BIOLOGY FACT FILE SUMMARY NOTES - GENE TECHNOLOGY

MICROARRAY TECHNOLOGY:

- Microarray also known as gene chip
    - miniature spotting tile
    - thousands of DNA probes attached to it
- each spot contains many copies of DNA with a unique base sequence.
- DNA probs are added to to the chip robotically
- individuals DNA is amplified by pcr
    - digested by restriction enzymes, made single stranded ad a label is added
        - label is fluorescent or chemiluminescent (light emitted as a result of a chemical reaction
- labelled DNA can be then added to the microarray
    - chip is digitally analysed to indicate where binding has occurred
        - all info can determine an individuals base sequence for the gene of interest
            - if the gene affects the way the individual responds to certain drugs then we know genotype which allows medication to be prescribed accordingly.
- thousands of genes can be investigated at the same time using this technology.
- techniques can be used to investigate genotypes including drug responses and disease alleles such as brca1 mutations

- when genes are expressed in a cell, transcription produces mRNA complementary to the gene.
    - analysing which genes are expressed all mRNA is extracted from each interested tissue and then reverse transcriptase is used to make cDNA copy each mRNA
        - CDNAs are then labelled as before and added to the microarray and digitally analysed
            - researchers can see which genes are up-regulated and which are down- regulated in cancer cells.

GENETIC FINGERPRINTING:

- Producing a genetic finger print
    1. sample DNA amplified by pcr cut into smaller pieces by restriction enzymes
    2. Fragments added to Agarose gel and separated by size using gel electrophoresis
    3. DNA is made single strand and copied onto nitrocellulose sheet.
    4. Labelled DNA probes added and bind via base complementary
    5. Detective system used to see where probes binding using the label
- probability of two people having the same sequence is nil
    - the sequence is inherited in Mendelian fashion
        - useful in paternity tests/ crime scene
- assess genetic variation in populations

GENE SEQUENCING:

- An organisms genome can be defined as all of the genetic material DNA.
- techniques have been used for many years to determine order of bases A,T,G AND C, process known genome sequencing
- useful in determining causes of disease and tailoring treatment
    - DNA sequence will over take microarray technology however is more expensive
- gene enables primary structure of the protein to be worked out
    - molecular software can predict secondary, tertiary structure and qaurternary structures

HUMAN GENOMES PROJECT:

- Sequence the entire human genome
- some have implicated in certain types of cancer and Alzheimer's disease
- complexity of the human genome containing overlapping genes, genes within genes and pseudogenes elements of our genetic code is still to be unravelled.
- HGP have significantly reduced the costs involved in sequencing a gene.

SOCIAL AND ETHICAL IMPLICATIONS OF GENE SEQUENCING:

- direct to consumer gene sequencing products
    - obtain a report on various aspects of their genome whether they carry genes which increase their risks of developing disease later in life
        - how they react with certain medications

PHARMOGENETICS:
- Tailoring of drug treatments to individuals bases on genotypes.
- Both microarray technology and gene technology provides info on individuals genetic make up
- Due to genetic variation people can respond differently to certain drugs, may be ineffective or even dangerous
    - dosage varies between genotypes
- CODEINE response varies some people can be classified as poor, intermediate, extensive and ultra- rapid metabolisers depending on the alleles they possess
    - different alleles result in different levels of enzyme activity for codeine conversion to morphine
- ultra - rapid metabolisers if given normal dosage effects could become toxic and life threatening
    - in contrast a poor metaboliser the dosage may be completely ineffective.
- African Americans increase in ultra- rapid metaboliser genotype incidence
- cancer genotypes
    - specific mutations which have occurred in the cancerous cells and which genes are being up or down regulated can help determining chemotherapy treatment.
        - microarray and gene sequencing can be used to investigate

DESIGNER DRUGS:
- drugs which only work in a subgroup of patients
    - can be highly effective e.g. Herceptin
    - reduces adverse drug reactions and side effects less common

THERAPEUTIC GENETIC MODIFICATION:
-1. Herpes virus to treat malignant melanoma
    1. No longer make a protein which enables reproduction
    2. Enables antigen presence, more visible to the immune system
    3. Human cytokines gene inserted into it, triggers an immune response to infected cells.
- 2. Improve antibiotic efficacy
    - GM virus disrupts this DNA repair, allowing antibiotic to work
- 3. Haemophilia B is a sex linked blood clotting disorder caused by a recessive allele on the x - chromosome
    - injection of x-factor not produced in suffers
        - vector delivers gene to cells in the liver
            - gene successfully directs synthesis of factor IX
- used a virus not normally found in humans to prevent trial patients having immunity
    - steroids also given to patients to suppress immune reaction

CYSTIC FIBROSIS:
- cells in the lungs are regularly renewed so renewed dose of gene therapy needed regularly
        - 5/10 years gene therapy will be part of an effective treatment if not a cure