- **Reproduction**

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

- *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*

➢ Animals: advantages of external and internal fertilisation:

In animals, the union of male and female gametes (sperm & ova) can occur outside the body (external fertilisation)- e.g. the Corroboree frog, or internally- e.g. the Red Kangaroo.

- Usually land animals = internal fertilisation

	ADVANTAGES & DISADVANTAGES	
Characteristics	**External fertilisation**	**Internal fertilisation**
Gametes	Large numbers of male and female gametes produced	Large number of male gametes and fewer female gametes
Union	Occurs in open water environments	Mostly on land, inside the reproductive tract of the female
Conception mechanism	Simultaneous release of gametes	Male needs to insert the sperm into the female's reproductive tract via penis or cloaca (copulation)
Chance of fertilisation	Low chance of fertilisation because male gametes are released into a large open area where there is less chance of successfully uniting with female gametes	High chance of fertilisation because male gametes are released into a confined space where there is more chance of successfully uniting with female gametes
Environment for zygote	Zygote usually develops externally in a watery environment which is vulnerable to environmental elements such as temperature and predation, infection and rapid dispersal from the area	Zygote usually develops in a very protected environment inside the female's body. Temperature is controlled, there is less chance of predation, infection and loss of zygote from the area
Nature of offspring/zygotes	After many zygotes perish a smaller number of offspring survive; however, the number of offspring produced is usually larger compared to internal fertilisation	Smaller number of zygotes produced because very few perish (higher success rate), therefore, smaller numbers of offspring compared to external fertilisation

Breeding frequency	Will breed more frequently compared to internal fertilisation due to the lower fertilisation success rate	Will breed seasonally and less frequently due to higher fertilisation success rate
Success in Terrestrial environment	NOT SUCCESSFUL Embryo less protected	ADV: Confined space→ higher successful fertilisation rate, avoids dehydration, not exposed to environment/predation, fewer gametes required DISADV: high STD rate, organism spends more energy for reproduction
Success in Aquatic environment	ADV: Watery environment necessary and gametes won't dry out, protected from heat stress DISADV: Breeding is needed more frequently, low fertilisation rate, vulnerable to environment, must release thousands of eggs	ADV: Higher chance of gametes uniting→ less gametes required DISADV: unnecessary- useless energy expenditure

- Plants: asexual and sexual reproduction

Sexual reproduction

- **Pollination**
  - The process in which the pollen moves from the anther (male reproductive part) to the stigma (female reproductive part)
  - Flowers are the reproductive organs of angiosperm plants
  - Male reproductive organs: Stamen- made of anther & filament
  - Meiosis occurs in anther and produces pollen grains
  - Pollen grains have a thick outer layer & 2 haploid nuclei
  - Female reproductive organ: Pistil- made up of a no. of carpels→ each carpel is made of a stigma, style & ovary
  - Meiosis occurs in the ovules, which are in the ovary

Pollination & fertilisation

Fertilisation occurs after pollination in the following way:

- The pollen on the stigma sends a pollen tube down the style to the ovary
- The two haploid nuclei of the pollen grain travel down the tube. One of the nuclei become the nucleus of the new tube cell, while the other nucleus divides again and they both travel down the tube to the ovule
- The pollen tube enters the ovule through a tiny hole called the micropyle
- One of the nuclei fuses with the ovum to form the zygote
- The other nucleus fuses with the other two haploid nuclei to form a triploid cell
  - Self- pollination involves pollen going on the stigma of the same plant
  - Cross-pollination involves pollen falling on the stigma of different plants

- **Seed dispersal**
  - Following successful pollination and fertilisation of the flower, the seed develops
  - It is an advantage for a plant to spread or disperse its seeds over a wide distance to prevent overcrowding from occurring within the same plant species & increases the chances of survival in situation of environmental change (e.g. fire, disease)
  - Seeds are dispersed by wind or by animals (insects, birds, mammals) & are designed to disperse in many ways
  - Australian native plants have evolved a variety of adaptations to aid in the effective and successful dispersal of their seeds

Asexual reproduction

- **Binary fission:** every time a single celled organism undergoes mitosis, it creates 2 new organisms
- **Spore formation:** only occurs in non-flowering plants (and other microscopic organisms). The parent plant produces thousands of single-celled spores which can grow into new plants.
- **Budding:** the parent produces a replica of itself by mitosis. This replica continues to grow as a new organism but is attached to the parent. This tends to form large colonies.
- **Vegetative propagation:** Flowering plants produce new plants from points on roots of stems called nodes. Grasses do this.
- **Regeneration:** a process in which organisms grow back parts that have been removed or lost. In some cases, it can be a form of sexual reproduction, of the broken body part grows to form a new organism.

➢ Fungi: budding, spores

- **Spore formation:** Fungi reproduce asexually by producing and releasing thousands of single-celled spores from the parent, which allows colonisation of new environments. These spores are produced by one parent only, through the process of mitosis, and will germinate if conditions are right.
- **Budding:** in this process, a bulge forms on the side of the cell, and initially the cytoplasm of the bud and the parent is continuous, until the bud ultimately detaches after the nucleus divides mitotically, with one of the daughter cells migrating to the bud, whilst the other remains in the parent cell. This method of asexual reproduction occurs in most yeasts.

➢ Bacteria: binary fission

- **Binary fission:** a method of asexual reproduction by which a single celled parent organism undergoes mitosis to produce 2 new organisms.
  - Firstly, the bacteria must replicate its genetic material to produce 2 copies
  - Cytokinesis then occurs, dividing the organism into two parts
  - Each new organism receives one copy of DNA

➢ Protists: binary fission, budding

- **Binary fission:** a method of asexual reproduction by which a single celled parent organism undergoes mitosis to produce 2 new organisms.
  - Firstly, the protist must duplicate its genetic material
  - Cytokinesis then occurs, dividing the organism into two parts
  - Each new organism receives one copy of DNA
- **Budding:** occurs when a new organism forms by growing out/from the body of the parent organism. The new organism may ultimately detach from the parent, or remain attached, forming colonies.

❖ *analyse the features of fertilisation, implantation and hormonal control of pregnancy and birth in mammals (ACSBL075)*

Fertilisation and Implantation in Mammals

In mammals, **gametes** are developed in the female ovaries or the male testes. In females, ovum (eggs) are such gametes and are released into the fallopian tubes. This release is called **ovulation** and 12-24 hours after ovulation occurs, **fertilisation** (the fusion of an ovum with a sperm cell) may be successful.

If fertilisation is successful, the newly formed **zygote** travels from the fallopian tube to the uterus where it embeds itself into the uterus wall (the **endometrium**). This process, called **implantation**, provides the growing embryo with oxygen and nutrients.

Hormonal Control of Pregnancy and Birth

The normal processes of fertility such as ovulation are controlled naturally by hormone levels. However, in order to prevent pregnancy and birth, hormonal contraceptives can alter the levels of such hormones in order to prevent ovulation, fertilisation and implantation. Most hormonal contraception is taken in the form of oral contraceptive pills.

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

Manipulation of animal reproduction in agriculture

- *Artificial insemination*
  - Sperm is chosen from a male and artificially introduced into several females
  - Increases the chance that the selected sperm will fertilise the selected female
  - Advantages: can be frozen, travel large distances without transporting the whole animal, used on a number of females
  - Disadvantages: reduces genetic variation, population be susceptible to changes in environment e.g. disease

Manipulation of plant reproduction in agriculture

- *Artificial pollination (plants):*
  - Fertile stigmas are dusted with pollen from favourable male plants
  - Pollinated flower is covered to prevent pollination from others
  - Advantages: relatively cheap, useful and easy
  - Disadvantages: limits genetic variation

- *Cloning (plants and animals):*
  - Method of producing genetically identical organisms- form of asexual reproduction
  - methods include tissue culture or cutting and grafting
  - Tissue culture: mass cloning – section is pulverised (e.g. root tip) to release individual cells, grown on a nutrient medium under controlled conditions
  - Cutting and grafting: short section of stem is cut off, dipped in root growth hormones and planted
  - Advantages: have the desirable features, reduces the 'unknown' element in selective breeding – characteristics can be bred and controlled
  - Disadvantages: Crops – all plants are susceptible to the same disease, expensive and limited techniques
    - Alters genetic composition of a population
    - Genetically identical, if many organisms were produced from one parent the net effect would be an overall decrease is the variety in a population as they would all have identical DNA
    - If all members of a species are identical, the population is less likely to survive sudden environmental changes and would be vulnerable to foreign pathogens

Scientific knowledge that lead to these reproductive technologies

- Mutation- a change in nucleotide base sequence of a gene which can lead to the generation of new allele's
- Meiosis- increases genetic variation- new combinations of alleles
- Fertilisation- the fusing of a male and female gamete forming a zygote – fertilisation of different gametes (with different combinations of alleles (i.e. different genotypes) will produce offspring with varied phenotypes- some of which are more favourable for the population or for industry (e.g. the food industry)
- Hybridisation- the mating of different varieties or species of an organism- which may result in hybrid vigour→ when the process of hybridisation results in a hybrid offspring superior to the parents
- Selective breeding– man chooses what is considered to be the most desirable characteristics e.g. size, taste, growth rate

Evaluation: this scientific knowledge was fundamental to the development of various reproductive technologies, and thus also critical to the manipulation of plant and animal reproduction in agriculture. This knowledge has allowed agricultural practices to be much more efficient and cost-effective.