

## Evolution of Reproductive Systems Notes

1. There are two principal modes of reproduction.
  - a. Asexual reproduction is the creation of new individuals from a single parent. Because all the genetic material comes from one parent, the result of asexual reproduction is genetically identical individuals, or clones.
  - b. Sexual reproduction is the production of offspring by the joining of haploid gametes from two different parents.
    - i. The female gamete (the egg) and the male gamete (the sperm) fuse. This process, called fertilization, yields a diploid cell called a zygote (or fertilized egg).
    - ii. Sexual reproduction increase the genetic diversity in a population because offspring possess unique combinations of the genes inherited from two parents.
    - iii. This diversity is important because it can produce individuals better-suited to a particular environment and provides the basis for natural selection.
2. Prokaryotes have a single circular chromosome attached to the inside of the plasma membrane.
  - a. New cells are produced by asexual reproduction when a cell simply splits in two in a process called **binary fission**. The DNA is copied and the cell divides into two identical cells.
  - b. Genetic diversity is achieved in a variety of ways.
    - i. **Conjugation** involves two cells joining briefly and one cell donates some DNA (called a **plasmid**) to the other one. Sometimes part of the cell's chromosome is donated as well. Note that there is no increase in the number of cells.
    - ii. Bacteria are able to pick up pieces of DNA from the environment in a process called **transformation**.
    - iii. **Transduction** is a process in which viruses transfer pieces of DNA from one cell to another.
    - iv. Because bacteria reproduce so quickly, mutation is a large source of genetic diversity.
3. Protists all are capable of asexual reproduction but some reproduce sexually as well.
4. Most fungi reproduce sexually although there are a few examples of those that reproduce asexually.
  - a. Yeast are fungi that show mostly asexual reproduction. They reproduce by **budding**, in which a new individual develops as an outgrowth from existing ones.
  - b. The above ground structure that we call a mushroom is actually the reproductive structure of the fungus.
  - c. Spores produced in the mushroom are dispersed and grow into new individuals. Spores are non-motile, unlike the gametes of plants and animals. Spores are dispersed over great distances by wind, insects, and animals.
5. Plant life cycles have two alternating phases, a **haploid** (n) phase and a **diploid** (2n) phase.
  - a. The diploid phase is called the **sporophyte** and produces spores, while the haploid is called the **gametophyte** and produces gametes. The term diploid means having a complete set of chromosomes. Haploid means having half a set of chromosomes.
  - b. Throughout the evolution of plants we see a progression from a dominant gametophyte to a dominant sporophyte. Simple plants spend most of their life in the gametophyte phase while more complex plants spend most of their life in the sporophyte phase. This is

because the gametophyte produces gametes which require water to swim. In order to live in terrestrial habitats away from water, plants had to rely less on gametes.

- c. **Seedless** plants (*e.g.*, ferns) reproduce using spores. As in Fungi, spores are tiny reproductive cells that can be carried long distances by the wind.
  - d. **Seed** plants reproduce using seeds. The seed is tough, drought-resistant, protective covering for the embryo inside. Food packaged in the seed provides energy for the young plant until it can grow above the soil and begin photosynthesizing.
    - i. **Gymnosperms** (*e.g.*, pine) have seeds that are not enclosed.
    - ii. **Angiosperms** (*i.e.*, flowering plants) have seeds that are enclosed, usually in a fruit. Angiosperms are, by far, the most successful plants.
      - (1) The success of angiosperms is due to the flower and the fruit as well as their co-evolution with insects to improve pollination.
      - (2) Flowers increase the efficiency of pollination because pollinators can locate flowers by odor, shape, color, and texture. The pollen is also a food source for bees which attracts them to the flower. While collecting pollen, bees get it on their legs and carry it to another plant. Some flowers are pollinated by insects such as butterflies and moths which have mouthparts specialized for collecting nectar.
      - (3) Wind-pollinated flowers are small, have no petals and little color and do not produce nectar.
      - (4) Adaptations of seeds help in their dispersal. Some seeds are carried by wind or water, while others stick to the fur of animals or are eaten.
      - (5) Fruit is a very efficient way of dispersing seeds. Fruit is very attractive to animals and when they eat the fruit, they also ingest the seeds. The indigestible seeds pass through the animal's digestive tract and are deposited elsewhere.
6. Remember that sexual reproduction is a characteristic of Kingdom Animalia, so nearly all animals reproduce sexually. Of course, there are exceptions. Several genera of fishes, amphibians, and reptiles reproduce by **parthenogenesis**, involving the production of diploid eggs that do not need to be fertilized. In fact, in some lizard species, there are no males!
- a. The sponges in Phylum Porifera are **hermaphrodites** but produce eggs and sperm at different times to avoid self-fertilization. This is called **sequential hermaphroditism**. Asexual reproduction by budding is common. Hermaphroditism is helpful for organisms that are sessile or burrowing and would have difficulty finding a mate.
  - b. In Phylum Cnidaria, there are separate sexes in jellyfish but lower cnidarians like the hydra show asexual budding as well. Many sponges and cnidarians also reproduce by **fragmentation** – the breaking of the body into pieces which then develop into complete adults.
  - c. Flatworms are hermaphrodites with the reproductive system only appearing during mating season. Flatworms are also unusual in that they can reproduce asexually if the animal is split in two.
  - d. Phylum Nematoda is the first phylum in which sexual reproduction with separate sexes is the general rule.
  - e. Most mollusks show sexual reproduction with separate sexes.
    - i. Young care is highly developed in the octopus.
  - f. Some annelids show separate sexes while some are hermaphrodites.

- g. Arthropods have separate sexes.
  - i. **Pheromones** are chemicals released by one individual to affect the behaviour of another individual. Sex pheromones are used to attract a mate.
- h. Separate sexes is the rule among vertebrates.
  - i. In bony fishes, fertilization is external. Cartilaginous fishes are **ovoviviparous**, meaning that eggs are fertilized inside the female and live young are born.
- i. The external fertilization of most amphibians requires them to stay in or near water for reproduction because sperm must swim through the water to the egg. The simple eggs do not have an outer covering or shell and therefore are not protected from drying out.
- j. Reptiles are **oviparous** (although ovoviviparous examples exist), meaning fertilization is internal and the female then lays fertilized eggs. Internal fertilization is necessary because reproduction occurs on land so sperm must be deposited inside the female. Internal fertilization allows animals to mate without having to be in water.
- k. The eggs are encased in leathery shells to protect them from drying out. This eliminates the need for a swimming larval stage.
  - i. The amniotic egg has several membranes which make it a valuable adaptation for a terrestrial lifestyle. The egg has structures to surround and protect the embryo, provide food, store wastes, and allow oxygen to enter, but retain water.
  - ii. Most reptiles do not care for their young.
- l. Like reptiles, birds are oviparous. Birds have internal fertilization and produce hard-shelled, amniotic eggs.
  - i. Birds exhibit complex behavior including extensive parental care. For example, build a bower to impress females and decorate it with blue objects.
- m. Mammals are divided into three groups based on their method reproductive.
  - i. Unlike other mammals, the platypus and spiny anteater are **monotremes**. These mammals lay eggs which the female incubates. Milk is secreted by glands on the mother's belly and the baby sucks the milk from the mother's fur.
  - ii. Opossums, kangaroos, and koalas are called **marsupials**. Marsupial young begin development in the female's body but are born very immature (in as few as eight days after fertilization) and then crawl into the mother's pouch. There they feed by attaching to a nipple and continue to develop.
  - iii. Marsupials do have a simple placenta but it is not as developed as the placenta found in **placental mammals**. The placenta is a structure in which nutrients, oxygen and wastes pass between the mother and fetus. This exchange is possible because the blood of the fetus and of the mother are in close contact in the placenta. Placental mammals are born relatively mature because the well-developed placenta enables them to remain within the mother for an extended period of development.
  - iv. The length of young care is proportional to the complexity of behaviour in adults.