

HUMAN BIO EXAM REVISION!!!!!!

CHAPTER 2 – CHEMICAL MESSENGERS:

~ The endocrine system influences the activity of cells by the release of chemical messengers known as hormones – done to maintain a DYNAMIC EQUILLIBRIUM.

Endocrine Glands (ductless) – Secrete hormones into the extracellular fluid that surrounds the cells that make up a gland – secretion then passes into the capillaries to be transported by the blood. Major endocrine glands include:

- Hypothalamus
- Pituitary
- Pineal gland
- Thymus
- Para/thyroid
- Adrenal glands
- Pancreas
- Ovaries
- Testes

Exocrine glands – Secrete into a duct that carries the secretion to the body surface/cavities – include:

- Sweat glands
- Mucous glands
- Salivary glands
- Alimentary canal

Hormones may be proteins, steroids or amines and are transported through the body via the blood.

Paracrines or (local) hormones are secreted by cells in order to communicate with other cells in the same tissue.

Hormones can only be secreted by specialized cells and travel via bloodstream where paracrines can be secreted by all cells and travel (diffuse) through extracellular fluid.

PROTEIN AND AMINE HORMONES (water soluble) – attach to receptor proteins in the membrane of the target cell – causes a secondary messenger substance to diffuse through the cell and activate particular enzymes. I.E. Insulin binds to receptor protein and this leads to an $\uparrow$ in glucose absorption by the cell.

STEROID HORMONES (lipid soluble) – enter target cells and bind to receptor proteins on the inside (this may be on the mitochondria or in the nucleus). The hormone-receptor complex activates the genes controlling the formation of particular enzymes.

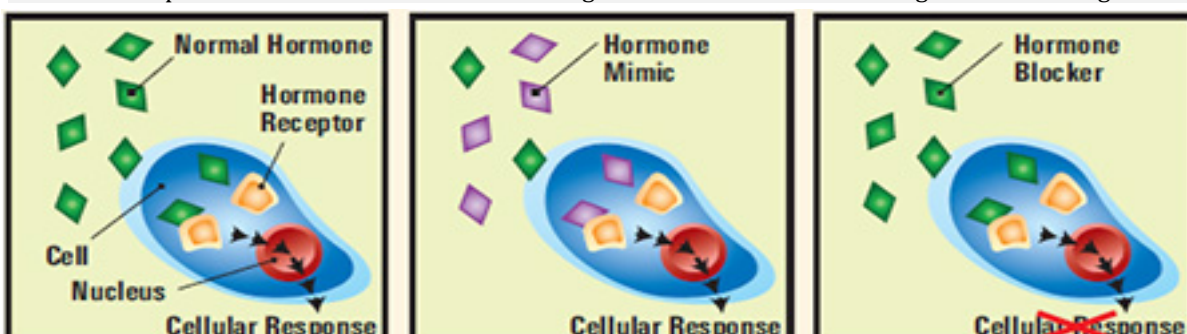
* HORMONES MAY CHANGE THE FUNCTION OF A CELL BY CHANGING THE TYPE, QUANTITY OR ACTIVITY OF THE PROTEINS PRODUCED – THEY ARE NOT ENZYMES BUT CAN EXERT INFLUENCE BY CHANGING THE ENZYME ITSELF OR THE CONCENTRATION OF THE ENZYME *

HORMONES MAY:

1. Activate certain genes in the nucleus so that a particular enzyme or structural protein is produced.
2. Change the shape or structure of an enzyme so that it is turned on/off.
3. Change the rate of production of an enzyme or structural protein by changing the rate of transcription/translation during protein production.

Endocrine disruptors can:

1. Mimic or partly mimic naturally occurring hormones in the body like oestrogens (the female sex hormone), androgens (the male sex hormone), and thyroid hormones, potentially producing overstimulation.
2. Bind to a receptor within a cell and block the endogenous hormone from binding. The normal signal then fails to occur



and the body fails to respond properly. Examples of

- Top 1/3 of the extensions are the light chains

Attenuated vaccines – microorganisms of a reduced virulence are injected into the bloodstream (longer lasting than dead vaccination)(measles, mumps, TB, yellow fever)

Dead vaccines – dead microorganisms (cholera, bubonic plague, typhoid, hepA, whooping cough)

Toxoids – made from filtrates of bacterial cultures containing toxins (diphtheria and tetanus)

Sub unit – vaccines made of a fragment of an organism (HPV, hepB)

Lymphocyte – Specialized WBC's that have a spherical nucleus surrounded by a thin granular cytoplasm.

B CELLS

- Humoral and antibody mediated immunity
- Educated in bone marrow
- Chemical based system
- Produce antibodies (Ig – immunoglobulin)
- Effective against extracellular bacteria and some viruses

T CELLS

- Cellular and cell mediated immunity
- Educated in thymus
- Cell based system
- Produce killer, memory and helper cells
- Effective against intracellular viruses, cancer and some bacteria

KILLER T (CYTOTOXIC) CELLS – destroy body cells infected by viruses or transformed by cancer

HELPER T CELLS – perform many immune functions – they are essential for activating killer cells and B cells

MEMORY CELLS - remain in the body and enable the immune system to react rapidly should it encounter the same antigens again

CYTOKINES – stimulate T cells to divide and differentiate into killer, helper or memory cells

ANTIBIOTICS – chemicals specifically designed to kill a certain bacteria – produced by fungi or other microorganisms (penicillin)

AGGLUTINATION - a reaction in which particles (as red blood cells or bacteria) suspended in a liquid collect into clumps and which occurs especially as a serological response to a specific antibody

ANTIBODY MEDIATED IMMUNITY:

1. Pathogen displaying antigens
2. Antigen recognized by compatible antibody
3. B cells digest antigen and display fragments of antigen
4. T helper cell recognises antigen
5. Activated T helper cell releases cytokines
6. Cytokines cause B cell to mature into plasma cell
7. Plasma cell secretes antibody

CELL MEDIATED IMMUNITY:

1. Internal cell infection is displayed on the cell surface by MHC class one
2. MHC class one molecules bind to cytotoxic T cells
3. Costimulation occurs with helper T cells and CD8
4. T cells are activated, proliferate, and differentiate
5. Some T cells differentiate into cytotoxic T cells
6. Cytotoxic T cells lyse cells and produce cytokines
7. Cytokines kill the cell
8. Memory T cells form
9. Memory T cells remember the antigen and produce faster immune response during subsequent exposures

ACTIVE IMMUNITY:

(antigen activated)

- immune system activated
- memory cells produced = immunity acquired

Geographical barriers include: oceans, mountain ranges, large lake systems, deserts and expansive ice sheets.

Sociocultural barriers include: language, economic status, educational background, religion and social position.

The Basque people of the Pyrenees in France and Spain have a language that appears unrelated to any other. This has served to unite them and preserve their cultural identity despite sharing the same religion and occupations as their neighbours – they are characterised by broad features such as broad foreheads, narrow jaws and distinctive frequencies in their blood groups – 35% are RH- while in the surrounding European countries, on 16% of people are RH-.

GENETIC DISEASES – The allele that causes tay-sachs is an example of how genetic diseases affect allele frequencies in gene pools. It is a hereditary disorder of lipid metabolism that mostly affects Ashkenazi jewish people. It affects around 1/500000 births worldwide, but around 1/2500 births in Ashkenazi jews. One possible reason for the high frequency of this allele in the population is genetic drft – jewish populations tend to be small and isolated – factors that increase the chances of genetic drift. Another reason is that those who are heterozygous for Tay-sachs have a selective advantage/resistance to tuberculosis – that is, that people who are homozygous for the dominant normal allele (TT) are susceptible to TB, those who are homozygous for the recessive lethal allele (tt) are likely to die very young due to the disease but those who are heterozygous - that is the lethal recessive is masked by the dominant normal allele (Tt), they are not affected negatively by the disease, but still have a specific resistance to TB – and are thus more likely to reproduce and pass their genes on to subsequent generations. Due to discrimination, Ashkenazi Jews often found themselves in overcrowded ghettos that increase the threat of TB – meaning that the frequency of the tay-sachs allele could be maintained.

It is interesting to note that the same disorder has been seen in the Cajun population of southern Louisiana – Cajuns are an ethnic group that have been reproductively isolated for several hundred years because of language differences – the mutation may have been introduced when an Ashkenazi family integrated into the society who were carriers/affected – if this was the case it is another example of how migration affects allele frequencies in populations.

THE PROBABILITY OF HAVING A CHILD (FROM A MARRIAGE BETWEEN FAMILY MEMBERS) WITH GENETIC DISEASE CAUSED BY A RECESSIVE ALLELE IS COMMON – THE RELATED PARENTS HAVE RECEIVED SOME OF THEIR GENES FROM A COMMON ANCESTOR AND THEREFORE HAVE AN INCREASED CHANCE OF BEING CARRIERS OF AN ALLELE FOR THE SAME ABNORMAL CONDITION.

THE THEORY OF EVOLUTION THROUGH NATURAL SELECTION:

Evolution is the gradual change in the characteristics of a species (Charles Darwin and Albert Wallace in 1858)

Darwins theory of natural selection was based on three observations:

1. Variation – all members of a species vary with these being passed on down subsequent generations. It is because of variation that survival of the fittest (more organisms with favourable characteristics suitable to survival in their environment survived long enough to reproduce and pass those characteristics on to their children).
2. Birth rate – all living organisms reproduce at a rate which exceed the rate at which their food and resource supply increase – creates a struggle for existence with favourable variations being preserved.
3. Natures balance – although birth rate was high, each species numbers tended to remain at a relatively constant level.

Natural selection can thus be defined as the selection of alleles in a population that give an organism a greater survival advantage. Those organisms that survive will pass on their favourable alleles to their offspring with the characteristics of a population over an extended period of time changing to be better suited to their environment.

EVIDENCE: Body stature – longlimbed/short bodied people in Africa VS. shortlimbed/longbodied people of the Inuit (eskimo).

Sickle cell anemia and Anophlese malaria virus in africa.

SPECIATION:

primitive egg-laying mammals (echidna and platypus) are only found in Australia – the exception being one species of echidna being found in New Guinea (which is close to Aus) – the most likely explanation being that the unique species found in Australia have been evolving for millions of years in isolation from the rest of the world.

CHAPTER 16 – FOSSIL EVIDENCE FOR EVOLUTION:

One of the crucial pieces of evidence for evolution, the gradual change in characteristics of organisms over time, is the record of those changes left in the form of fossils. Any preserved trace left by an organism that lived long ago is a fossil – fossils therefore include footprints, burrows, faeces or impressions of all or part of an animal or plant (as well as bones, shells or teeth) - - in the case of humans, fossil remains are usually bones, teeth and sometimes footprints. Other material associated with the bones, such as the rock they were found in and fossils of other plants and animals allows the scientist to develop a picture of life in the past – what they ate, what other things existed at the same time and sometimes even what the climate was like.

One of the best known cases of a fossil record allowing scientists to build up a sequence of evolution is the evolution of the horse – it can be traced through the remains of a small creature not much bigger than a small dog through to the horses we know today.

FOSSILFORMATION:

Normally dead organisms are decayed by micro-organisms and no trace of their existence is left. Parts of organisms may become fossilised when buried by drifting sand, mud deposited by rivers, volcanic ash or burial by other members of the species (if buried rapidly, conditions may not be suitable for the activity of decay organisms and decomposition may be slowed/prevented).

In wet, acid soils, the minerals of the bone are dissolved and no fossilisation occurs, however if such soil contains no oxygen (i.e. peat) complete preservation of the soft tissues and bones of the organism may occur. Bones buried in alkaline soils produce the best fossils because the minerals in the bones are not dissolved – new minerals (lime/iron oxide) are deposited into the pores of the bones replacing the organic minerals that make up 35% of the bone weight – the bone becomes rock (petrified) but the details of the structure are still preserved.

FOUR CONDITIONS REQUIRED FOR FOSSIL FORMATION:

1. A quick burial of the material
2. The presence of hard body parts
3. An absence of decay organisms
4. A long period of stability – the organism needs to be left undisturbed

DISCOVERY OF FOSSILS:

Small hand tools are used to gently remove the soil so as not to damage any of the material (the soil is usually then sieved). In the case of fossils of human ancestors, artefacts (objects deliberately made by humans) are often found in association with the fossils – including stone tools, beads, carvings, charcoal and cave paintings. In the laboratory, fossils are carefully scraped clean, broken parts are pieced together, measurements are made and plaster casts/latex moulds may be made.

DATING OF FOSSILS:

Knowledge of the age of fossils and artefacts is crucial in finding out the sequences of changes that have resulted in present day humans. Some methods of dating provide absolute dates – the actual age of the specimen in years – or relative dates – which tell us if one sample is older/younger than another.

ABSOLUTE DATING:

POTASSIUM ARGON TECHNIQUE :

Is based on the decay of radioactive potassium to form calcium and argon. Potassium is a mixture of three different forms with atomic weights 39, 40 and 41. The isotope K-40 is radioactive and decays to form Ca-40 and Ar-40 – such decay takes place at an extremely slow but constant rate and so determining the amounts of K-40 and Ar-40 allows the age of the rock to be calculated. P-A dating has limited usefulness however as not all rock

types are suitable for this method of dating and it can only date rocks older than 100 000 – 200 000 years (at the earlier date of 100 000 years, only 0.0053% of the K-40 in a rock would have decayed to Ar-40, pushing the limits of detection devices currently in use. To determine the age of a fossil using this method, a suitable rock of the same age must be available – this occurs when rocks produced in volcanic eruptions bury bones.

CARBON-14/RADIOCARBON DATING:

This method is based on the decay of the radioactive isotope carbon-14 to nitrogen. Carbon 14 is produced in the upper atmosphere by the action of cosmic radiation on nitrogen at about the same rate that it decays. In the atmosphere there is a ratio of one carbon-14 atom to every million million (trillion) atoms of the stable isotope carbon-12. When plants use atmospheric carbon dioxide in photosynthesis, one atom in every trillion of the carbon atoms incorporated is carbon-14. Should an animal eat the plant, the carbon 14 then becomes part of the animals tissues. With death, an organisms intake of carbon 14 ceases, but the carbon 14 already in the tissues continues to decay at a fixed rate – by measuring the amount of radiation liberated by a sample, the ratio of carbon 14 – carbon 12 can be estimated and from this, the age of the sample can be calculated.

5730 +/-40 is the half life of carbon 14 – in other words, every 5730 (+/-40) years, there will be half the amount of carbon 14 than previously – the normal method of radiocarbon dating requires at least 3g of organic material so that the amount of C-14 in a sample can be measured.

A more refined technique called the ACCELERATOR MASS SPECTROMETRY (AMS) RADIOCARBON DATING can be used to date a sample as small as 100micro grams by breaking the sample up into its constituent atoms so that the number of atoms of each isotope of carbon can be counted. Using AMS dating it has become possible to date cave paintings accurately from tiny samples of pigment as some of the pigments contain organic material such as charcoal.

DATING METHOD	MATERIAL USED	USEFUL RANGE (YEARS BP)
Tree growth rings	Wood	Up to 9000
Carbon -14	Carbon compounds	Up to 60 000
Protactinium	Sea sediments	Up to 250 000
Uranium-thorium	Sea sediments, coral	Up to 600 000
Potassium-argon	Volcanic deposits	200 000 and earlier
Electron spin resonance	Calcium carbonate, quartz and flint	Between 100 000 and 300 000
Fission tracks	Minerals and glass	100 years ago to 4550 million
Thermoluminescence	Sediments, lava, ceramics	300 years ago to 100 000

After about 70 000 years radiocarbon dating is null and void because the amount of carbon 14 left is negligible – therefore radiocarbon dating cannot be used to date back more than 60000 years – another limitation is that material to be dated must contain organic carbon compounds.

RELATIVE DATING METHODS:

STRATIGRAPHY:

The study of layers (strata) can be useful in two ways:

1. Principle of superposition – assumes that in layers of sedimentary rock, the layers at the top are younger than the layers at the bottom – 2 problems with this – distortions in the earth's crust do occur and a sequence of rock layers may be turned upside down and it is possible for fossils or artefacts to be buried by animals or humans some time after the deposition of sediment.
2. The correlation of rock strata – involves matching layers of rock from different areas – matching can be done by examining the rock itself and also by studying the fossils it contains. Rocks that contain the same fossils can be assumed to be of the same age. Certain fossils are of great value in correlation studies as they are widely distributed and present for only a limited period of time – they are called index fossils (i.e. a trilobite fossil).

FLUORINE DATING (Pit down man):

It is based on the fact that when a bone is buried/left in soil, fluoride ions which are present in the water in the soil replace some of the ions in the bone itself. All the fossil bones in a particular deposit should have the same amount of fluoride and so fossils that have been displaced can be detected – the older the fossil, the more fluoride it should contain and so the relative ages can be established.

PHYLOGENETIC TREES:

Also called a DENDROGRAM represents the evolutionary relationships between a number of organisms derived from a common ancestor where the ancestral organism forms the base of the tree and those organisms that have derived from it make up the branches. Closely related groups are placed on branches close to each other – keep in mind however that these are only inferred relationships; different researchers may come up with different trees to fit their interpretation of the data.

THE GEOLOGICAL TIME SCALE:

Because of the tremendous time span involved, Earth's geological history has been divided up into a geological time scale that consists of Eras, broken into Periods and further divided into Epochs. In studying the origins of humans, we are only interested in the Cainozoic era as this is when the primates (the group modern humans belongs to) started to evolve.

CHAPTER 18 – EVOLUTIONARY TRENDS IN HOMINIDS:

More than 3 million years ago, the ancestors of modern humans walked over the wet volcanic ash of Laetoli, Tanzania leaving behind their footprints. As the ash dried and hardened it became fossilised and then covered by more ash until its accidental discovery in 1978.

- interesting – the ancestors of modern humans that made these footprints were walking much the same way as we do now – BIPEDAL LOCOMOTION – walking upright on 2 legs – differs from other great apes who used QUADRUPEDAL LOCOMOTION.

APES + HUMANS = GREAT APES = GENUS HOMINIDAE

Shared characteristics of the great apes:

1. A brain that is larger and more complex than other primate – bigger cerebral cortex
2. Distinctive molar teeth in the lower jaw which have a 'Y5' pattern (5 cusps/ridges in the shape of a y)
3. A shoulder and arm structure that enables it/the arms to rotate freely around the shoulder
4. A ribcage that forms a wide but shallow chest
5. An appendix
6. No external tail

However, humans differ from primate apes in the appearance and majority of their structure – each animal species has adapted/developed characteristics that helped it to survive and reproduce in their respective environment.

Humans as such are classified as HOMININS, belonging to the tribe HOMININI.

A TRIBE – given to a relatively new level of classification between subfamily and genus.