DE Bio (102) Unit 5 Study Guide

Compare the types, advantages, and disadvantages of asexual and sexual reproduction.

Asexual reproduction does not involve any gamete fusion and occurs when one organism, usually unicellular, replicates itself as a clone. While this is a faster process that ensures the transmission of positive genetic information, it does not create diversity leading to higher susceptibility to disease. Sexual reproduction is when two organisms of the opposite sex undergo sexual intercourse for the formation of a zygote from two separate gametes. While this is inherently slower due to the need for the coordination of two organisms, it creates genetic diversity, which increases survivorship.

Describe the structures and functions of the female and male human reproductive systems.

The male reproductive system consists of the testes, epididymis, vas deferens, ejaculatory duct, urethra and accessory organs. The testes produce sperm which is carried by the epididymis to the vas deferens to the ejaculatory duct. From the ejaculatory duct, the sperm is transported into the urethra for its release out of the penis. The accessory organs give nutrients to the sperm before it leaves.

The female reproductive system consists of the ovaries, vagina, cervix, fallopian tube, and the uterus. The egg is formed in the ovary which then transports to the fallopian tube, where fertilization occurs if sperm is present. The fertilized egg will transport the uterus for development; the cervix opens to allow sperm to come in. Lack of fertilization maintains the menstrual cycle. The developed fetus will exit through the vagina.

Describe and compare the processes and products of spermatogenesis and oogenesis.

Spermatogenesis is the process of producing sperm where the testes first produce diploid spermatophytes that later undergo meiosis to produce haploid sperm.

The process of oogenesis refers to the formation of eggs. While four eggs are formed, only one is viable and termed the primary oocyte. The primary oocyte forms into the secondary oocyte which completes meiosis becoming a mature egg after fertilization.

State the hormones that control the production of sperm and androgen.

FSH and testosterone control the production of sperm while LH controls the production of androgen.

Describe the events of and control of the menstrual cycle.

The menstrual cycle is controlled by the hormones FSH, progesterone, and estrogen. The first step of the menstrual cycle is the follicular phase where FSH stimulates the formation of follicles in the ovary. The second step is ovulation where an egg forms from the ovary and goes through the fallopian tube into the uterus. The third step is luteal phase: ruptured follicles form corpus luteum which produces progesterone, getting the body ready for pregnancy. The final step is menstruation which occurs if fertilization did not take place. Menstruation is when the corpus luteum breaks down and progesterone/estrogen levels decrease; this leads to the degrading and shedding of the uterine lining which is expelled through the vagina as menstrual blood.

Relate the structure of sperm to its role in fertilization.

The process of fertilization is when the sperm fuses to the egg; then, the egg is activated due to metabolic changes being triggered allowing the start of embryonic development. The flagellum of the sperm allows it to move while the mitochondria gives it energy to do so. The sperm consists of acrosomal enzymes and a haploid nucleus at its head. These acrosomal enzymes play a role in piercing through the egg coat allowing for fertilization. Furthermore, the sperm consists of surface proteins that bind to the receptors of the eggs, making sure no incorrect sperm comes through. The nucleus located at the head of the sperm allows for proper unification of thereof and the eggs nucleus. Finally, the plasma membrane location in front of the flagellum allows for the fusion of its plasma membrane and the eggs, kickstarting embryonic development by successfully producing a zygote.

Describe the process and results of cleavage.

Cleavage occurs after zygote formation where rapid cell division occurs producing more, smaller cells and a fluid cell cavity called the blastocoel. Now, the zygote is a blastula.

Describe the process of gastrulation and the role of somites.

Gastrulation is when the cells migrate to opposite sides and a rudimentary body cavity forms and the zygote is now a gastrula. A basic tissue foundation forms: endoderm (digestive tract), mesoderm (muslce and bone), ectoderm (nervous system and skin). Somites function in organogenesis (organ formation from the basic tissues); somites form around the notochord and form the vertebrate, rib cage, and some muscles.

Define Homeotic genes and their role in embryo development.

Homoeotic genes are genes that help regulate the formation of organs. These genes are responsible for identifying different structures of the body and help coordinate their orderly formation.

Explain how apoptosis contributes to continued development.

Apoptosis is regulated, timely cell suicide. This helps form the structure of the embryo because when there is a dead cell, the alive cell digests the dead cell in, making it bigger. These bigger cells are better for organ formation.

Describe the initial embryonic stages and the formation and functions of the extraembryonic membranes in humans.

The extraembryonic membrane is mainly the chorion which makes up the placenta. This nourishes the embryo as it develops.

Explain how labor begins and describe the main events of the three stages of labor.

Labor begins due to increased muscle contractions as a result of a positive feedback loop created by the pituitary-secreted hormone oxytocin. The first stage is the dilation of the cervix, then the delivery of the baby, and finally the delivery of the placenta.

State and describe the two main divisions of the human nervous system.

The two main divisions of the human nervous system are the central nervous system and the peripheral nervous system. The CNS consists of the brain and spinal cord while the PNS consists of the ganglia and nerves. The brain and the ganglia can serve as regions where information is processed.

Compare and contrast the terms nerve, ganglia and brain.

The term nerve refers to bundles of peripheral neurons which are essentially nerve cells. Ganglia are clusters of neurons that function for information processing; likewise, the brain is a compartmental organ in complex animals that also functions for integration. The neuron is the smallest unit giving off information to the ganglia and brain. The brain can be thought of as the head of the nervous system.

Describe the structures and function of neurons.

The main structures of neurons are dendrites, axons, and axon hillocks. The dendrites are extensions of the neuron that function as the receiving region of other signals. Axons are long extensions of the neuron where signals are sent while the axon hillock is a cone-shaped region of the axon where the signal is generated.

Describe the function of glial cells. Understand why Schwann cells (myelin sheath) and the nodes of Ranvier are important.

The glial cells are important to the neurons as they act as support - nourishing the neurons, insulating the axons, and regulating the extracellular space of the neuron. Both schwann cells (PNS) and glial cells (CNS) produce the myelin sheath which increases the rate of conduction of the action potential. The nodes of Ranvier are important because they are the regions where the action potential forms. Action potentials are integral parts as they allow for the neurotransmitter to be released from the axon of presynaptic cells.

Define a resting potential and explain how it is created.

The resting potential refers to the membrane potential of idle neurons that are not sending or transmitting signals. Resting potential is when the inner-membrane charge is negative while the outer membrane charge is positive. The concentration of potassium ions and sodium ions are quintessential in maintaining the resting potential. Usually, there is a higher concentration of potassium ions inside the membrane while there is a higher concentration of sodium ions outside the membrane. This creates a negative charge inside and a positive charge outside; thereby, neurons use ATP-using sodium-potassium pumps to maintain this gradient.

Explain how an action potential is produced and the resting membrane potential restored. (lots of detail to know!)

First, it is critical to understand the concept gradient potential which refers to change in polarization where the magnitude of the change depends on the strength of the stimuli. When there is a major alteration in the membrane potential, there is also a huge change in voltage which creates an action potential. The action potential maintains a constant magnitude and can send signals over large distances. The action potential occurs when depolarization increases the membrane potential to a certain value or threshold. The resting membrane potential forms due to repolarization of the active potential which is facilitated by the gated ion channels. These channels will facilitate the movement of negatively charged ions back into the inner membrane space for the restoration of the resting membrane.

Describe the function of acetylcholine.

Acetylcholine is a major neurotransmitter that functions in muslce stimulation, memory formation, and learning.

Describe what occurs at the synapses, both with the presynaptic cell and postsynaptic cell.

The transmission of information occurs at synapses. Most synapses are chemical synapses where presynaptic neurons send chemical signals to the postsynaptic cell. The presynaptic cells synthesize and package neurotransmitters in synaptic vesicles in the synaptic terminal. When an action potential forms, the neurotransmitter is released and diffuses to the postsynaptic cell causing a change. Signaling at the chemical synapse brings about a response/change that depends on the type of neurotransmitter and type of receptors on the postsynaptic cell.

Explain the general mechanism of toxins and drugs.

The general mechanism of toxins and drugs is to affect neurotransmission. Toxins usually negatively affect neurotransmission whereas drugs have therapeutic benefits. For example, SSRIs treat depression by inhibiting the neurotransmitter reuptake of serotonin which increases the amount of serotonin.

Name the 5 human senses and describe the essential roles of sensory receptors in producing these “senses”.

Touch - this allows us to feel the world around us and grasp different textures

Taste - this allows us to ensure what we are eating is good and not bad

Smell - allows us to avoid poor odors which could be damaging to our system

Vision - allows us to see the world effectively

Hearing - allows us to avoid areas where we could be harmed

Define sensory transduction, receptor potential, and sensory adaptation.

Sensory transduction refers to the process by which a stimulus binds to a receptor causing the stimulus to be converted into an electrical signal. Receptor potentials are formed when a sensory transduction is triggered, causing changes in the ion concentration by allowing

gated-ion channels to open/close. The receptor potentials allow for the release of neurotransmitters. Sensory adaptation occurs when there is a repeated stimulus; therefore, the receptors become less sensitive to it.

Describe the 5 general categories of sensory receptors found in animals and provide examples of each.

Pain receptors - they detect dangerous stimuli like dangerous heat and pressure

Thermoreceptors - they detect heat/cold

Mechanoreceptors - they respond to mechanical energy like touch, sound, and pressure

Chemoreceptors - these are present in the mouth and nose and they respond to chemicals

Electromagnetic receptors - these respond to electricity, magnetism, and light

Explain how taste buds start the processing of information that results in the sense of taste

Let's use the example of consuming sugar. Sugar is taken in via the oral cavity and will bind to sugar chemoreceptors in the taste buds. Due to the binding, a sensory/signal transduction pathway is triggered. The signal transduction pathways make gated ion channels in the membrane to open and close. Due to the movement of ions, there is a change in the membrane potential called receptor potential. The change of charge/voltage due to the conversion from the resting potential to the receptor potential results in the release of neurotransmitters. These neurotransmitters are then picked up by sensory neurons, which will result in the sense of taste.

List the structures of the ear in the sequence in which they participate in hearing.

Sound waves travel first through the outer cap which is a flap-like pinna, and then goes down the auditory canal. Then, the sound wave travels through the eardrum which separates the outer and middle ear. Next, the sound wave travels through a bunch of bones in the middle ear finally making it to the fluid in the coiled cochlea in the inner ear. Due to the movement of fluid because of the sound waves, there is a bending of the hair of hair cells in the organ of corti.

This triggers a nerve signal which goes to the brain and is processed as an actual coherent sound. *The louder the sound the greater the stimulus. Also, different pitches will have different effects on the organ of corti.*

Name the parts of the ear associated with body position and movement.

There are three compartments of the ear that can detect body position and movement. They do this by the bending of the hair of the hair cells. There are three semicircular canals that detect changes in the heads rotation and angular movement. Finally, there is the utricle and saccule which detect the position of head with respect to gravity.

Describe the parts of the human eye and their functions.

Light waves enter the eye through the pupils. The pupil is controlled by the iris. The lens focuses the light waves to the retina by changing shape which bends the light waves. The center of focus is called the fovea as it has the highest concentration of photoreceptors. The rods and cones are the photoreceptors of the retina. The rods contain rhodopsin which absorbs light and can detect shapes in dim light. The cones contain photopsin which absorbs light and can perceive color. These photoreceptors integrate the sensory information of the light waves and send a nerve impulse to the brain, where the brain allows us to see. The lens and ciliary bodies of the eye divide the eye into two fluid filled matrixes. The larger chamber behind the lens is called the vitreous humor and the smaller chamber in front of the lens is called the aqueous chamber. These chambers give structure to the eye and give nutrients to the cornea, iris, and lens. The sclera is a region of tough connective tissue around the eyeball. In the front of the eye, the sclera becomes the cornea, which helps light enter through the pupil and helps focus light. The sclera also surrounds a pigmented region called the choroid. The anterior choroid forms the iris, which gives the eye its color. There are also glands on top of the eye, where tears are produced; this cleans and gives moisture to the eyes.

Explain how odor and taste receptors function.

Odor and taste receptors are based on genetics. The odor receptors are on the nasal lining and the taste receptors are on the tongue. The odor receptors are able to detect airborne molecules while the taste receptors detect solutions. When a certain chemical stimuli attaches to the receptors, an action potential is formed that allows for a nervous signal to be sent to the brain. The brain integrates sensory information, which gives us the ability to smell and taste.

Describe the role of the central nervous system in sensory perception

The CNS is critical in sensory perception because sensory receptors integrate information and either cause the formation of an active potential or not. The active potential allows for the release of a signal to the brain of the CNS, which integrates that signal giving the feeling of sensory perception.

Define and distinguish between the different levels within ecosystems.

Organism - one singular cellular entity

Population - a group of organisms of the same species interacting with their environment

Community - a group of populations interacting in their environment and with each other

Ecosystem - a collection of the abiotic and biotic factors in an environment

Biome - multiple ecosystems coexisting in an area determined by its vegetative properties

Biosphere - the whole earth

Distinguish between the biotic and abiotic components of an ecosystem.

Both the biotic and abiotic components of an ecosystem affect the organisms interactions with their environment. Biotic factors are living factors (predators, plants, algae), while abiotic (topology, water, rocks, light) factors are non-living.

Describe the abiotic factors that influence life in the biosphere.

Abiotic factors that influence the biosphere are like water as it is critical for life. Similarly, rocks containing phosphorus are a major source of minerals for certain organisms. Light and topology are major abiotic factors in plant potential and growth.

Describe the abiotic and biotic characteristics of the different ocean zones, adjacent aquatic biomes, and freshwater biomes.

The different types of ocean zones are the benthic realm, pelagic realm, aphotic zone, and photic zone. The biotic factors are the algae, plants, and marine life in the oceans. The abiotic characteristics include amount of light, salinity, and ocean wave movement.

Adjacent aquatic biomes are characterized by salty ocean water meeting fresh water or terrestrial land. These biomes include estuaries, wetlands, and intertidal zones. The abiotic factors are salinity, topology, rocks, and climate. The biotic factors are wildlife both marine and terrestrial, plants, and algae.

The freshwater biomes are flowing or standing freshwater biomes. Flowing freshwater biomes are like streams and rivers while standing freshwater biomes are like lakes and ponds. Flowing freshwater biomes have abiotic factors of the speed of the stream, climate, and minerality. Standing freshwater biomes have abiotic factors such as light, water pH, water temperature, and oxygen concentration. Boht have biotic factors such as algae, plants, and animals.

Describe the different types of freshwater biomes. Describe the characteristics used to define terrestrial biomes.

The different types of freshwater biomes are standing freshwater (lakes, ponds) biomes and flowing freshwater biomes (streams, rivers). These distinctions are made by the water velocity.

The characteristics used to define terrestrial biomes are vegetation. Plants are in different biomes because of light prevalence and amount of rainfall.

Explain how all parts of the biosphere are linked by the global water cycle.

All parts of the biosphere are linked by the global water cycle as through transpiration, evaporation, and precipitation, water flows from oceans to lands to the atmosphere. This makes all the different biomes connected as they are all contributing to the global water cycle.

Define population and population ecology.

A population is a group of the same species in one particular area. Population ecology is concerned with factors that affect population size, which regulate a population overtime. Factors that increase population are immigration and birth while factors that decrease population are emigration and death.

Define population density and describe different types of dispersion patterns.

Population density is the amount of a certain species per unit of area. Dispersion patterns relate to how a population is spaced out. Clumped dispersion pattern is when the population is in different clumps, uniform dispersion pattern is when the population is equally distributed and spaced out, and random dispersion is when the population is randomly spread.

Explain how life tables are used to track mortality and survivorship in populations.

Life tables are able to track mortality and survivorship by showing how many individuals of a certain population are alive at each age, showing how well the population survives. Using this data, the average mortality rates can be calculated.

Describe and compare the exponential and logistic population growth models, illustrating both with examples.

The exponential growth models show rapid, unlimited population growth without any limiting factors. The logarithmic population growth is much slower and shows the population growth with account of limiting factors and it can be seen that the population growth plateaus when it reaches its carrying capacity.

Explain the concept of carrying capacity.

The carrying capacity is the amount of organisms that an environment can support at a given time. The carrying capacity is best characterized as the maximum amount of resources that a population can use in an environment.

Describe the factors that regulate growth in natural populations.

The factors that regulate growth are density independent factors like floods, droughts, and natural disasters. Density dependent factors that regulate growth are like disease, toxins, and predators.

Define boom-and-bust cycles, explain why they occur, and provide examples.

Boom and bust cycles are seen in populations of birds, insects, and mammals. It shows rapid fluctuations in population density. At first, the “boom” phase is when the population is rapidly growing due to the abundance of nutrients and natural resources. However, when the nutrients are depleted, the population declines rapidly (bust). This is a repeating cycle.

Explain how life history traits vary with environmental conditions and with population density.

This can be understood with examples. So, if an organism has a lot of offspring, then it may not be able to provide enough nutrients for the offspring, leading to death. This is an example of how population density affects life history traits. Another example is when an environment has no nutrients, and so inherently many in a population will be prospering.

Compare r-selection and K-selection and indicate examples of each.

R-selection are traits where organisms prosper in low density environments and populations with low competition. *Frogs and insects.* K-selection is when organisms that do better with high competition and a population density close to the carrying capacity. *Trees and humans.*

Define a biological community. Explain why the study of community ecology is important.

A biological community is when there are many populations interacting with each other. The study of community ecology is important to understand the dynamics of the earth and how communities are structured and change over time. This also can be studied to show the behavior of animals and plants in contact with other organisms.

Define interspecific competition, mutualism, predation, herbivory, and parasitism and provide examples.

- **Competition**: -/- because competition is when two organisms compete for resources, and in the long run, that just limits resources, being negative to both organisms.
- **Mutualism**: +/+ this is when two organisms help one another like mycorrhizal fungi at the roots of plants.
- **Predation**: +/- this is when one species kills another, only benefits one
- **Herbivory**: +/- this is when invertebrates and insects damage plants or eat them entirely, only benefitting the animal
- **Parasitism**: +/- a host parasites extracts the nutrients from a host

Define an ecological niche. Explain how interspecific competition can occur when the niches of two populations overlap.

An ecological niche is the sum of an organism's use of the biotic and abiotic resources in its environment. Interspecific competition occurs when two niches of a population come in contact and both need a resource that is in short supply. This causes a decrease in carrying capacity because one population uses up the resources needed for the other population, leading to population extinction.

A keystone species that has a huge impact on its community as it holds the community in place. Like oysters.

Identify and compare the trophic levels of terrestrial and aquatic food chains.

In both terrestrial and aquatic food chains the producers are at the bottom following herbivores and then there are small carnivores after. At the top of the food chain is the quaternary consumer which is the apex predator that other organisms cannot engage in predation with.