Module 5: Heredity

Reproduction

Inquiry question: How does reproduction ensure the continuity of a species?

Students:

- explain the mechanisms of reproduction that ensure the continuity of a species, by analysing sexual and asexual methods of reproduction in a variety of organisms, including but not limited to:
  - animals: advantages of external and internal fertilisation
  - plants: asexual and sexual reproduction
  - fungi: budding, spores
  - bacteria: binary fission (ACSBL075)
  - protists: binary fission, budding

Types of Asexual Reproduction		
Type	Process	Examples
Binary Fission	Equal division of a single parent cells into two, genetically identical daughter cells. (Basically mitosis)	Bacteria Protozoans
Budding	Mitotic division (at a cellular level the division of cytoplasm is unequal). New organism grows on parent before detaching, after detaching the cell ill grow to full size.	Yeast Hydra Protist
Fragmentation	Part of organism breaks off and regenerates new individuals.	Flatforms – Sick cross module flex Echinoderms (Star fish)
Spore Formation	Spores released into environment and germinate, forming new individuals. (Can be sexual or asexual)	Fungi Mosses and ferns
Vegetative Propagation	Natural occurrence: Horizontally propagating rhizomes or stolons forms buds, which produce their own root systems and develop into genetically identical plant.	Many plants -Strawberry
Parthenogenesis	A type of cloning resulting from the formation of a new individual from an unfertilised egg. All offspring are clones of the female.	Some animals including insects, lizards, and birds.

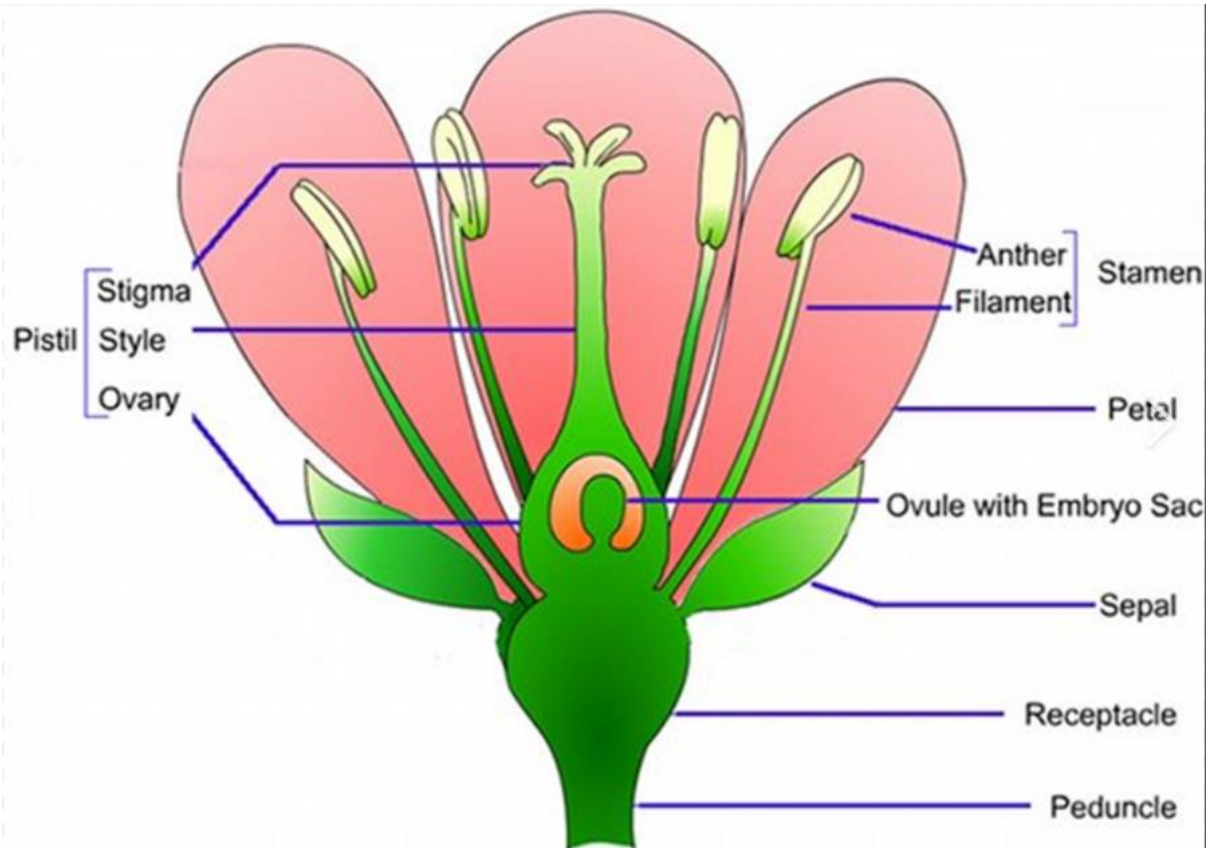
Sexual and Asexual reproduction in plants:

Asexual:

- Vegetative propagation: In table.
- Apomixis: Sexual formation of a seed from the maternal tissues of the ovule, avoiding the process of meiosis and fertilisation. Produces genetically identical daughters.

Sexual:

Structure:



Pistil (Female organ) – consists of the stigma, style, and ovary.

Stamen (Male organ) – consists of anther and filament.

Fertilisation:

Pollen on anther → through wind/ insect vector goes onto stigma of another plant (fertilisation)→ goes through style to ovary→ fertilises ovules → seed.

Angiosperms (flowering plants) vs Gymnosperms (cones)

Angiosperms:

produce flowers, attracting pollinators with nectar. After fertilisation flower → fruit containing seeds. Seeds dispersed by wind, water animals.
Advantages: highly diverse, due to pollinators, populations can be far apart.

Gymnosperms:

Produce cones that are pollinated by wind. Specific female and male cones. Once fertilised seed forms in female cone. Dispersal: winged seeds or fleshy seeds.
Advantages: Grow will in climates that may not support pollinating animals like insects, successful when growing in groups, not as much genetic diversity as populations rarely mix.

Internal vs External Fertilisation			
External		Internal	
Pros	Cons	Pros	Cons
Produces many offspring			Produces small amount offspring
Low energy Commitment from parents (shoot and scoot)			High energy commitment (whole pregnancy process)
	Gametes and developing offspring exposed to external environment	Gametes and developing offspring protected inside the female's body	
	Only in water	Anywhere	
	Low rate of successful fertilisation	High rate of fertilisation	
Greater genetic variation than internal fertilisation as more offspring			Less genetic variation than external fertilisation as little offspring
Genetic variation		Genetical variation	
Occurs in animals and plants		Occurs in animals and plants	

Sexual vs Asexual Reproduction			
Sexual		Asexual	
Pros	Cons	Pros	Cons
	Foetal development takes long time (pregnancy), much energy required	Energy efficient and takes minimal time	
	Slow population growth makes adaptability to acute selection pressures bad	Rapid population growth makes adaptability to acute selective pressures good	
	Energy expended in finding and attracting mate	No energy used to find and attract sexual partner	
Many genetic diversities, such resistance to selective pressures			Genetic diversity ☹ → susceptible to disease and other selection pressures
Slow population growth makes intraspecies competition not as significant			Rapid population growth may lead to increased competition and overcrowding
Allows for the continuation of the species		Allows for the continuation of the species	
Offspring inherit parental alleles		Offspring inherit parental alleles	
Allows for adaptation to environment		Allows for adaptation to environment	

- analyse the features of fertilisation, implantation and hormonal control of pregnancy and birth in mammals (ACSBL075)
  - **Implantation**
  - After fertilisation, the zygote begins to divide as it moves from the fallopian tubes into the uterus.
  - Now called a blastocyst, it implants itself into the endometrium (wall of the uterus) which provides nutrients and oxygen to the developing embryo before a placenta is formed.
  - **The three stages in implantation:**
  1. Blastocyst comes into contact with the implantation site (this process is called apposition)
  2. Cells of the blastocyst attach to the epithelial cells of the endometrial lining.
  3. Invasions of cells into the endometrium and diffusion of nutrients into the blastocyst.

- **Ovulation**
  - **Process**
    - An oocyte (immature egg) resumes meiosis in a follicle due to **follicle stimulating hormone** → follicle containing the maturing ovum released **oestrogen**, thickens endometrium & acts on anterior pituitary gland that then releases **luteinising hormones** → increased **LH** causes ovulation, follicle bursts and forms the **corpus luteum**→ **Corpus luteum** releases **oestrogen + progesterone** causing further thickening of the endometrium
- **Birth**
  - **Progesterone** is used throughout pregnancy with levels rising intil birth, initially from corpus luteum, then from the placenta, initially thickening uterus, then prevents lactation and contractions until birth.
  - **Oestrogen** rises throughout pregnancy, is used in development of some organs
  - **Process:**
    - **Progesterone and oestrogen** drop → Prostaglandins decrease increasing the sensitivity of the cervix and uterus to oxytocin → Wack ass hormone balance causes contractions → contractions cause a positive feedback loop with **oxytocin** until the baby and the placenta are removed from the uterus and it returns to a somewhat normal size.

- evaluate the impact of scientific knowledge on the manipulation of plant and animal reproduction in agriculture (ACSBL074)

- **Selective breeding**
  - **Pro:** Able to increase the frequency of desirable alleles in offspring
  - **Cons:** Biodiversity ☹

Cell Replication

Inquiry question: How important is it for genetic material to be replicated exactly?

Students:

- model the processes involved in cell replication, including but not limited to:
  - mitosis and meiosis (ACSBL075)

Mitosis

- Follows IPMAT
- **Interphase:**
  - Not necessarily part of the replication process
  - DNA replicated during the synthesis phase of the cell cycle, forming chromatin
  - Centrioles move to opposite sides of the cell
- **Prophase:**
  - Chromatin begins to coil and separates into individual chromosomes
  - Each Chromosome contains two copies of the DNA, each copy called a sister chromatid
  - Nuclear membrane breaks down, from this material a spindle begins to form
- **Metaphase:**
  - The cells align along the equatorial plane between the two poles

- Centromeres are attached to spindle fibres which are attached to centromeres

➢ **Anaphase:**
- Spindles contract pulling sister chromatids to opposite sides of the cell
- Centromeres between sister chromatids are cleaved

➢ **Telophase:**
- Nuclear membranes form around both sets of chromosomes
- Spindles break down

Note: Cytokinesis then occurs forming two daughter cells and the cells both restart the cell cycle

Meiosis

➢ Follows $IP_1M_1A_1T_1P_2M_2A_2T_2$

➢ **Prophase 1:**
- Specifically important because of **CROSSING OVER**
- Introduces genetic variation

➢ **Indendant Assortment**
- Occurs in Anaphase 1 and 2
- The segregation of one homolgous pair does not impact the segregation of another

➢ **Random Segregation**
- Occurs in Anaphase 2
- Each gamete will only have 1 allele for each gene, both alleles will never be inherited unless something goes wrong.

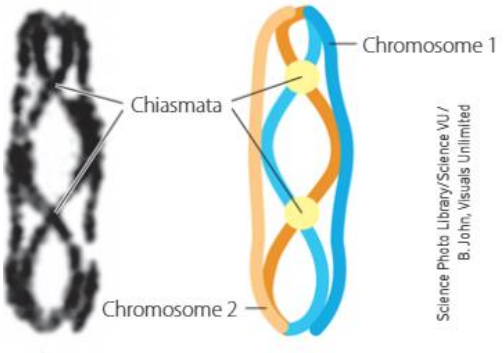


FIGURE 5.4 Electron micrographs of a bivalent with chiasmata

– DNA replication using the Watson and Crick DNA model, including nucleotide composition, pairing and bonding (ACSBL076, ACSBL077)

➢ **X-ray Crystallography**
- From Photograph 51 W&C deduced that the phosphate backbone was located on the outside of the DNA molecule and the nitrogenous bases were located on in inside (protected)
- Through analysis of Photograph 51, found the double helix structure of DNA had anti-parallel backbones (5'-3' stuff)

➢ **Used corroboration of prior knowledge (related the already known Chargaff's Law to the evidence presented through X-ray crystallography)**

➢ **Also basic structure shit that you should already know**

- assess the effect of the cell replication processes on the continuity of species (ACSBL084)

Cell Replication Processes on the Continuity of Species			
MITOSIS		**MEIOSIS**	
PROS	CONS	PROS	CONS
Growth + Repair	Controlled cellular division results in neoplasms (tumours)	Genetic Variation	Can result in aneuploidy and other chromosomal mutations (inversion from synapsis + other shit)

Provides form of asexual replication for some unicellular organisms (Binary Fission) + plants	No genetic variation	Leads to speciation (Think natural selection + stimulus questions in trials)	

DNA and Polypeptide Synthesis

Inquiry question: Why is polypeptide synthesis important?

Students:

- construct appropriate representations to model and compare the forms in which DNA exists in eukaryotes and prokaryotes (ACSBL076)

Chromosomal Structure of Eukaryotes and Prokaryotes

	Shape of Chromosome	Number of Chromosomes	Relative Frequency of Exons vs Introns	Location	Histones
Prokaryote	Circular	One	High	Nucleoid	No
Eukaryote	Linear	2 or more	Low	Nucleus	Yes

- model the process of polypeptide synthesis, including: (ACSBL079)
  - transcription and translation

1. DNA helicase splits DNA
2. RNA polymerase creates a complimentary mRNA strand from the non-coding DNA strand
3. mRNA travels outside of the nucleus
4. mRNA is "read" by the ribosome
5. tRNA with corresponding anticoding temporarily attaches to mRNA
6. As this process is repeated amino acids on the other end of the tRNA begin to form a chain through peptide bonding
7. A peptide is formed.

transcription

translation

  - assessing the importance of mRNA and tRNA in transcription and translation (ACSBL079)
    - mRNA allows the code from the DNA to be transported outside of the nucleus for polypeptide synthesis
    - tRNA has unique amino acids that form peptide chains through translation
  - analysing the function and importance of polypeptide synthesis (ACSBL080)

➢ Polypeptide synthesis is important as it allows the phenotype coded for in one's DNA to be expressed through proteins.

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  - assessing how genes and environment affect phenotypic expression (ACSBL081)

➢ Genes: dominant and recessive, different alleles code for different phenotypes.

➢ Environment:
  - Hydrangea
    - pH of the soil (acidity/alkalinity) determines what colour the flowers
    - Chemical imbalances prevent some, or encourage other genes from being expression

- investigate the structure and function of proteins in living things

  - **Enzymatic Proteins**
    - **Example: Lipase**
      - Catalyses the hydrolysis of fats and lipids
      - Essential role in digestion (is a metabolic enzyme)
      - Helps body to break down and absorb nutrients thus leading to survival
      - Fats →Triglycerides (fats for body ☺)
  - **Structural Proteins**
    - **Example: Collagen**
      - Most abundant protein in mammals
      - Found in connective tissues
      - Can basically just do anything (can be rigid in bones or compliant in tendons or anything in between (cartilage, blood vessels, etc))

Genetic Variation

Inquiry question: How can the genetic similarities and differences within and between species be compared?

Students:

- conduct practical investigations to predict variations in the genotype of offspring by modelling meiosis, including the crossing over of homologous chromosomes, fertilisation and mutations (ACSBL084)
  - **So cringe just talk about plasticine?**

- model the formation of new combinations of genotypes produced during meiosis, including but not limited to:
  - interpreting examples of autosomal, sex-linkage, co-dominance, incomplete dominance and multiple alleles (ACSBL085)
  - Everything ez but co-dominance and incomplete dominance
    - **Co-Dominance**
      - Both alleles in genotype are dominant and express the respective phenotypes simultaneously simultaneously

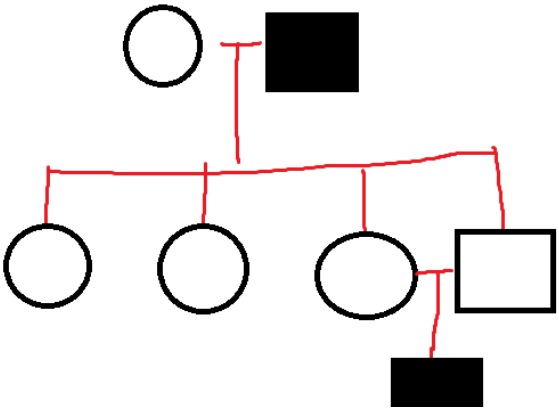
- i.e. Roan Cows

- **Incomplete Dominance**
  - Neither allele in the organism's genotype is dominant resulting a weird phenotypic mixture of both.
  - i.e. (White allele + Red allele) in genotype → pink phenotype in some species of flowers

– constructing and interpreting information and data from pedigrees and Punnett squares

➢ I'm good at these so these are here for anyone that needs some tips (just get good)

Implies Recessive Autosomal



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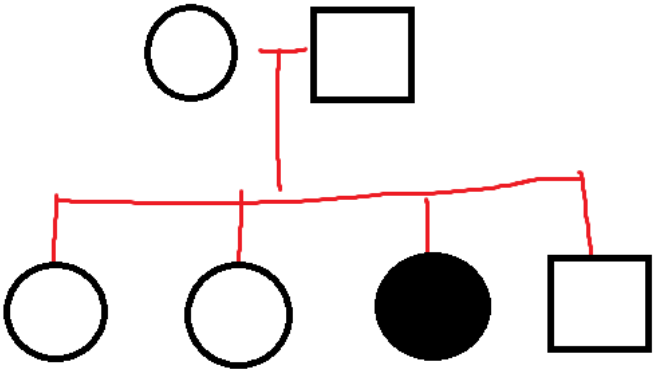
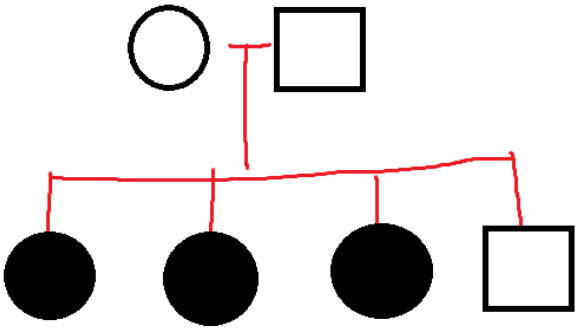


Implies Something to do with sex
(idk figure it out on the day)



- collect, record and present data to represent frequencies of characteristics in a population, in order to identify trends, patterns, relationships and limitations in data, for example:
  - examining frequency data
  - analysing single nucleotide polymorphism (SNP)
  - **SNPS**
    - Occur in ≥2% of the population
    - Found mostly in introns (due to 98% of our DNA being non coding)
    - The inheritance of SNPS can be used to trace inheritance

Inheritance Patterns in a Population

Inquiry question: Can population genetic patterns be predicted with any accuracy?

Students:

- investigate the use of technologies to determine inheritance patterns in a population using, for example: (ACSBL064, ACSBL085)
  - DNA sequencing and profiling (ACSBL086)
  - **Sequence**
    - human genome project, finding specific point mutations and correlating genes to phenotypes
    - Specific order of nucleotides.
  - **Sanger method:**
    - Single stranded DNA
    - In soup with dideoxy nucleotides
    - Complementary strands are made, at random points until 1 complementary strand for each new nucleotide
    - Placed into a capillary cell here a voltage is applied, separating the complementary strands and a laser is shone at them
    - Wavelengths are then interpreted by a computer and the sequence of the complementary strand can be determined
    - Because we know the complementary strand then the original strand.
  - **Profile**
    - **Criminal cases or who is the father**
    - Polymerase chain reaction + gel electrophoresis
    - Qualitative comparison between individuals.

- investigate the use of data analysis from a large-scale collaborative project to identify trends, patterns and relationships, for example: (ACSBL064, ACSBL073)
  - the use of population genetics data in conservation management
  - population genetics studies used to determine the inheritance of a disease or disorder
  - Tracking genes through following SNPs, Short tandem repeats or mitochondrial DNA through a family allows scientists to determine how certain diseases are inherited, autosomal/sex

linked, and in corroboration with DNA profiling and sequencing allows for certain genetic disorders to be attributed to certain genes.

- population genetics relating to human evolution
  - Used to study how humans have evolved/ migrated from our origin.
  - Multi regional hypothesis
    - From homogeneous (from Africa) the human population spread and gene flow between regions caused the eventual evolution of Neanderthals and homo spaians
  - Replacement/ out of Africa hypothesis
    - Two waves of humans
    - First wave was homo erectus and he got to basically all the continents
    - Second wave was early homo sapiens leaving Africa again and then out competing/ interbreeding with Neanderthals.

Module 6: Genetic Change

Mutation

Inquiry question: How does mutation introduce new alleles into a population?

Students:

- explain how a range of mutagens operate, including but not limited to:
  - electromagnetic radiation sources
  - **Ionising radiation (Uv and above)**
    - **Direct**
      - Directly damages DNA. Causes dimers to be created between pyrimidines (thymine and uracil), prevents DNA replication, or impacts polypeptide synthesis.
    - **Indirect**
      - Ionises atoms in the cells creating free radicals like reactive oxygen species that can damage the DNA by binding to it, preventing replication or impacting polypeptide synthesis.
  - chemicals
  - **Base Analogues**
    - Structurally similar to nitrogenous bases and can sometimes be inserted by polymerase by mistake.
    - DNA no longer functions / polypeptides are wrong
  - **Intercalating Agents**
    - Squeeze between base pairs (through the hydrogen bonding) (remember INTER)
    - Can be used to stain DNA such as in gel electrophoresis
    - Alter shape of DNA leading to subsequent errors
  - **Reactive Chemicals**
    - Are normally free radicals (charge not 0) in the nucleus
    - Damage back bone of DNA causing a breaking or cross link to occur
    - Naturally occur in the cell but ↑ exposure can lead to disease (cross module with mod 8)
  - naturally occurring mutagens
  - **Kinda cringe cause most mutagens i.e ionising radiation are "naturally occuring"**
  - **Extra biological examples**
    - **Transposon**
      - DNA that can change position in the DNA strand/ gene thus altering various polypeptides are various times (may be introduced through a viral vector)
    - **Virus**
      - Can insert viral DNA into an individual's genome (think viral vectors and shiz)
      - Diversifies gene function
- compare the causes, processes and effects of different types of mutation, including but not limited to:
  - point mutation
    - Substitution
      - Where one nitrogenous base is substituted with another.
      - Original code: ATCGGTC
      - Substitution : AGCGGTC

- Frameshift
  - Deletion
    - Original code: AGTATCGGTC
    - Deletion mutation: AGTACGGTC
  - Insertion
    - Original code: AGTATCGGTCATGTCCA
    - Inertion mutation: AGTATCCGGTCATGTCCA

– chromosomal mutation

- Affects multiple genes / a large portion of a chromosome
- Inversion
  - The gene or multiple genes are inverted (the code is reversed)
  - Original DNA: ATGC
  - Inversion: CGTA
- Translocation
  - A gene or multiple genes translocate onto different parts of a chromosome or inbetween chromosomes
  - Duplication
  - A gene or multiple genes are duplicated
- Amplification
  - Is multiple duplications such that the frequency of one or multiple genes is far greater than the frequency of other alleles.
- Aneuploidy
  - Trisomy
    - There are 3 chromosomes in a group for a single chromosome instead of the usual 2 (paternal and maternal)
  - Polyploidy
    - Duplication (1 or more times) of the entirety of a karyotype
  - Monosomy
    - Only 1 missing chromosome from the usual pair.

- distinguish between somatic mutations and germ-line mutations and their effect on an organism (ACSBL082, ACSBL083)
  - **Somatic mutations**
    - Occurs in body cells that aren't germ cells
    - Cannot be passed on to offspring or anyone
    - They only affect the phenotype of the individual
  - **Germline mutations**
    - Occurs in the germ cells of an individual
    - Doesnt affect the phenotype of the individual if first occurs in
    - Can be passed on to offspring
    - Impact the phenotype of the offspring and subsequent generations

- assess the significance of 'coding' and 'non-coding' DNA segments in the process of mutation (ACSBL078)
  - **Introns (non-coding)**
    - Turn genes on and off
    - Provides a binding site for enzymes to bind to begin functioning
    - Most of the DNA in eukaryotic is non-coding
    - **Mutations**
      - It is more likely to be silent
      - Cause the "turning on" of genes that were originally turned off
      - Or prevents/promotes a binding site of enzyme
      - Similiarity : both have the ability to alter the phenotype
  - **Exons (coding DNA)**
    - Codes for proteins (used in polypeptide sequences)
    - Most of the DNA in prokaryotic cells is coding DNA
    - **Mutation**

        - Causes codon sequence to alter creating a change in a polypeptide sequence and thus an alteration in protein structure and function.

- investigate the causes of genetic variation relating to the processes of fertilisation, meiosis and mutation (ACSBL078)
    - **Meiosis**
        - **Crossing over (synapsis)**: crossing over occurs between a homologous pair of chromoomes and introduces genetic variation by altering the genetic sequence of the chromsomes by swapping sequences from one chromome to the other.
        - **Independant assortment:** The orientation of the paternal and maternal chromosomes in random and is not influenced by other chromsomes
        - Random Segregation:
    - **Fertilisation**
        - Introduces genetic variation through the selection of sexual partners and also the random chance of any individual sperm fertilising an ovum

- evaluate the effect of mutation, gene flow and genetic drift on the gene pool of populations (ACSBL091, ACSBL092)
    - **Genetic drift**
        - **Bottleneck effect**
        - After a random event, which causes the death of randomly selected individuals, the surviving population does not reflect the allele frequencies/alleles present in the original population
        - **Founder effect**
        - A portion of a population migrates to a new location where that species does not exist and forms a new population. The allele frequencies of this new population will not represent the allele frequencies of the original population.
        - **New population has reduced genetic diversity and a change in allele frequency.**
    - **Gene flow**
        - The mixing or introduction of new alleles into an existing population by some other existing population. (two populations exchange alleles.)

Biotechnology

Inquiry question: How do genetic techniques affect Earth's biodiversity?

Students:

- investigate the uses and applications of biotechnology (past, present and future), including: (ACSBL087)
    - Biotechnology: is the use of living organisms to benefit society.
    - Past:
        - Yeast: anaerobic respiration of yeast => beers and ethanol, aerobic respiration is used as a raising agent in bread.
        - Cheese, bacteria is used to curdle milk into cheese
    - Present:
        - **Reproductive tech**
            - **Artificial insemination / pollination**
            - **Cloning**
                - **Gene cloning**
                    - **PCR (polymerase chain reaction)**
                        - **Complimentary DNA strand denatured (split into single DNA strands) through the application of heat**
                        - **Single DNA strand is in a solution of nucleotides and enzyme (DNA polymerase)**
                        - **The DNA polymerase creates the original strand of the DNA**

        - **Amplifies the gene**

    - **Recombinant DNA in bacteria.**
        - DNA from the human genome is cut using restriction enzymes, leaving sticky ends on both sides of the genes
        - A plasmid is retrieved from a bacterial cell, and is cut, leaving complementary sticky ends
        - Then the human gene bonds with the sticky ends of the plasmid closing the plasmid again. (this is a process done by the ligase enzyme (ligation))
        - Inserted back into a bacterial cell where the gene will be replicated as the bacteria replicate.
        - Example: insulin
- **Whole organism cloning**
    - Ovum doner has nucleus removed (enucleation)
    - The nucleus is removed from a separate sheep's mammary cell (breast)
    - The nucleus and the ovum are recombined through the application of an electric current
    - The new ovum + nucleus is then inserted into a surrogate mother where the embryo develops
    - Offspring will be phenotypically identical to the nuclear donor, but wont be genetically identical to either (mtDNA)
- **Selective breeding**
    - **Recombinant DNA**
    - **Vaccines**

– analysing the social implications and ethical uses of biotechnology, including plant and animal examples

- The disparity between first and third world countries (differences in economic status)
- Animal welfare
- Playing god
- Better production of food and in industry and medicine
- Environmental impacts
- Legality

– researching future directions of the use of biotechnology

- CRISPR
    - Used to treat genetic disease through gene therapy
    - Provides a cure to previously incurable genetic diseases such as cystic fibrosis.
    - Allows us to "edit" dna by deleting and inserting specific genes.
- Gene therapy through viral vectors
- Examples of recombinant species: Bt cotton, Golden rice, Aqua advantage salmon

– evaluating the potential benefits for society of research using genetic technologies

- Provides cure to uncurable genetic disease (gene therapy / CRISPR)
- Allows us to remove genetic defects from infants before they are born
- Recombinant species -> better production in industry + less pesticide in agriculture
- Profit to industry
- Insulin for patiens through gene cloning making diabetes type 1 less deadly
- Pollution prevention through use of biological substitutes for materials (fungal coffins)
- Targetted supplementation for lacking diets (golden rice)

  - evaluating the changes to the Earth's biodiversity due to genetic techniques
- Pro: in the short term any form of selective breeding will allow for a temporary increase in biodiversity
- Con: in the long term biodiversity is decreased from only choosing the best allles
- Pro: future directions of biotech are looking into reviving extinct species like the tasmanian tiger

Genetic Technologies

Inquiry question: Does artificial manipulation of DNA have the potential to change populations forever?

Students:

- investigate the uses and advantages of current genetic technologies that induce genetic change
- compare the processes and outcomes of reproductive technologies, including but not limited to:
  - artificial insemination
  - artificial pollination
- investigate and assess the effectiveness of cloning, including but not limited to:
  - whole organism cloning
  - gene cloning
- describe techniques and applications used in recombinant DNA technology, for example:
  - the development of transgenic organisms in agricultural and medical applications (ACSBL087)
- evaluate the benefits of using genetic technologies in agricultural, medical and industrial applications (ACSBL086)
- evaluate the effect on biodiversity of using biotechnology in agriculture
- interpret a range of secondary sources to assess the influence of social, economic and cultural contexts on a range of biotechnologies

Module 7: Infectious Disease

Causes of Infectious Disease

Inquiry question: How are diseases transmitted?

Students:

- describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data

and information relating to disease transmission, including: (ACSBL097, ACSBL098, ACSBL116, ACSBL117)
  - classifying different pathogens that cause disease in plants and animals (ACSBL117)
  - investigating the transmission of a disease during an epidemic
  - design and conduct a practical investigation relating to the microbial testing of water or food samples
  - investigate modes of transmission of infectious diseases, including direct contact, indirect contact, and vector transmission.
- investigate the work of Robert Koch and Louis Pasteur, to explain the causes and transmission of infectious diseases, including:
  - Koch's postulates
    - Designed a scientific method to verify the causation (/identify the pathogen) that causes an infectious disease
    - **POSTULATES:**
      - Microorganism present in ill population but not in healthy population
      - Organism must be cultured in vitro (in a lab)
      - Upon inoculation from the culture, a healthy individual should become symptomatic
      - Culture the inoculated bacteria from the now infected healthy individual and compare to original culture.
  - Pasteur's experiments on microbial contamination
    - Provided evidence in support of germ theory, that heavily disputed the theory of spontaneous generation
    - Swan neck flask
      - Broken one had decay implying decay was caused by **microbes** in the air, and not ones that generated in the sterile flask.
- assess the causes and effects of diseases on agricultural production, including but not limited to:
  - plant diseases
  - animal diseases
- compare the adaptations of different pathogens that facilitate their entry into and transmission between hosts (ACSBL118)

Responses to Pathogens

Inquiry question: How does a plant or animal respond to infection?

Students:

- investigate the response of a named Australian plant to a named pathogen through practical and/or secondary-sourced investigation, for example:
  - fungal pathogens
  - viral pathogens
- analyse responses to the presence of pathogens by assessing the physical and chemical changes that occur in the host animals cells and tissues (ACSBL119, ACSBL120, ACSBL121, ACSBL122)

Immunity

Inquiry question: How does the human immune system respond to exposure to a pathogen?

Students:

- investigate and model the innate and adaptive immune systems in the human body (ACSBL119)
- explain how the immune system responds after primary exposure to a pathogen, including innate and acquired immunity.

Prevention, Treatment and Control

Inquiry question: How can the spread of infectious diseases be controlled?

Students:

- investigate and analyse the wide range of interrelated factors involved in limiting local, regional and global spread of a named infectious disease
- investigate procedures that can be employed to prevent the spread of disease, including but not limited to: (ACSBL124)
  - hygiene practices
  - quarantine
  - vaccination, including passive and active immunity (ACSBL100, ACSBL123)
  - public health campaigns
  - use of pesticides
  - genetic engineering
- investigate and assess the effectiveness of pharmaceuticals as treatment strategies for the control of infectious disease, for example:
  - antivirals
  - antibiotics
- investigate and evaluate environmental management and quarantine methods used to control an epidemic or pandemic
- interpret data relating to the incidence and prevalence of infectious disease in populations, for example:
  - mobility of individuals and the portion that are immune or immunised (ACSBL124, ACSBL125)
  - Malaria or Dengue Fever in South East Asia
- evaluate historical, culturally diverse and current strategies to predict and control the spread of disease (ACSBL125)
- investigate the contemporary application of Aboriginal protocols in the development of particular medicines and biological materials in Australia and how recognition and protection of Indigenous cultural and intellectual property is important, for example:
  - bush medicine
  - smoke bush in Western Australia

Module 8: Non-infectious Disease and Disorders

Homeostasis

Inquiry question: How is an organism's internal environment maintained in response to a changing external environment?

Students:

- construct and interpret negative feedback loops that show homeostasis by using a range of sources, including but not limited to: (ACSBL101, ACSBL110, ACSBL111)
  - **Homeostasis**: The process by which organisms maintain a relatively stable, internal environment. (Not static but in a tightly regulated equilibrium)
  - **Consists of two stable states**:
    - Detecting changes from stable states (Receptors (nerve cells in animals, shoot and root tips in plants.))
    - Counteracting change from stable states through the use of effectors (muscles, glands, hormones.)
  - **Types of feedback loops**
    - **Negative:** If stimulus ↑, body acts to ↓ (reversing change)
      - Change → Receptor detection → Signal to control centre → Control signals effector → Effector responds to signal
    - **Positive:** very increase

– temperature (ACSBL098)

- **Thermoregulation**

Occurs naturally without stimulus through conduction (contact with surroundings), convection (heat moves from inside body to surface), radiation (dissipates from surface to atmosphere), and evaporative cooling.

- **Body Temp > hypothalamic set-point**
  - Temp detected by receptors in skin and hypothalamus → Induces **sweating** in eccrine swear glands (↑ evap cooling), **vasodilation** (↑ convective and radiation cooling) → hypothalamus detects that change in temp has ceased, body returns to homeostasis.
- **Body Temp < hypothalamic set-point**
  - Temp detected by receptors in skin and hypothalamus → induces **vasoconstriction** (↓ convective and radiation cooling), **Piloerection** -goose bumps- (Contraction of piloerector muscles around hair follicles, resulting in trapped air increasing insulation around body), **Decreasing surface area** (↓ area exposed to cold, ↓ radiation and conductive cooling) → hypothalamus detects that change in temp has ceased, body returns to homeostasis.

– glucose

- **Regulation of BGL (blood [glucose] level)**

Source of energy stored has glycogen, which is broken down into glucose when the body needs it for cellular respiration. Maintained from 3.5-8 mmol/L

- **Hyperglycaemia (BGL too high)**
  - Detected by cells in pancreases → signals response of **islets of Langerhans (beta cells)** (effector) → produces insulin (↑ uptake into cells and formation of glucose to glycogen in the liver) → ↓[glucose] returning body to homeostasis.

- **Hypoglycaemia (BGL too low)**
  - Detected by cells in pancreases → signals response of **islets of Langerhans (alpha cells)** (effector) → produces glucagon (↑ glycogen break down) → ↑[glucose] returning body to homeostasis.

- investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:
  - trends and patterns in behavioural, structural and physiological adaptations in endotherms that assist in maintaining homeostasis (ACSBL099, ACSBL114)

➢ **Animals**

- **Behavioural Adaptations (pretty much just thermoregulation)**
  - Burrowing
  - Huddling together
  - Nocturnal
- **Structural Adaptations**
  - The liver (manages BGL)
    - Discussed above; extra info includes that if glycogen levels are too high, then excess glucose in the blood is converted to fats, also, the blood leaving the liver is still slightly higher in concentration than normal, this is mixed with sugar depleted blood from the rest of the body in the vena cava to maintain homeostatic levels
  - Surface area to volume ratio
    - Volume of organism generates heat, surface of organism radiates heat. Therefore to stay warmer they will have higher volume to surface area ratio and to stay cool they will have higher surface area to volume ratio.
    - Spheres are best for heat conservation.
  - Body insulation
    - Self explanatory (remember the whole hair movement thing from previous dot point.
- **Physiological Adaptations**
  - Thirst
    - Controlled by hypothalamus
    - Blood volume is detected by osmoreceptors in the brain
    - Balance between extracellular and intracellular fluid levels
    - Generally maintained at an isotonic state
    - If the hypothalamus detects one is greater than the other, the feeling of thirst will occur, also fluid from one section can flow into another to maintain equilibrium.
  - Metabolism
    - Maintains constant body temp, as metabolising substances is exothermic.
    - Decreased body temp increases metabolism and vice versa.

  - internal coordination systems that allow homeostasis to be maintained, including hormones and neural pathways (ACSBL112, ACSBL113, ACSBL114)

➢ **Hormones**

- **Endocrine system**
  - A collection of specialised tissues that excrete hormones

        - Hormones act as chemical signals used for intercellular communication
        - Travel using diffusion through cells and in extracellular fluid
        - Generally targeted to cells with the specific receptor (Adrenalin example)
        - Can be used to respond to change in homeostasis (BGL and the pancreas)
    - **Neural pathways**
        - Neurons
            - Nerve cells
            - Respond to stimuli
            - Consists of dendrites, cell body and axon
            - Can have one of 3 functions, sensory, motor or interneurons.
            - Creates action potentials, sending electrochemical signals throughout the central nervous system (hypothalamus control centre and spinal cord, main conductive pathway.
            - Faster than hormones
    - **Osmoregulation**
        - Water balance
        - Detected by osmoreceptors and controlled by the hypothalamus

– mechanisms in plants that allow water balance to be maintained (ACSBL115)

➢ **Main source of water loss is through evapotranspiration in open stomata.**

➢ **Water Retention**
- **Reducing exposure of stomata to sunlight**
    - Less stomata
    - Stomata open at night/cold parts of day
    - Stomata on underside of leaves
- **Reducing internal temp**
    - Leaves coated with waxy cuticle

➢ **Water (Opposite of retention)**
- **Hydrophytes (plants in constant fresh water)**
    - Large stomata density
    - Stomata on top of leaves
    - Wants to lose water cause has plenty

➢ **Case study cause this one trial paper had "use a named example" >: (**
- **Marram grass**
    - Grows in coastal soils (is xerophyte) adapted to arid conditions))
    - In addition to low stomata density and stomata on the underside of the leaves, leaves are able to roll up.
    - Rolling up occurs due to the partial collapse of bulliform cells in the leaves in hot, arid conditions
    - Forms microclimate around the stomata traps moisture in microclimate which lessens the concentration gradient around the stomata
    - Weaker concentration gradient = reduction in evapotranspiration.

Causes and Effects.

Inquiry question: Do non-infectious diseases cause more deaths than infectious diseases?

Students:

- investigate the causes and effects of non-infectious diseases in humans, including but not limited to:
    – genetic diseases
    ➢ **Cystic fibrosis**

- Cause
  - Genetic mutation in CFTR gene in chromosome 7
  - Autosomal recessive, contracted through inheritance
- Effect
  - Disruption in producing of CFTR protein, sodium ions move into cells, making them hypotonic and drying out mucosa layers.
  - Accumulation of mucus is lungs causing breathing difficulties
  - Mucus becomes thick and sticky + cilia can't move mucus
  - Cough
  - Shortness of breath
- Treatment
  - Diagnosed through heel prick blood test
  - Gene therapy (potential to cross module with CRISPR), physiotherapy, IPPB machine.

– diseases caused by environmental exposure

- **Causes of Environmental Diseases**
  - **Lifestyle Factors:** Cardiovascular diseases and diseases from substance abuse.
  - **Physical Factors:** Skin cancer from UV exposure
  - **Chemical factors:** Heavy metal poisoning

Example: Immediate hypersensitivity

- **Causes**
  - Exposure to **allergens** that cause the immune system to incorrectly respond
- **Effects**
  - A rapid exaggerated immune response
  - Anaphylaxis (life threatening allergic reaction)
  - Large amounts of **histamine** released causing
    - Vasodilation
    - Increased blood vessel permeability
    - Contraction of smooth muscle linings in airways
    - Sensory stimulation (sneezing/itching)
- **Treatment**
  - Antihistamine
  - Allergen immunotherapy (exposure therapy for allergies)
  - EpiPen (Adrenalin/epinephrine Autoinjector)
    - Reverses effects of reaction, causing muscles to relax and heightens blood pressure.

Other examples include asbestosis and skin cancer (ez explaination)

– nutritional diseases

- **Causes**
  - Deficiency
  - Imbalance
  - Excess

  - These can be caused by a variety of things like inability to process nutrients or malnutrition.
- **Scurvy**
  - **Causes**
    - Lack of Vitamin C (abundant in citrus fruit)

- **Effects**
  - Heavily impaired sailors in past centuries as a lack of access to fresh fruit and veg lead to Vit C deficiencies.
  - Leads to degradation in skin and connect tissues due to lack of collagen
  - Weakness
  - Gum diseases
  - Easy bleeding
- **Treatment**
  - Sups (intravenous/oral)

– cancer

➢ **Types of cancers**
- Carcinoma – epithelial cells, skin and on organs
- Sarcoma – muscle/connective tissue
- Lymphoma – in lymphatic system
- Leukaemia - blood

➢ **Lung Cancer**
- Causes
  - Mutation in lung cells, causing accelerated and uncontrolled mitotic division
  - Chance of mutation increased by:
    - Smoking tobacco
    - Exposure to asbestos
    - Family history
    - Carcinogens!
- Effects
  - Uncontrolled replication of cells in the lungs causing tumours
  - Coughing up blood
  - Coughing
  - If cancer metastasises it can inhibit other bodily functions causing death
- Treatment
  - Diagnosed with CT scan and PET scan and biopsy
  - Chemotherapy
  - Lobectomy (lobe of the cancer is removed)
  - Pneumonectomy (whole lung is removed)

- collect and represent data to show the incidence, prevalence and mortality rates of non-infectious diseases, for example:
  – nutritional diseases
  – diseases caused by environmental exposure

➢ **Terminology**
- Incidence- the number of new cases of a disease diagnosed during a specific time period (usually one year).
- Mortality- the number of deaths occurring as a result of a disease during a specified time period (usually one year).
- Prevalence- the number of people alive with a prior diagnosis of a disease at a given time. It is distinct from incidence, which is the number of new cases of the disease diagnosed within a given period of time.
- Estimate- future estimates for incidence and mortality are a mathematical prediction of past trends. They assume that the most recent trends will continue into the future. Actual results are likely to vary.

Epidemiology

Inquiry question: Why are epidemiological studies used?

Students:

- analyse patterns of non-infectious diseases in populations, including their incidence and prevalence, including but not limited to:
  - nutritional diseases
  - diseases caused by environmental exposure
- investigate the treatment/management, and possible future directions for further research, of a non-infectious disease using an example from one of the non-infectious diseases categories listed above
- evaluate the method used in an example of an epidemiological study

➢ **Aims of Epidemiological Studies**
- To describe disease and other health related event patterns in human populations
- To identify the causes of disease and other health related events
- To provide data essential for the management, evaluation and planning of services for the prevention, control, and treatment of disease and other health related events.

➢ **Descriptive Studies**
- First used when investigating the cause of a disease.
- Provide information on:
  - Prevalence/incidence of disease
  - What populations it affects
- Information is gathered about the habits of people with the disease in order to determine a possible cause.
- Leads to hypotheses being proposed about the causes of disease.

➢ **Analytical Studies**
- Test hypothesis to find risk factors like tracking smokers for 20 years to see if lifestyle impacts incidence of lung cancer

➢ **Question: Design Epidemiological Study**
- Kind of like a chem experiment question, but without a dot pointed method
- **Structure:**
  - **Hypothesis**
    - Either make a hypothesis or determine infectious/non-infectious depending on question
  - **Method**
    - Not dot-pointed
    - Ensure validity through controlling variables
      - Control group
        - For analytical do control group + group that tests hypothesis to see differences in incidence
      - Other variables
    - Reliability
      - Large sample size
      - Further research into causation
    - Get info on lifestyle
      - Age/gender/broad subjects
      - Contacts/habits/locations/food/
    - Cross reference and eliminate non causes
      - Non causes are commonalities between environments
  - **Analysis**

- Determine what Q is asking to say send items off for further analysis to determine causation
- Quantitative analysis

- evaluate, using examples, the benefits of engaging in an epidemiological study

Prevention

Inquiry question: How can non-infectious diseases be prevented?

Students:

- use secondary sources to evaluate the effectiveness of current disease-prevention methods and develop strategies for the prevention of a non-infectious disease, including but not limited to:
  - educational programs and campaigns
    - **Case study: Slip Slop Slap**
      - **Why**
        - To reduce high incidence of skin cancer in Australia
          - Third most commonly diagnosed skin cancer in Australia (Melanoma)
      - **Purpose**
        - Provided information on how to safely be in the sun (put on clothes, where a hat and use sunscreen to reduce direct contact with sunlight)

Educational Programs and campaigns	
Pros	**Cons**
Accessible to a diverse portion of the population.	Targets more of a younger audience than an older generation
Backed by scientific evidence	Some aboriginal communities who didn't have access to technology like TVs (primary mode of distribution) may have remained unaware of the impacts of skin cancer.
Government funded	

      - **Results**
        - Incidence dropped from 25 cases of melanoma per 100k to 14 cases per 100k (1.1% decrease)

  - genetic engineering
    - **Gene therapy**
      - Used to treat diseases cause by dysfunctional genes.
      - **Process**
        - Therapeutic gene is spliced into **viral vector** using technology like CRISPR
        - Viral vector is inoculated into host (direct delivery) where it makes its way to the target organ. OR, Viral vector is inoculated into stem cells from the host invitro, these stem cells are then returned back into the host (indirect delivery)
        - Therapeutic gene is introduced into hosts genome where it acts to cure or mitigate the disease
      - **Notes:**
        - Only somatic used to not affect offspring
        - Liposomes may be used instead of viruses. New tech, safer.

Genetic Engineering	
Pros	**Cons**
Treats previously untreatable, genetic diseases	Virus vectors may produce unwanted mutations (poses danger to health).
Can prevent the development of genetic diseases (Pre-implantation IVF testing)	Due to risk in offspring, only somatic cells can be targeted using gene therapy.
Provides a permanent alternative to simply treating the symptoms	Expensive and relatively new technology.

High mark response scaffold

Evaluation of an example of non-infectious disease prevention

Chosen area of non-infectious disease prevention	
What disease(s) does this help prevent?	
What is currently being done?	
Evaluate the effectiveness of current disease prevention methods in this area	
Suggest improvements that could be made	

Technologies and Disorders

Inquiry question: How can technologies be used to assist people who experience disorders?

Students:

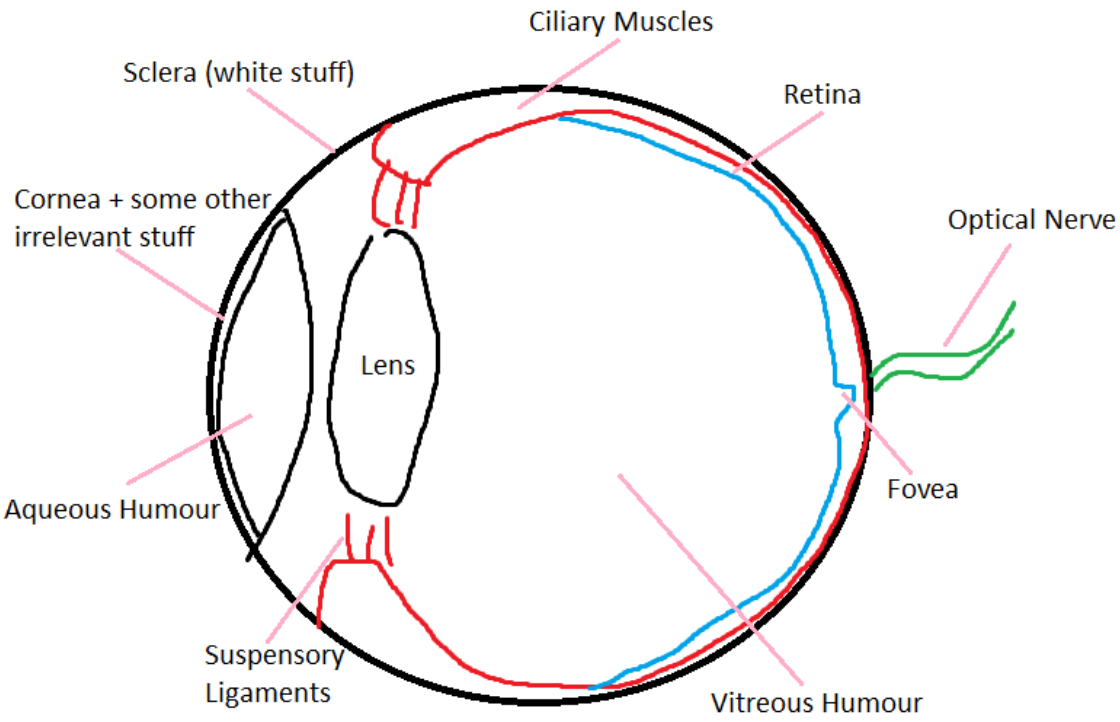
- explain a range of causes of disorders by investigating the structures and functions of the relevant organs, for example:
  - hearing loss

The Path of Sound

Sound waves → concentrated by pinna → travel down ear canal → sound revibrates on the tympanic membrane that transfers the wave into mechanical vibration in the ear's three ossicles → malleus, incus, and stapes where the vibration is amplified → stapes vibrates against oval window → pressure waves travel inside the cochlear through the endolymph in a sensory organ called the organ of corti.→ pressure waves vibrate the tectorial membrane which stimulate mechanoreceptors by vibrating stereocilia → mechanoreceptors convert the kinetic energy to electrochemical energy which is transferred though the nerves for the brain to interpret.

Disease	What	Causes
Conductive Hearing Loss	Problems physically conducting sound waves. (Outer-middle ear)	• Malformation • Infection • Fluid build-up • Perforated tympanic membrane
Sensorineural Hearing Loss	Problems with cochlear (usually damage) (Inner Ear)	• Exposure (repeated) to loud noises – Causes fatigue or death of stereocilia. • Aging (presbycusis)
Mixed Hearing Loss	Mixture of above	• Mixture of above

– visual disorders



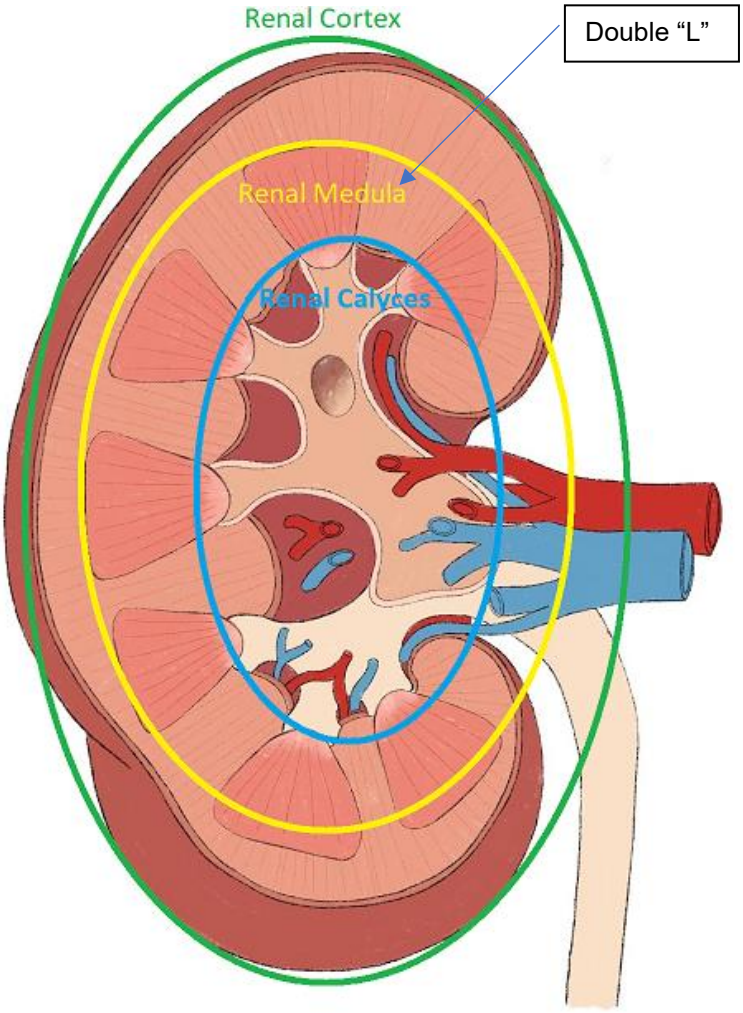
- **Lens**
- **Cornea**
- **Aqueous Humour**

Refraction

- **Retina**
  - Absorbs? Light (think of better word later)
  - Converts to electrochemical signal that runs through the optical nerve to the brain
  - The most focused part of the image is on the **fovea**
- **Ciliary muscles**
- **Suspensory Ligaments**

Allow for the elongation or squishing? (think of better word later) of lens. Kind of important as they wear out with time → Old age eye problems

– loss of kidney function



- **Structure of the Kidney**
  - **Renal Cortex:** Outer layer of the kidney, contains arterial and veinous vessels that supply nephrons with blood from the renal artery
  - **Renal Medulla:** Concentration gradient (High to low in respect to top and bottom) of water supplied by the descending part of Loop of Henle and salts (Cl, K, Na ions) first supplied by the ascending part of the Loop of Henle then through the collecting duct closer to the bottom of the medulla.
  - **Renal Calyces:** Plural of renal calyx, drains urine from the collecting duct into the ureter.
- **Structure of the Nephron**
  - **Glomerulus:** Encapsulated by the Bowman’s capsule. Allows oxygenated blood to pass by the capsule and supplies fluid into the rest of the nephron. (1/5 of fluid that passes).
  - **Bowman’s capsule:** Collects blood from glomerulus.
  - **Proximal tubule:** Reabsorbs good stuff (2/3 of Na + glucose)
  - **Loop of Henle:** Links between renal cortex and medulla. Descending part only allows water to pass through, ascending part only allows salts to pass through. Ascending part is actively pumped using ATP, causing a high concentration of salts in the renal medulla. (Causes the medulla to be hypertonic.)
  - **Collecting duct:** Supplied by multiple nephrons, releases waste (somehow (didn’t look into it)) into the calyces.
- **Function**
  - Filters blood (removes not very nice things)
  - Helps to maintain homeostasis in blood pressure and salt concentrations.

- investigate technologies that are used to assist with the effects of a disorder, including but not limited to: (ACSBL100)
  - hearing loss: cochlear implants, bone conduction implants, hearing aids

Technologies

Conventional Hearing Aid

Pros	Cons
Provides a relatively cheap	Uncomfortable for some (also very visible)
Effective solution for **Conductive Hearing Loss.**	Cheaper options cannot distinguish between background and conversation sounds, potentially making some situations disorienting

Bone Conduction Implant

Pros	Cons
By passes middle/outer ear (external sound processor send vibrations to cochlea) Allows for curing of permanent hearing loss in these regions	Requires surgery (relatively expensive)
Less visible/ more comfortable than conventional hearing aids	Only viable for conductive hearing loss

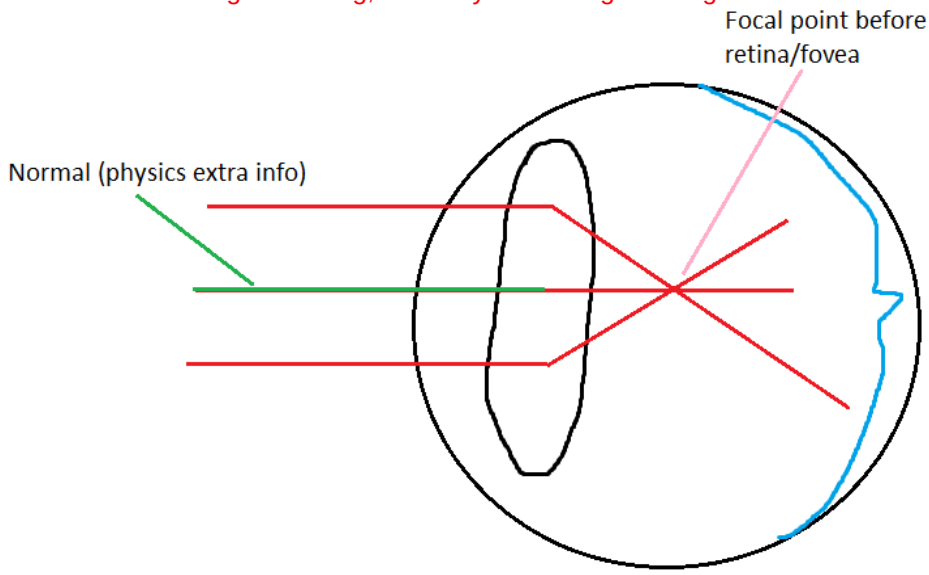
Cochlear Implant

Pros	Cons
Treatment for severe **Sensorineural Hearing Loss**	Cannot replace the accuracy of normal hearing
Directly stimulates neurons in the organ of corti, bypassing the stereocilia.	Many patients need educational therapy is vital to allowing patients to interpret the new sensory input.
More effective for young children (<5), as they are more adaptable to learning how to decode signals from the implant	Expensive, battery reliant (wireless through skin of scalp and amplifying and converting sound to electrical impulses), bad for background noise.

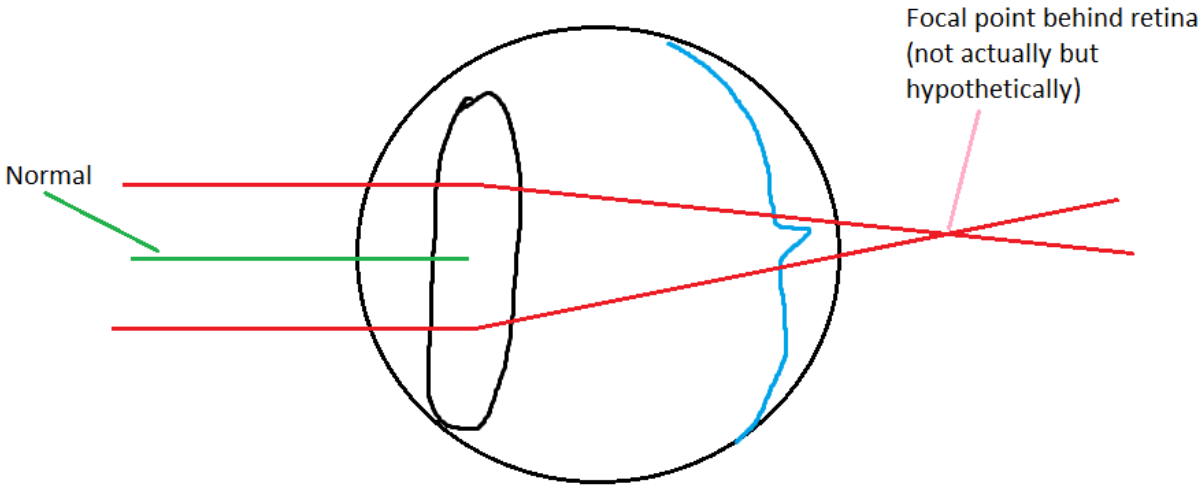
– visual disorders: spectacles, laser surgery

➢ **Disorders**

- **Myopia (short-sightedness)**
  - Occurs due to the refractive power of the cornea, aqueous humour or lens being too strong, or the eyeball being too long.



  - **Treatment**
    - **Concave spectacles**
      - Account for the excess refraction
      - Cheap + easy to use ☺
      - Don't provide permanent solution, only treats symptoms ☹
- **Hyperopia (long-sightedness)**
  - Occurs due to refractive power of the cornea, aqueous humour or lens being too weak, or the eyeball is too short. As short-distance things are in focus when the ciliary muscles are relaxed, this can develop in old age as the muscles + suspensory ligaments weaken.



  - **Treatment**
    - **convex Spectacles**
      - Account for too little refraction
      - Pros and cons of other spectacles…

- **Cataracts**
  - Clouding of lens
  - Can develop in old age
  - Causes clouding of lens → loss of vision
  - **Treatment**
    - **Laser Eye Surgery (process probs not particularly important)**
    - Incision is made through the cornea + lens, laser breaks down protein build-up (the cataract), artificial lens is placed inside the natural lens to repair vision alteration caused by the removal of the cataract.
    - Reduced risk of complications as less energy is used vs the traditional ultrasound method ☺
    - Studies show better healing ☺
    - More expensive than tradition method + often not covered my insurances ☹
    - Similar healing time :/

– loss of kidney function: dialysis

Haemo vs Peritoneal Dialysis			
Haemodialysis		Peritoneal Dialysis	
Pros	Cons	Pros	Cons
	You need a fistula which can cause a scar on the arm	Drain around your stomach which is easier to hide	
	Complicated surgery to create fistula (vein + artery)	Simple surgery placing catheter in artery	
3 times a week			≈ 6 times a week
	Must go to a center that allows the dialysis to be conducted	Can be done at home	
	Strict schedule	Work around patients schedule	
Good for people that have trouble remember/ maintaining a schedule			May be hard to maintain schedule do ensure safe levels of nutrients in blood
Only treats symptoms, doesn't actually fix the problem (kidney failure)		Only treats symptoms, doesn't actually fix the problem (kidney failure)	
Removes waste from blood		Removed waste from blood	
Improves quality of life (people depend on it to live)		Improves quality of life (people depend on it to live)	

- **Kidney transplant**
  - Completely/almost completely mitigates kidney failure
  - Intrusive surgery, may not be accessible to all people

- evaluate the effectiveness of a technology that is used to manage and assist with the effects of a disorder (ACSBL100)

Glossary

Glossary term	Definition
abiotic	The non-living components of the environment.
Aboriginal and Torres Strait Islander Peoples	Aboriginal Peoples are the first peoples of Australia and are represented by over 250 language groups each associated with a particular Country or territory. Torres Strait Islander Peoples whose island territories to the north east of Australia were annexed by Queensland in 1879 are also Indigenous Australians and are represented by five cultural groups. An Aboriginal and/or Torres Strait Islander person is someone who: • is of Aboriginal and/or Torres Strait Islander descent • identifies as an Aboriginal person and/or Torres Strait Islander person, and • is accepted as such by the Aboriginal and/or Torres Strait Islander community in which they live.
allele	A variant form of a gene.
biota (biotic)	All the living organisms in a specific region or area, including animals, plants and microorganisms.
conclusion	A judgement based on evidence.
controlled variable	A variable that is kept constant (or changed in constant ways) during an investigation.
Country	An area that is traditionally owned and looked after by an Aboriginal language group or community, or by certain people within that group. The term may indicate more than simply a geographical area – it is also a concept that can encompass the spiritual meanings and feelings of attachment associated with that area.
dependent variable	A variable that changes in response to changes to the independent variable in an investigation.
digital technologies	Systems that handle digital data, including hardware and software, for specific purposes.
environment	All surroundings, both living and non-living.
gene pool	The stock of different genes in an interbreeding population.
hypothesis	A tentative explanation for an observed phenomenon, expressed as a precise and unambiguous statement that can be supported or refuted by investigation.
independent variable	A variable that is changed in an investigation to see what effect it has on the dependent variable.
Indigenous cultural and intellectual property	Includes objects, sites, cultural knowledge, cultural expression and the arts, that have been transmitted or continue to be transmitted through generations as belonging to a particular Indigenous group or Indigenous people as a whole or their territory.

Glossary term	Definition
investigation	A scientific process of answering a question, exploring an idea or solving a problem, which requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include practical and/or secondary-sourced data or information.
microevolution	A change in gene frequency in a population over a short period of time.
model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.
niche	A position or function in a habitat that provides all the requirements for life of a species.
Place	A space mapped out by physical or intangible boundaries that individuals or groups of Torres Strait Islander Peoples occupy and regard as their own. Places are spaces that have varying degrees of spirituality.
plan	Decide on a course of action, and make arrangements relating to that course of action, in advance.
practical investigation	An investigation that involves systematic scientific inquiry by planning a course of action and using equipment to collect data and/or information. Practical investigations include a range of hands-on activities, and can include laboratory investigations and fieldwork.
primary sources/ primary data	Information created by a person or persons directly involved in a study or observing an event.
protocol	Appropriate ways of behaving, communicating and showing respect for the diversity of histories and cultures. This involves appreciation of the knowledge, standing and status of people within a local Aboriginal community. Protocols inevitably vary between communities, and between people within a community. In establishing partnerships between Aboriginal communities and industries or professions, it is especially important that protocols are acknowledged and respected.
reliability	An extent to which repeated observations and/or measurements taken under identical circumstances will yield similar results.
secondary-sourced investigation	An investigation that involves systematic scientific inquiry by planning a course of action and sourcing data and/or information from other people, including written information, reports, graphs, tables, diagrams and images.
symbiosis	Interaction between two different organisms living in close physical association, including mutualism, commensalism, and parasitism. Symbiosis can be positive (beneficial) or negative.
technology	All types of human-made systems, tools, machines and processes that can help solve human problems or satisfy needs or wants, including modern computational and communication devices.

Glossary term	Definition
theory	A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.
translation	The process by which a sequence of nucleotide triplets in a messenger RNA molecule gives rise to a specific sequence of amino acids during synthesis of a polypeptide or protein.
validity	An extent to which tests measure what was intended; an extent to which data, inferences and actions produced from tests and other processes are accurate.
variable	In an investigation, a factor that can be changed, maintained or measured – eg time, distance, light, temperature.
vector	An insect or animal that carries a disease from one animal or plant to another.

Students:

- investigate the causes and effects of non-infectious diseases in humans, including but not limited to: 💻
  - genetic diseases
    - Mutagens/inherited DNA replication failure -> genetic abnormality -> Down syndrome (aneuploidy) -> extra chromosome on chromosome 21 (trisomy) -> cognitive impairment + short neck + flattened facial profile -> how to fix
  - diseases caused by environmental exposure
    - Mutagens (UV radiation (ionising)) -> error in genetic code (DNA) -> Causes abnormal cellular growth (cancer) -> melanoma / other skin cancers through metastasis leading to organ failure / death -> links: Slip slop slap (education program + preventative measure) – module 6 – other preventative measures
  - nutritional diseases
    - Inadequate nutrition (malnutrition or over consumption) -> imbalances in nutrition -> Diabetes type 2 (excess glucose in diet ->unable to produce sufficient insulin to metabolise excess blood glucose levels) -> Poor circulation may require amputation of extremities, increased cholesterol, decreased energy, lethargy. -> preventative measures (monitoring of glucose level, insulin injections, diet management)-> Link: insulin bacteria technology
  - cancer
    - Mutagen (carcinogens in cigarettes) -> mutation of proto-oncogene -> Causes abnormal cellular growth (cancer) -> metastasis leading to organ failure / death (the lungs)-> links: education programs regarding smoking, preventative measures like not smoking.