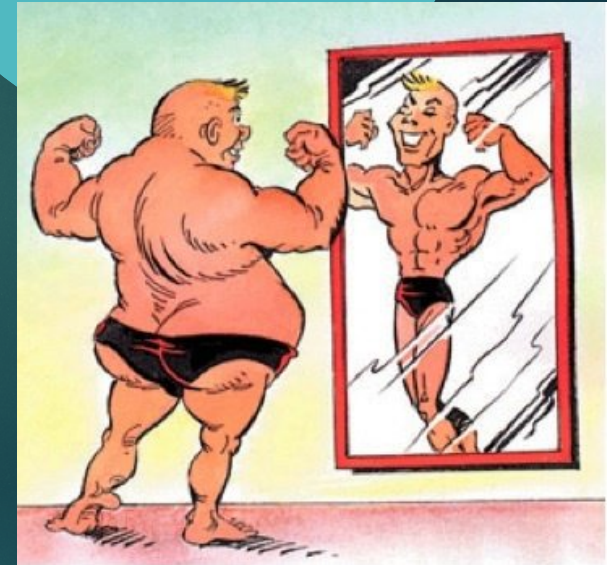
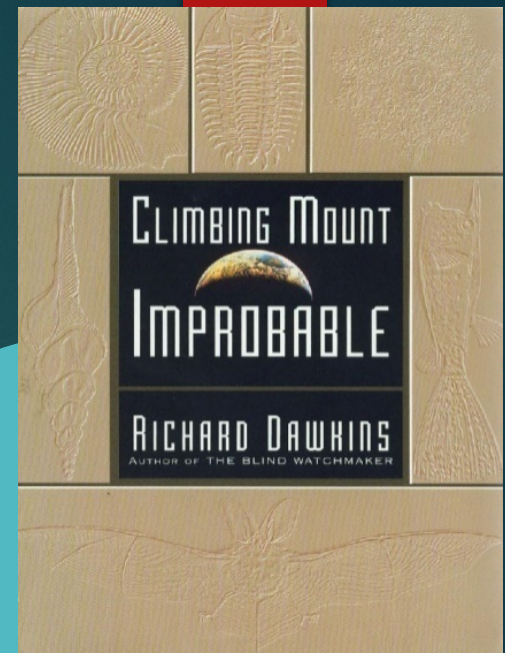
- ▶ Stimulated my letter to editor (in the common spirit of scientific discourse/debate), pointing out:
 - ▶ Natural selection, microevolution is NOT macroevolution
 - ▶ 2000 steps (assuming binary, etc) is NOT conceivable, even in an evolution time frame, etc (offering the math)
 - ▶ Eye is not an isolated unit – interacts with multiple (complex) systems
 - ▶ Evolution of eye multiple times further taxes logic
 - ▶ Why variation in other species, some with "better" eyes than humans?
- ▶ Response to my letter – standard evolutionists' attitudes/"reasoning"
 - ▶ "sophisticated scientists" know better; "theory" not appropriate to argue, not disproved after 150 yrs; DNA evidence misapplied as evidence; mutations of antibiotic resistance cited; buried Nilsson-Pilger model in "millions" of generations
 - ▶ Referred me to Dawkins's *Climbing Mount Improbable*, citing space limitations (I had already read that book)
- ▶ Private correspondence to me was at least 10:1 in my favor

So what about Dr. Fishman's suggested reading...

Climbing Mount Improbable

Richard Dawkins, 1996

- Replete with “pie in the sky” claims, based upon computer modeling programs
- Amazing spider web construction/design
- Sea shell categorization- beautiful but avoids main points!
- Flowers only role as genetic transfer points
- Characterizes cell as a colony of bacteria
- Acknowledges mathematic impossibility of protein construction, but stresses concept of random mutations, preprogramming, microevolution as example of evolution, etc. (neocatastrophism, remember)
- Chapter 5: Forty-fold path to enlightenment
 - “crustaceans...an ingenious solution”
 - 4-eyed fish, “reinvented lens”
- specifics are glossed over; computer simulation
- Same facts, different conclusions



A little math...



- ▶ Nilssen-Pilger's 2000 steps = 1 in $2^{2000} = 1$ in 10^{602} (if only 2 choices) (and this is just on a morphologic basis!)
- ▶ #collisions of the estimated 10^{78} electrons in the universe, reacting as fast as a molecule vibrates (10^{-15} s)², for the 10^{18} s (25 by) = 10^{111} , still only 10^{500} chance of N-P!
- ▶ Recall...for more perspective:
 - ▶ The 4×10^{26} watts that the Sun produces represents an output of "only" 10^{65} photons if production has been steady for those 25 by
 - ▶ the chance assembly of just a 100 component unit from its 100 already existing parts ($100! = 10^{159}$)
 - ▶ "Organic molecule" defined by NASA are larger, more complex combinations even more unfathomable: eg. 1000 nucleotide coding for a protein (4 nucleotide choices, some duplicity) = $4^{1000} = 10^{600}$
 - ▶ Huxley suggested 10^6 mutations for a horse = $10^{300\ 000}$
 - ▶ Spetner – 60K proteins, 100 AAs coded by DNA codons: $10^{24\ 082\ 400}$



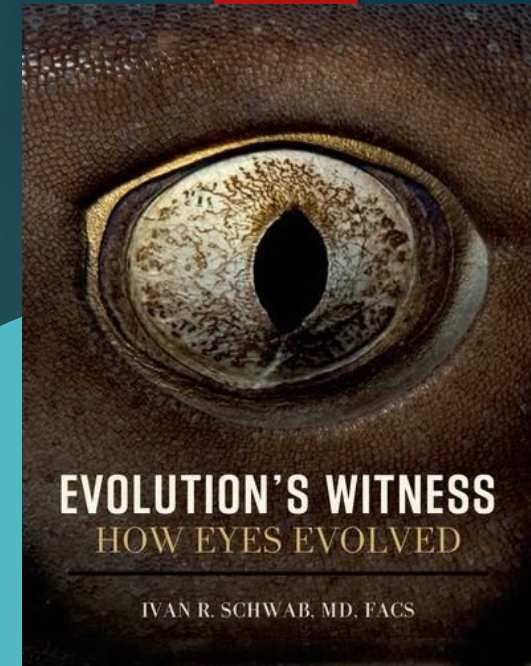
Figure 3. The Nilssen-Pilger model shows how a single-chambered complex eye may readily evolve from a flat patch of photoreceptors by a series of about 2000 steps of 1% tissue deformations. Reprinted with permission from Nilssen and Pelger.²⁰

Actually, a very interesting book...

Evolution's Witness. How Eyes Evolved.

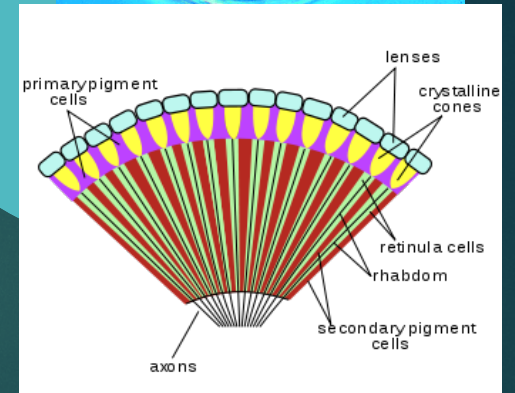
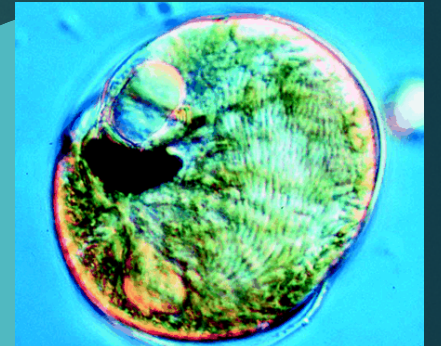
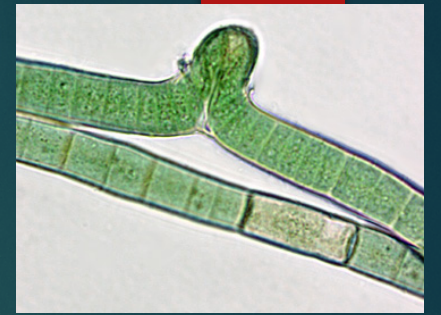
Ivan R. Schwab, MD, 2011

- Systematic survey of some unique features of eyes in various species
- Organized within an old earth framework: a sea to amphibian to reptile to bird to insect to mammal to man chronology
- Some telling statements:
 - “Eventually, **by chance**, hit upon a self-replicating molecule” (p5).
 - Atom to DNA to AA to Protein to cell to life not addressed
 - “**Acquired** mitochondria” (p10)
 - Evolution “discovered”(p81), “creativity”, “building this complexity” (p14)
 - 12 kinds of eyes- “evolved many times” (p23)
 - The “trochlea **appeared**” (p247)
- **Many examples: not of evolution but of design!**



Tracing “witnesses” (Schwab)

- Cyanobacteria (chlorophyll) as 1st witness (*scytonema*)- rhodopsin- ?>1 Byrs ago (prokaryotes)- **light sensor**
- Ocellus/Ocelloid – an **eyespot w/o a cornea or lens**- most primitive camera eye (*warnovia*, early eukaryotes, 500Myr)
- “**compound eye**” – units of **ommatidia**, lens with sensing fibers at end of a rhabdon (insects, crustaceans, millipedes)
- “**simple eye**”- a single lens; eg. Jellyfish (*tripedalia cystophora*)- 4 arms with 6 eyes each=24 “surprisingly complex” camera style eyes- date back 600 Myrs .
- “framework for bilaterality” (p27), “muscle and adnexa appear suddenly” (p23)-worms
- Each of these is alive and thriving!
- Tendency to equate taxonomic position with progression; no transitional forms!



Maybe "lower" animals demonstrate step by step eye development?...

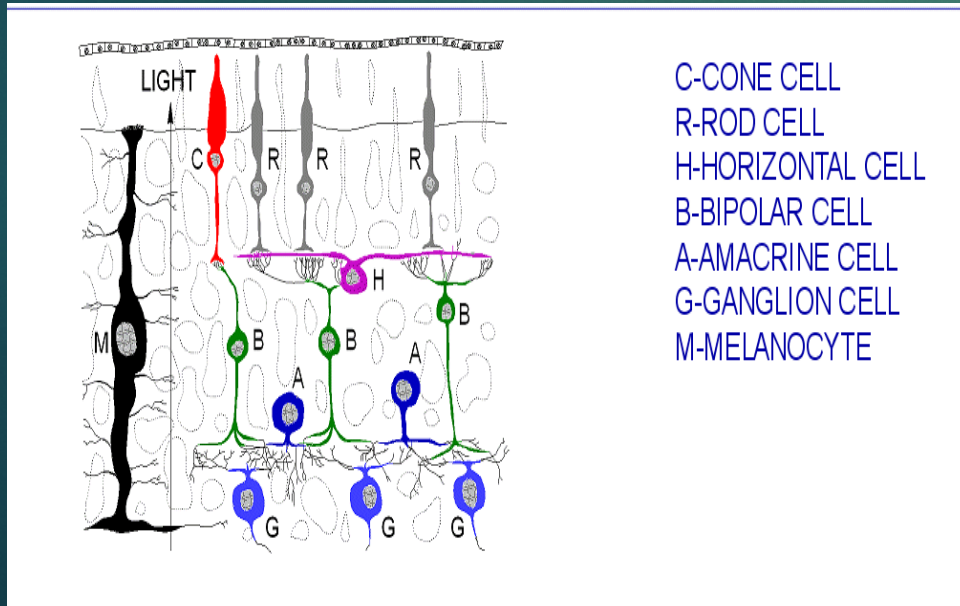
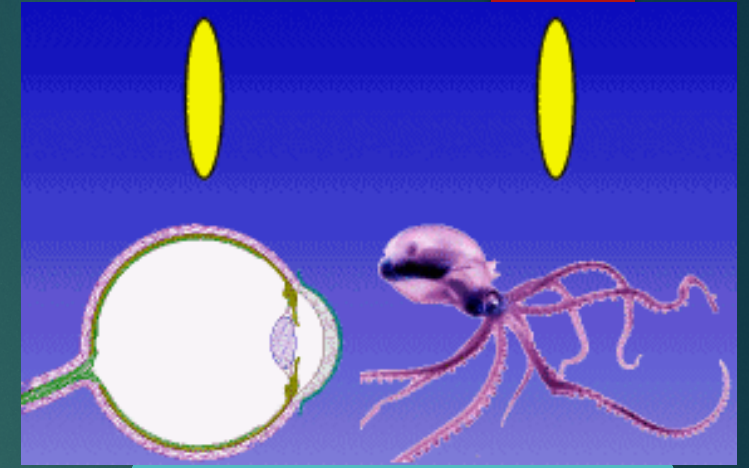
Mollusks- pretty low on the totem pole

- ▶ Scallops
 - ▶ 2 retinae
 - ▶ 40-50 eyes
- ▶ Conchs
 - ▶ Eyes on retractable stalks
 - ▶ Can move independently
 - ▶ Regenerate if injured
- ▶ Octopus (an invertebrate)...

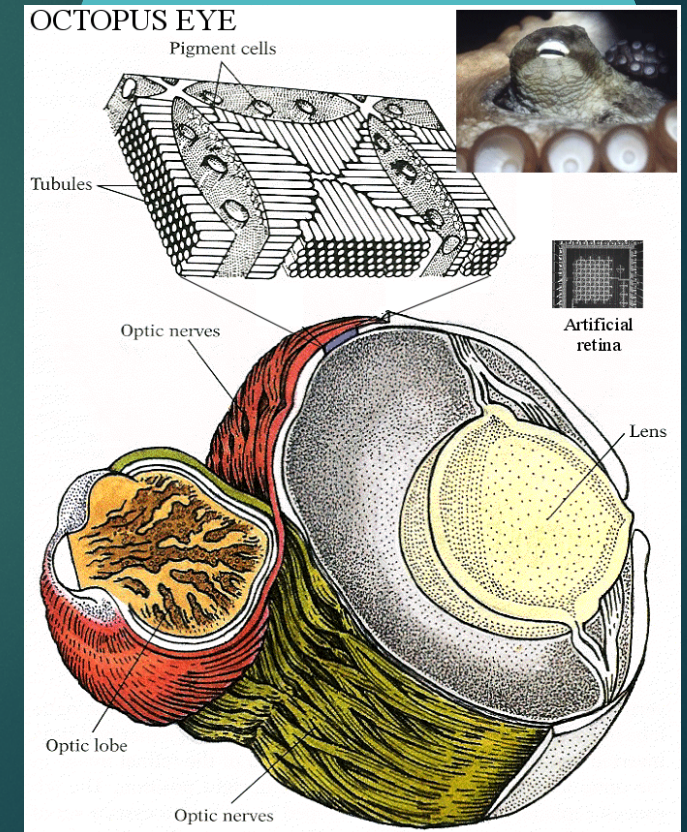
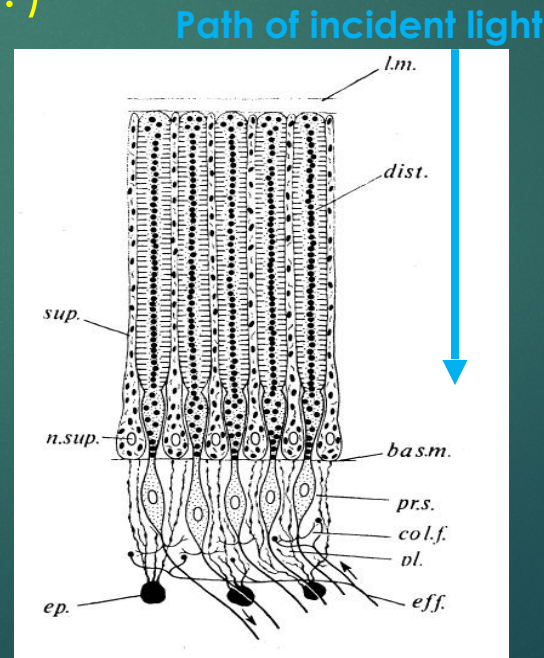


Octopus/squid eye – invertebrates

- ▶ Accommodation by moving lens position
- ▶ “non-inversion” of retinal cells (opposite in vertebrates)
- ▶ “on site” brain processing
- ▶ BTW, they can detect polarized light
- ▶ Where are the transitional forms?- “convergent evolution” (really, how could there be?)

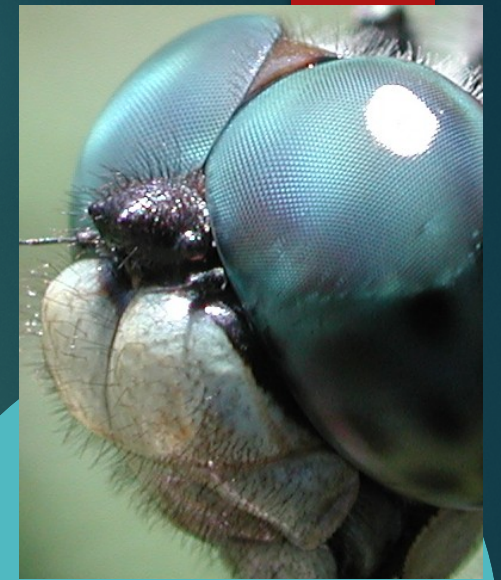


human



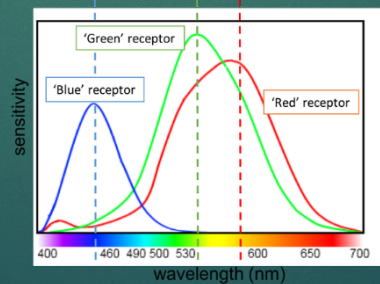
Insects (still pretty “low”!)

- ▶ Dragon fly (compound eye)
 - ▶ complex visual/neuologic needs
 - ▶ “lost” cornea
 - ▶ superposition eye
- ▶ Wolf spider (not actually an insect)
 - ▶ 4 pairs of eyes
 - ▶ polarization detection
- ▶ Whirligig beetle
 - ▶ Aquatic and aerial – 6 sets of eyes with at least 2 retinas each!
- ▶ These would likely have become extinct waiting for these features!

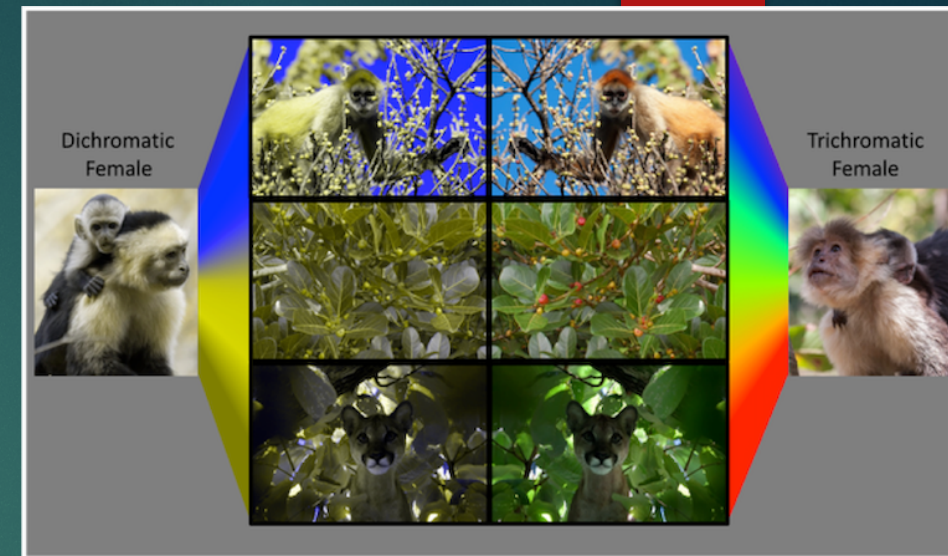


Color vision across species

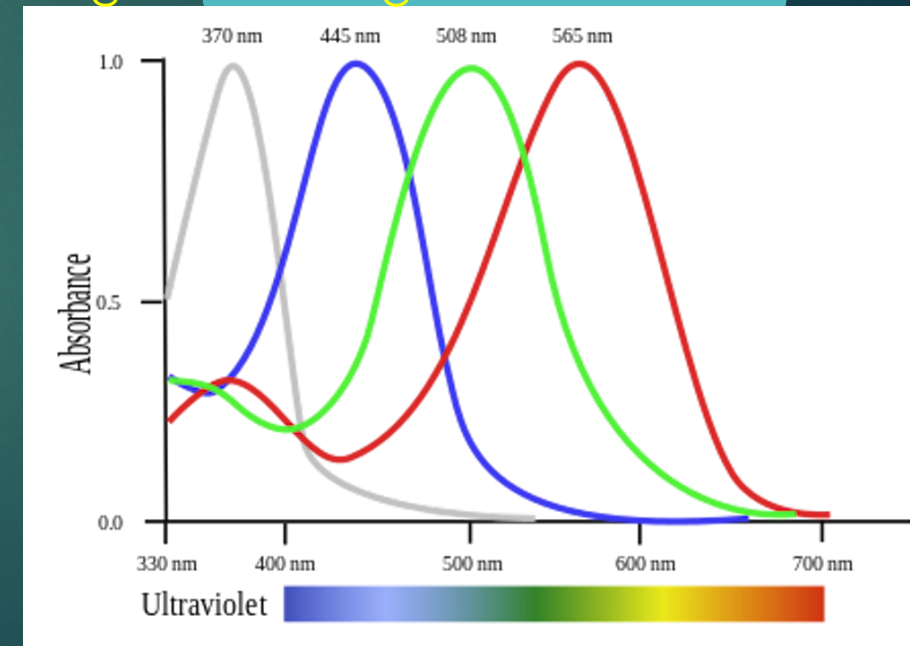
- ▶ Humans are trichromats (RGB) (case reports of a tetra female) (btw, 8% males RG color defect)
 - ▶ Old World monkeys (Asia/Africa) are tri- (eg. Gorillas, baboons, macaques)
 - ▶ New World monkeys (West) variable; female tri, male di- (eg some monkeys, marmosets)
- ▶ Most mammals are dichromats
 - ▶ Only mammal: Arctic reindeer tetra (ie can also "see" UV)
- ▶ many birds, reptiles, amphibians, insects are tetrachromats
- ▶ Although sensitivities might vary
- ▶ **But there is more...**



human



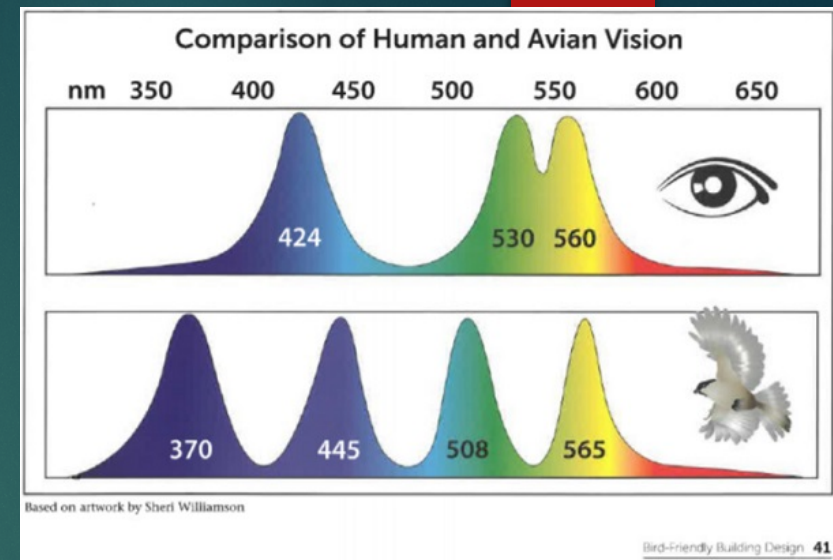
Maybe that is why wives are frequently having to find things for their husbands??



Bird (normalized)

Chickens have better color vision than humans

- ▶ <http://www.healthday.com/Article.asp?AID=636123>
- ▶ Humans have red, blue, green
- ▶ Chickens (most birds) also have UV (tetrachromats)
- ▶ A specialized receptor “double cone” that detects movement
- ▶ Alas, explained by: “The superior color vision in birds is likely because they didn't have to spend a lot of time in the dark during their evolution. In contrast, most mammals were nocturnal for millions of years.”
- ▶ Remember, most mammals di-, humans tri-, birds tetra-
 - ▶ Why would “lower” evolve tetra-, or more, and then “lose”?



Mantis Shrimp- Cambrian period, 500M yr

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Other vertebrates

- Placoderms (eg. sturgeon)
 - 7th extraocular muscle- **retractor bulbi**
- Elasmobranchs (eg rays)
 - **Accommodation by moving lens** towards retina
 - **Multifocal retina**, pear shaped eye
- Hammerhead shark- **chiasm completely crossed**



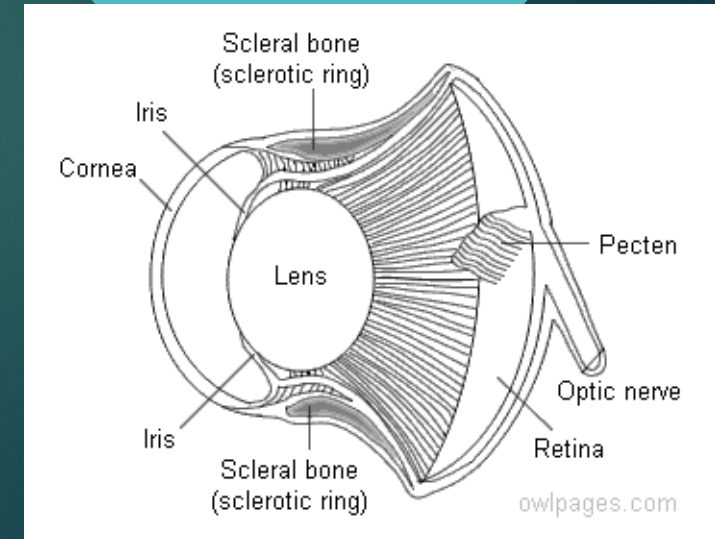
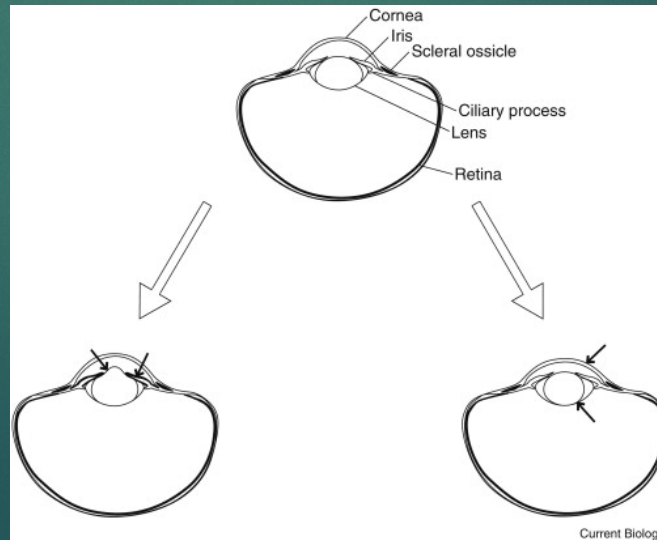
Fish eye designs

- ▶ Scleral ossicles to change shape of cornea
- ▶ Separate **divisions of cornea**
 - ▶ Flying fish- triangular
- ▶ **Sunshades** (puffer fish) from pigment in cornea
- ▶ Anableps: different curvatures for surface/water
- ▶ I know, evolutionists will argue these are from selection pressures, etc. What makes more sense do you?



Bird's eye view

- Avian eyes proportionately larger than reptile
 - Leukart's ratio: animal eye size proportionate to speed
- **3X More amacrine, horizontal cells than mammals**
- Diving birds: but how to see underwater?
 - stiff iris, accommodation via striated **muscles to prolapse ductile lens through pupil**
- Cf. Tubular eyes for nocturnal birds like owls; huge AC



Some other fish stories...

- Oil droplets within PR cells in fish, reptiles, amphibians, and some bird eyes- reduces glare, minimize chromatic aberration, improve/tune color range
- Bluefin Tuna- Large, has different index of refxn within lens to minimize aberration
- Marlin/sailfish- EOMs heat brain!
- Dragon fish
 - produces/senses red luminescence like night vision goggles
 - can detect colors (in dark deep) despite only having rods using pigments (Science 364(6440):588)
- Unequal or twin cones in certain teleosts (ray-finned)
 - to detect polarization
- Flatfish eye (flounder):
 - barrel eyes
 - second lens/eye moves to same side after birth (SFRS3 gene)

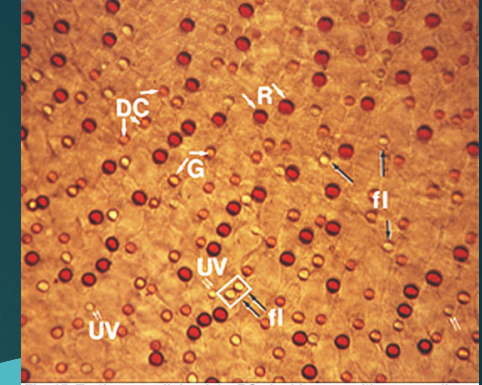
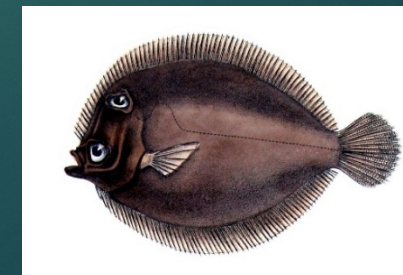
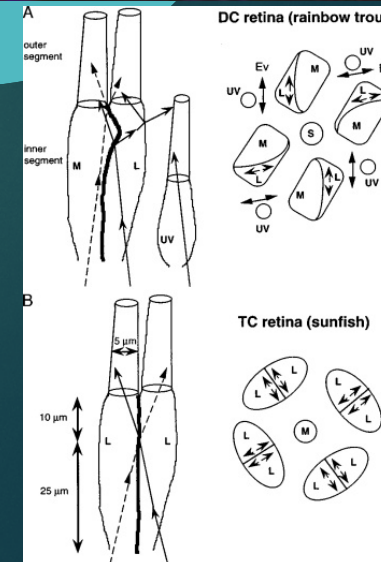
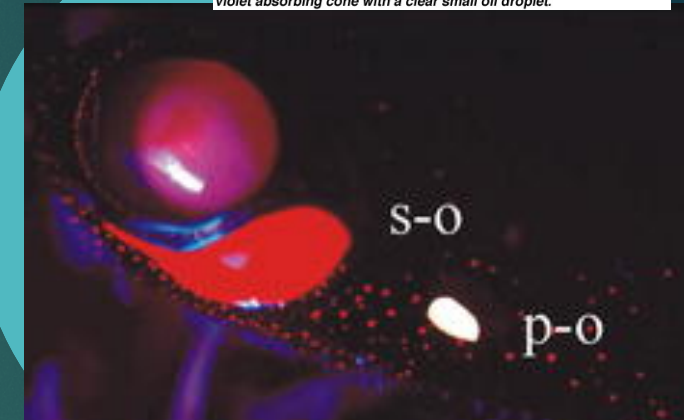


Fig. 15. Turtle cone oil droplets. DC, double cone with orange oil droplet; G, green cone with yellow oil droplet; R, red cone with red oil droplet; fi, blue cone with a fluorescent oil droplet; UV, ultra-violet absorbing cone with a clear small oil droplet.



Giant squid

- ▶ 2 dissimilar eyes, one to look upwards and the other downwards
- ▶ Also produces bioluminescence for camouflage
- ▶ Largest eyes in the world (10" diameter!)



Barreleye (*Macropinna microstoma*)- talk about complex!

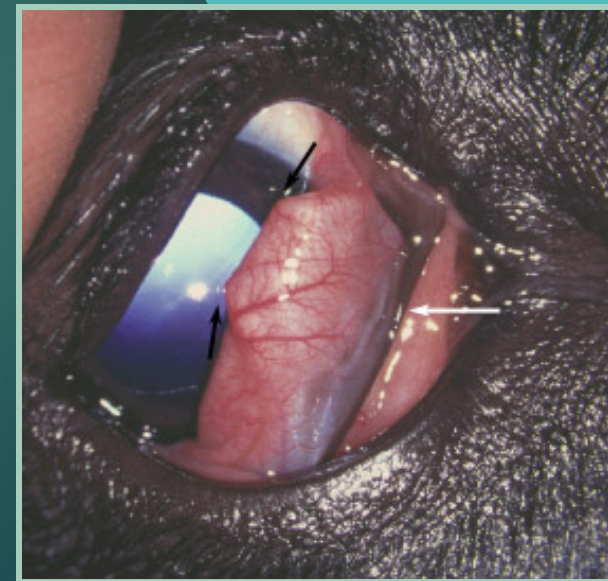
- ▶ A deep sea fish (dark) (6-800m)
- ▶ Fluid-filled shield on head protects
 - ▶ Robison BH (Copeia, 12/18/2008)- Monterey Bay Aquarium Research Institute; observed/captured with ROV
- ▶ Bright green lens cap eyes (filter)
 - ▶ upward oriented when looking for food
 - ▶ Rotate straight when eating “eyes on the prize”
 - ▶ Tubular design, ultrasensitive to silhouette, but narrow VF



www.youtube.com/watch?v=RM9o4VnfHJU

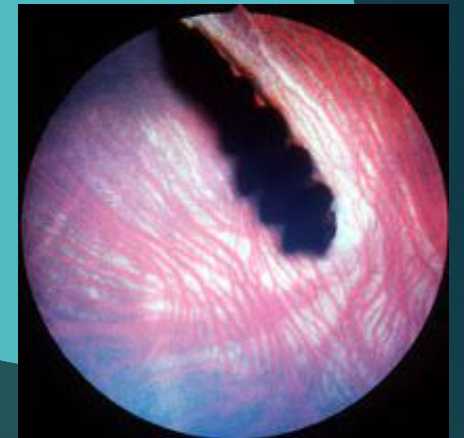
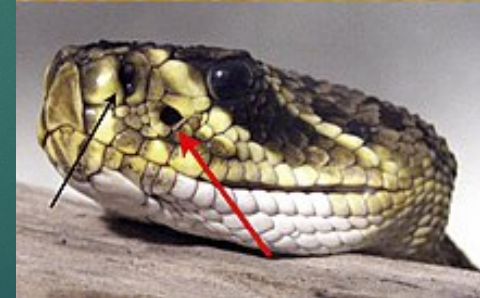
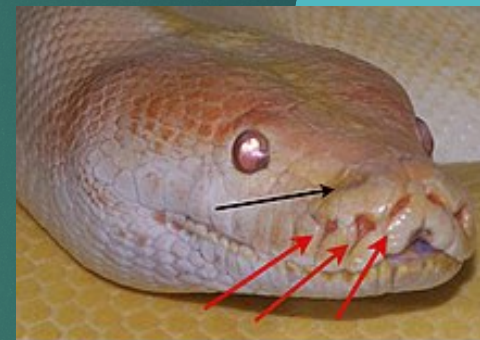
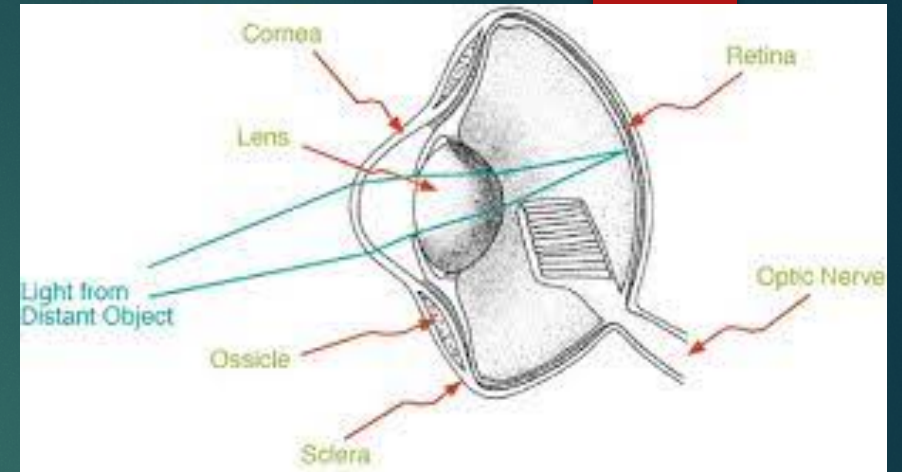
You have all seen this...

- **Tapetum**- 1st in fish; light reflection to amplify nocturnal conditions
- Nictans
 - “so important it evolved twice”- amphibians not homologous with reptiles/ mammals
 - Often referred to as a 3rd lid
- Adnexa “developed with land migration”- quite an oversimplification!



Reptiles

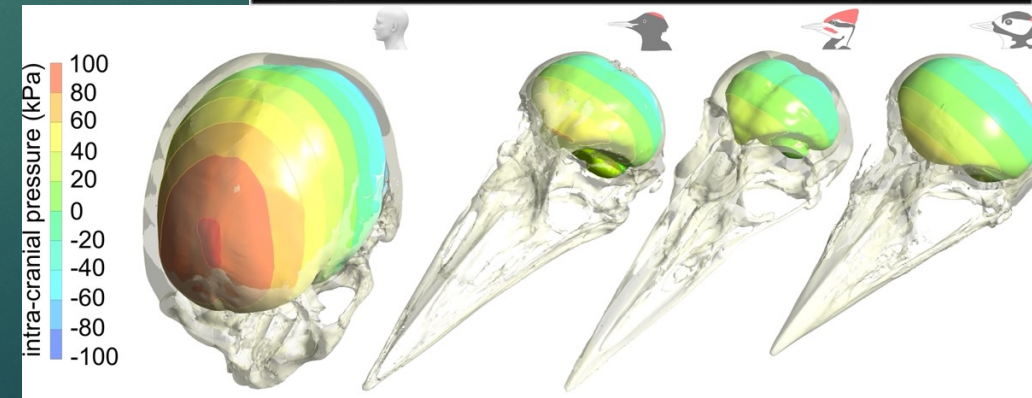
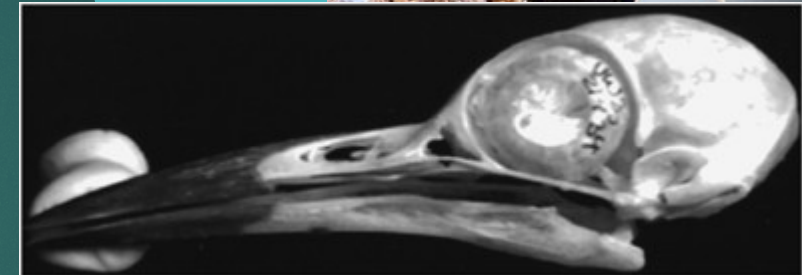
- Alligators- lack apparent retinal vascular support! Humans have central retinal artery, birds have pecten (avascular retina), fish falciform process, other reptiles conus papillaris- “evolutionary loss”
- Pit viper
 - burrowing does not need vision, replaced with exquisitely sensitive thermal sensors;
 - But later snakes “reinvented” eye



Cf. human

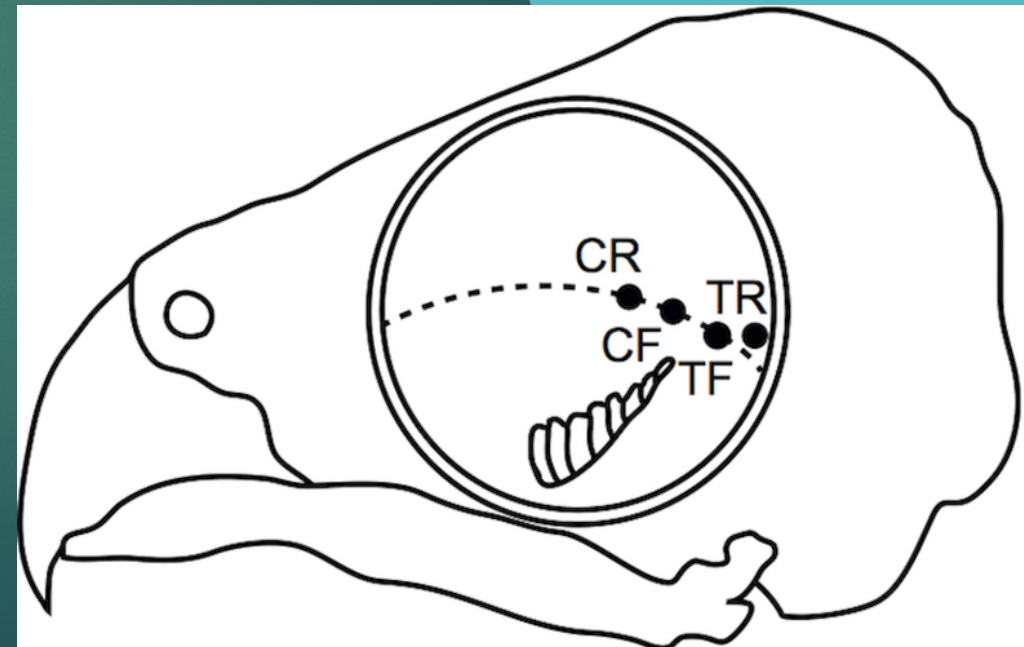
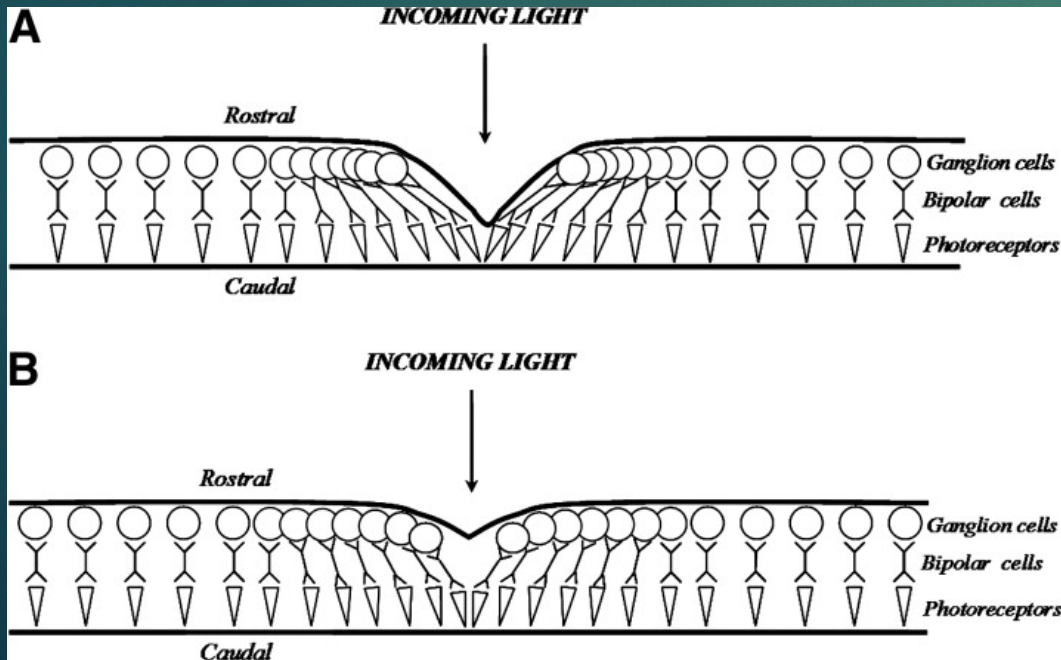
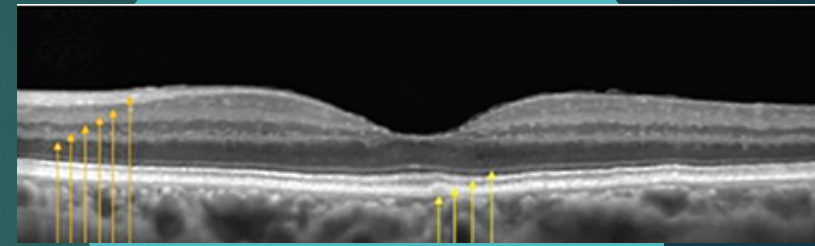
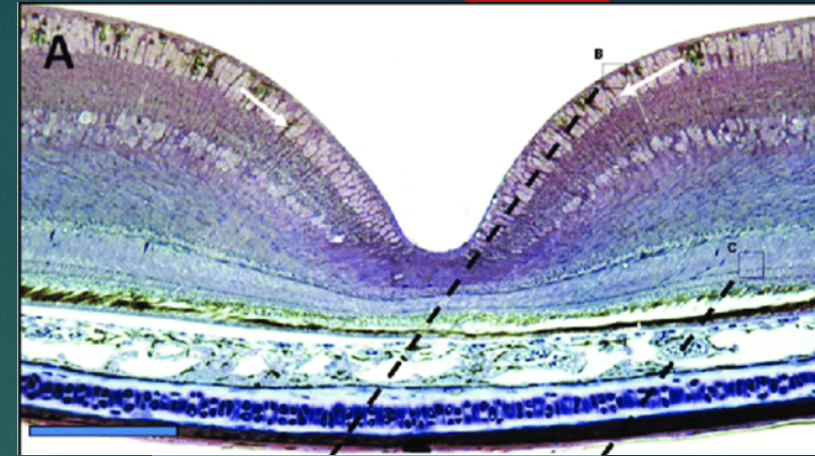
Why don't woodpeckers get shaken baby syndrome? Why no RDs (or concussions)?

- ▶ Wagnanski-Jaffe T, et al. Protective mechanisms in woodpeckers Eye 2007;21:83.
 - ▶ Restricted axial globe movement (tight orbit)
 - ▶ Fascial connections between orbital rim and sclera
 - ▶ Sclera reinforced with cartilage and bone (all birds)
 - ▶ ON lacks redundancy (can't wiggle)
 - ▶ No vitreoretinal attachments
 - ▶ Avascular retina (all birds)
- ▶ Concussion protection similar mechanism
 - ▶ Also, muscles in neck work to absorb impact



Raptors (Eagle, hawk)

- ▶ 1M photoreceptors/mm² (human 200K)- yields 20/5 VA!
 - ▶ And pecten keeps retinal vessels from blocking some vision
- ▶ Convexiclvate fovea (steep walls, uses edge of fovea as a lens= 11% mag
- ▶ Remarkably, they have two foveas!...



Theory of Spiral Hunting in Raptors

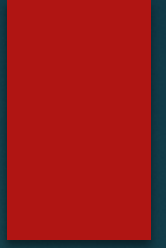


Raptor



Prey

- Approach prey at angle
- Looking straight ahead, aerodynamic
- Image focused on monocular, central (deep) fovea
- Higher visual acuity



Summary of Primates Eye “Deficiencies”

- “Lost” features (cf “lower”):
 - Retractor bulbi
 - Nictans (semilunar fold)
 - Several photopigments, oil droplets, special PR, protective orbital bones
- Never got:
 - Double lens, multifocal, presbyopia protection; extra fovea
 - Striated intraocular muscle
 - Extra eyes
- Given:
 - Inverted retina

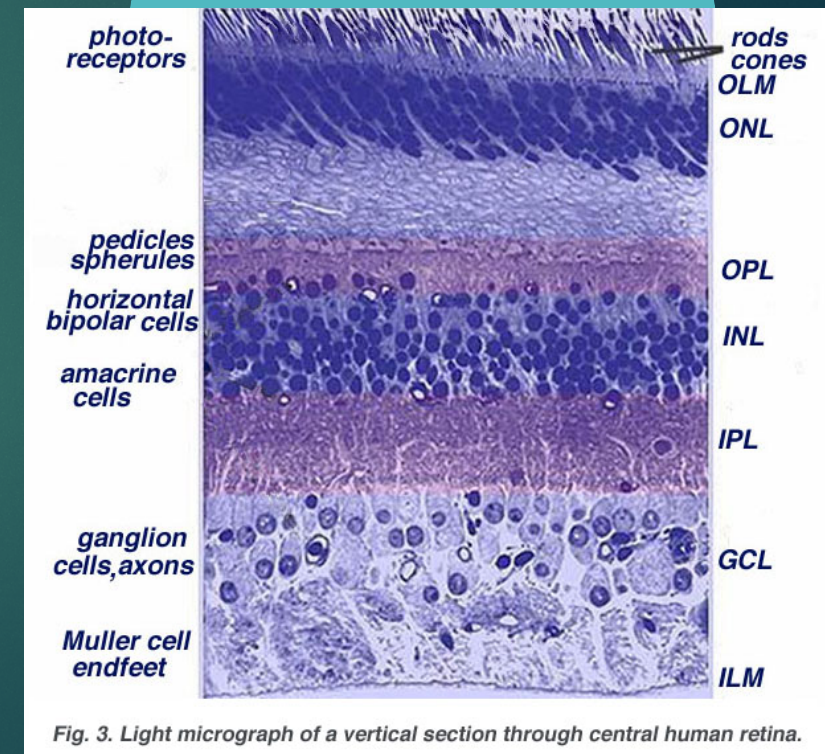


Fig. 3. Light micrograph of a vertical section through central human retina.

Evolution went
backwards?

Eye as an Example: Evolution or Design?

- ▶ Improbable
- ▶ Contradictory
- ▶ Much more complex than modeled
- ▶ Irreducibly complex
- ▶ Which theory explains the facts best?
- ▶ **The eyes cry out, DESIGN!**



Levels of "evolution" hurdles

- the eye is just a picture

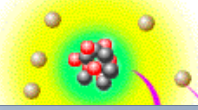
- ▶ Quarks/leptons
- ▶ Molecules
- ▶ organic molecules
- ▶ Cells
- ▶ Organisms
- ▶ geology
- ▶ Cosmology
- ▶ Humans
- ▶ – just the beginning

But the most important evidence is yet to come: Scriptural basis for Creationism

Scale in m:

10^{-10} m

atom



Scale in 10^{-18} m:

100,000,000

10,000

1,000

n

≤ 1

Intermediate
EVENTS

cellsalive.com

Reticulum
reticulum

