

After division of the nucleus has occurred, the cytoplasm divides in a stage called **cytokinesis**. Interphase is the period between divisions, when cell organelles and DNA are replicated.

Stage of division	Chromosomes	Centrioles	Nuclear	Cell
			envelope	membrane
Interphase (S and G2)	DNA replicates.	Exist as pair outside the	Intact.	Present.
		nucleus.		
Centrioles	Chromosomes are			
Chromatin	uncoiled and not visible.			
Cytoplasm (B)				
envelope Nucleolus				
Prophase	Coil & condense.	Separate and move to	inte ameller	Present.
	Exist as pairs of	opposite person the eni.	vesicles	
Centromere	chromatids joined	0100	vesicies.	
	centromere.	<u> </u>		
		Spindre filmes radiate out		
Chromosomes	900	from the centricle and		
(pared 10 have	Pay	(end of prophase)		
		(end of prophase)		
Metaphase	Line up in single file on	At opposite poles of the cell.	Absent.	Present.
	the equator of the cell.			
Spindle				
Anaphase	Chromatids from each	At opposite poles of the cell.	Absent.	Present.
	pair are pulled to			
(B)	opposite poles of the cell			
Telophase	Reach the poles of the	Spindle breaks down.	Reforms.	Present.
	cell - now called			
	chromosomes.			
	Chromosomes			

(I) explain the term *differentiation*, with respect to the production of erythrocytes and leucocytes derived from stem cells in bone marrow.



All blood cells are derived from stem cells (haemopoietic cells) in the bone marrow.

Intercellular signals and uneven distribution of growth factors in dividing cells give rise to daughter cells with different properties.

B-lymphocytes and T-lymphocytes differ because they mature in different parts of the body.

Erythropoietin triggers the changes that give rise to red blood cells, i.e. loss of nucleus, synthesis of haemoglobin.

When a cell differentiates, its size, shape, polarity, metabolic activity and responsiveness to signals may change dramatically. These

changes are largely due to modifications in gene expression.

With a few exceptions, cellular differentiation almost never involves a change in the DNA sequence. Thus, different cells can have very different physical characteristics despite having the same m Notesale.co.u genome

2.1.2 Detecting and Treating Cancer

risk factors and symptoms associated with cancer in the An understanding Ott generator Patton contributes on Usary diagnosis of cancer and an improvement in prevention and recovery.

(a) you need to be able to outline the factors that may increase the risk of developing cancers, with reference to

- types of radiation, •
- carcinogens, •
- ageing, •
- viruses and heredity:

(b) evaluate the epidemiological evidence linking smoking with lung cancer; diet with bowel cancer and mutations in the BRCA1 gene with breast cancer.

- You need to be able to interpret data in the form of graphs and tables. •
- You need an awareness of how statistics are used to determine the significance of results.

(d) define the term *prevalence*, with reference to breast cancer in post-menopausal women compared with the rest of the female population;

Prevalence is the total number cases in a population at a given time, i.e. number of cases divided by the number in the population. There are more post-menopausal women with breast cancer per 100,000 than the population as a whole.

• Detection of cancer involves skilled professionals from a variety of backgrounds, including radiologists, who conduct and interpret the results of scans, and pathologists, who interpret the results of biopsies.

(c) outline the methods of detecting cancers of the breast and lungs, with reference to MRI, X-rays, mammography, thermography, CT scans, ultrasound and PET scans;

- <u>X-ray techniques</u> used in mammography, CT scans and chest screening rely on the greater density of tumour tissue compared with normal tissue. Tumours show up as a light mass on the film. Expert analysis is necessary.
- <u>Thermography</u> detects the infra red radiation emitted from the tissues. Hot spots show areas of high metabolic activity and so may indicate cancer.
- <u>Ultrasound</u> uses the differential reflection of high frequency sound waves from tissues of different density.
- <u>PET</u> (positron emission tomography) images biochemical activity and can detect tumours and gauge their malignancy. A small quantity of radio-nuclide is injected and scanners detect gamma rays that are emitted (why gamma rays?) It is used in diagnosis and in follow up checks.
- <u>MRI</u> (magnetic resonance imaging) uses a strong magnet and radio frequency detection to detect the number and molecular environment of hydrogen atoms. Because water has two hydrogen atoms, this technique visualises tissues according to their different water content. An image in shades of grey is produced providing a detailed image of the body organs without harmful X-rays or invasive surgery.
- <u>Biopsy</u> A sample of suspect tissue is taken and examined under a microscope to determine the nature of the cells.

• Treatment and advice involves health projessionals who in term and support both the patient and their family through up their treatment

(e) outline methods used to treat cancers at the breast, with reference to Tamoxifen™, surger (unsectomy and matteriany, emoval of lymph nodes), chemotherapy, immunotherapy and complementary therapies

- <u>Tamoxifen</u> blocks the oestrogen receptors in breast cells and is prescribed for women for five years after surgery to prevent recurrence of the cancer. This only works for breast cells that are sensitive to oestrogen, so tests are made to check which receptors are present before prescribing.
- <u>Lumpectomy and mastectomy</u> is the surgical removal of the affected tissue and its immediate surroundings, including the associated lymph glands. This aims to prevent metastasis.
- <u>Chemotherapy</u> Neoadjuvant chemotherapy is given to shrink the tumour before surgery, adjuvant chemotherapy is given after surgery to prevent recurrence. Palliative chemotherapy is given to control tumour growth where surgery is not possible. In all three, a cytotoxic drug is administered that targets dividing cells.
- <u>Immunotherapy</u> The immune system is persuaded to attack tumour cells specifically by locking on to specific antigens on the cell surface. Advances in the production of artificial antibodies and the drug Herceptin have made this treatment more available.
- <u>Complementary</u> therapies are *usually* used alongside other treatments and include acupuncture, dietary regimes, relaxation, meditation and herbalism.

Two particular steps are especially important. They involve the woman's immunity to rubella and making sure she has plenty of folic acid in her diet.

Rubella: Sometimes known as German measles, is an illness caused by a virus. It is not usually a dangerous disease for children or adults; they suffer a raised temperature, tiredness and spots all over the skin, but normally recover within ten days or so. But for developing foetus, it is a very different story. If the mother has rubella, the virus can cross the placenta and get into the foetus' blood. If this happens in the early stages of pregnancy, within the first 3 months, the baby's heart, brain, ears and eyes may fail to develop properly. Babies which have been exposed to the rubella virus may be born with heart and brain defects, deafness and perhaps cataracts. So it is important that a woman who is trying to get pregnant finds out if she is immune to rubella. A simple blood test to check for antibodies to rubella, will give the answer. If she is immune, she does not need to do anything else. If she is not, then she can have a rubella vaccination. But it is important to do this at least 3 months before



Folic acid

sale.co.uk en vegetables, some breakfast This is a B vitamin which is found in foods such as dake cereals, milk products, oranges and bt nines. A link has been for the etween lack of folic acid and the birth of a baby with neural tube defects. The neural tube is the part of the embryo which develops into the suparcord and brain. Form, and grows during the very early stages of premai cycrobably even be de de de man knows she is pregnant. If the neural tube does not develop properly, the baby may be born with spina bifida or other serious defects of the nervous system. So, even if she eats a good diet, she should think of taking folic acid supplements. Taking folic acid pills each day before getting pregnant reduces the risk of having a baby with spina bifida by about 70%.

Measuring infant height (length)

The height of the infant is measured with the lying on specially designed equipment. The infant's head rests against a fixed headpiece and a moveable footpiece can be slid to touch the feet. A ruler in the device is used to take a reading. The infant must not be wearing shoes or have any ornaments on its head. It should be dressed in light underclothing.

Measuring infant head circumference

Calciur

A tape is used that is flexible but cannot stretch. Plastic tapes are often used, designed so that one end of the tape can be inserted into the other end to take a reading. The tape is placed over the most protruding part at the back of the head, above the ears and just above the eyes, where there is a bony ridge.

for growing b



(b) outline the importance of: carbohydrates, lipids, essential fatty acids, proteins essential amino acids; calcium, iron, phosphorous; vitamins A C and D in maintaining healthy growth in infants;

Carbohydrates and **lipids** are needed for energy. Lipids also supply the raw materials for myling cell membranes, and the protective sheaths which form around many nerve cells. These is considerable evidence that the presence of certain kinds of fatty acids in the dietonic area significant effect on brain development.

Growth occurs as cells divide to form revicells. A large component of these cells is **protein**, so a growing child needs plents of broken in the diet.

Iron is needed for the formation of haemoglobin in the millions of new red blood cells which are being formed.

Vitamin A plays an important role in vision (makes the pigment rhodopsin needed for vision in dim light), bone growth, reproduction, cell division and differentiation.

Vitamin C is a highly effective antioxidant, and necessary in the biosynthesis of many important molecules like collagen and dopamine. Vitamin C is also indirectly involved in the transport of fatty acids into mitochondria for ATP production (aerobic respiration).

Vitamin D: enzyme in the liver convert vitamin D into active vitamin D which act as a hormone to stimulate epithelial cells in the intestine to absorb calcium







c) Describe, with the aid of diagrams & photographs, the structure of *Mycobacterium tuberculosis* as an example of a prokaryotic cell



d) Describe, with the aid of diagrams, the structure of the Human Immunodeficiency Virus (HIV)



TB lung x-ray of patient with resistant TB

Transmission of TB occurs in the following ways:



MRSA is on the increase in hospitals for the following reasons:

25% of the population carry *S.aureus* on their skin or in their noses without any harmful effects



http://www.sumanasinc.com/scienceinfocus/antibiotics/a





f) Distinguish between active and passive immunity and natura and attiticial immunity

 Active immunity – occurs when the person is exposed to a live pathogen, develops the directory and becomes immune as a result of the primary immune restors.

Passive immunity arrowing produced by the transfer to one person of antibodies that were produced by another person. Protection from passive immunity diminishes in a relatively short time, usually a few weeks or months. This type of immunity exists between a mother and her (unborn) child as maternal antibodies can be transferred through the placenta and are also carried in breast milk

- Natural immunity immune cells and mechanisms that defend the host from infection by other organisms, in a non-specific manner
- Artificial immunity immunity can be induced by a vaccine that contains the antigens of a given pathogen or by exposure to another persons' antibodies. Injections of a vaccine containing antigens generally produce life-long immunity to the pathogen whereas injection or exposure to another persons' antibodies provides short lived immunity

Natural immunity

Great site for immune system

http://www.immunecentral.com/immune-system/iss16.cfm

g) Describe the role of memory cells in long term immunity

- Initial exposure to a pathogen triggers the production of B & T memory cells
- This first response (primary response) is slow because it takes time for:
 - 1. the specific B & T cells to encounter a particular antigen
 - 2. for the B & T cells to divide and form a large population of plasma cells (antibody producing B cells)
- During the primary response the pathogen is multiplying and damaging the body • leading to the symptoms of the disease
- When you re-encounter the same pathogen the secondary response is seen •
- During the secondary response the increased number of B memory cells will divide • rapidly to form a large population of plasma and memory cells
- The plasma cells then generate huge numbers of antibodies and the pathogen is . usually destroyed before the person has any symptoms
- •

The person is now described as being immune to the mass of the mas Concentration of antibody/arbitran secondary response units (log scale) 10 primary response 1 0 20 30 40 50 60 10 0 Time/days second injection first injection of antigen of identical antigen

A graph to show the primary & secondary response

j) Explain the role of antibodies in ABO blood group incompatibility and Rhesus (Rh) incompatibility

- At the turn of the last century Karl Landsteiner began researching why blood transfusions sometimes caused death and at other times saved a patient
- He identified the ABO blood group system as follows:





- It is used when the victim has become unconscious due to an abnormal or 'fluttering' heart rhythm known as ventricular fibrillation.
- It is used to shock the heart back into it's normal rhythm.

Aspirin is given to prevent the role of platelets in the blood clotting process.

(g) Describe the global distribution of CHD and discuss the influence of environmental, behavioural, social and genetic factors on the distribution;

- The distribution of CHD varies widely not only between different countries in Europe but on a world wide basis. There are many factors that influence this distribution, E.g.:
- •
- 1) Environment who around you smokes, availability of healthy food.
- 2) Behaviour stress levels, exercise regimes.
- 3) Social peer pressure, low income, education
- 4) Genetic certain groups of people will have similar genes that give them a predisposition to developing CHD.
- Epidemiology is the study of the patterns of disease to help understand the underlying causes. This can then be used to help prevent further cases of CHD.
- The Framingham Heart Study is a study of CHD that's been going on for more than 50 years. <u>http://www.framingham.com/heart/</u>

(h) Identify the risk factors associated with CHD including, and, blood pressure, exercise, smoking, genetic influences;

There are many risk factors that night influence in positility of developing CHD.

Diet



• **Triglycerides** are a type of lipid that contains a glycerol molecule and three fatty acids. They are bonded together by a **condensation** reaction (which produces water) to form an **ester** bond.

• There are different types of fats; **saturated** and **unsaturated**. A **saturated** fat contains only single bonds between the carbons in the fatty acid chain and so contain the maximum number of hydrogen atoms possible. An **unsaturated** fat has double bonds between the carbons in the fatty acid chain and therefore don't contain as much hydrogen as the bonds are used up.

- Cholesterol is used to synthesise lipids. These lipids and cholesterol itself are called steroids.
- Lipids are hydrophobic and therefore not soluble in water. Most lipids are transported in the blood as lipoproteins. These are tiny balls made up of different proportions of protein, lipid and cholesterol molecules. The more protein there is the denser the lipoprotein. Lipoproteins are classified as High Density Lipoproteins (HDL) or Low Density Lipoproteins (LDL).

(e) analyse data to describe the distribution of type 2 diabetes within populations (to include changes due to migration and accelerated economic development).



This graph clearly shows it ink between age and the incidence level of diabetes, but look carefully at the old enmormation you can be the from it.

E.g. look carefully at the estimated numbers for each gender and compare it in each group. Can you think of a possible reason for the differences at each age?

The distribution of diabetes is however more complex than just age and gender. This second graph shows the levels of obesity, a major contributor to type II diabetes, according to country of birth and gender. These people are all living in NSW, Australia. There appears to be a link between migration which is often for economic reasons and diabetes. For example the incident rate of diabetes in the Lebanon is fairly low but those who migrated to NSW show quite a high incidence level. As a country increases in wealth there are more refined sugary foods available and the increase level of car ownership means less exercise is taken, both of which are contributory factors to the development of type II diabetes. The same is believed to happen as people migrate to more affluent countries.