

## Inherited variation

The features of organisms are called their **characteristics** (e.g. blue eyes). Offspring normally share some characteristics with their parents and brothers and/or sisters. Offspring can **inherit** characteristics from their parents. Characteristics can be different and this is known as **variation** (e.g. brown eyes and blue eyes). Variation occurs in both plants and animals.

An organism's characteristics are controlled by **genetic information**, which is carried on **genes**. Genes are sections of **chromosomes** which are found inside the **nucleus** of almost all of an organism's cells. Genetic information is passed from parents to offspring during reproduction.

In sexual reproduction, two **gametes** (sex cells) **fuse**; one from the male and one from the female. In animals, the male gamete is the **sperm cell** and the female gamete is the **ovum** (egg cell). This fusing produces a **fertilised egg cell**, which then splits in two, by a process called **cell division**, to form an embryo. The cells of the embryo continue to divide to form a ball of cells, which then grows into a new organism.

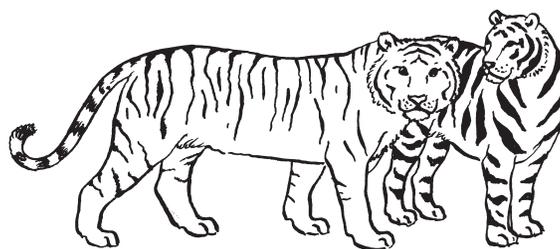
Each gamete contains half the amount of genetic information that a normal body cell has. So the fertilised egg cell gets half its genetic information from the male and half from the female.

In many animals, when two egg cells are each fertilised by different sperm cells, non-identical twins are born. Sometimes a fertilised egg cell splits into two and identical twins form.

## Species, breeds and varieties

A **species** is a group of organisms that are able to produce offspring that are also able to reproduce. Members of the same species have very similar characteristics, but there is some variation in these characteristics. Some members of a species may have **mutations** in their genes, giving them very different characteristics compared with other members of the species.

A group of animals may have special differences in their inherited characteristics from the rest of their species. A group like this is called a **breed** (e.g. different breeds of dog). There are also breeds of plants and these are called **varieties**.



*All tigers have stripes but there is variation in the stripes between each tiger.*

## Selective breeding

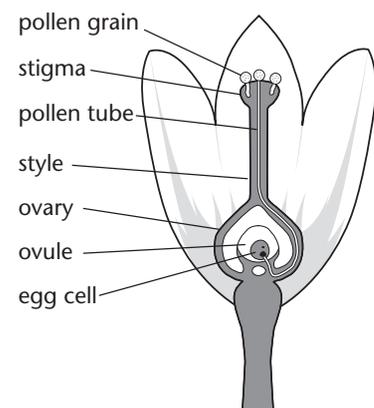
Farmers and plant breeders may choose or 'select' an animal or plant with certain characteristics (e.g. good milk production in cows). This animal or plant is then used to breed from. The offspring that have the best of these characteristics are then bred from again. This is called **selective breeding** and is how many new breeds and varieties are created. Sometimes two different breeds or varieties are bred together to produce offspring with characteristics from both breeds/varieties. This is called **cross-breeding**.

## Plant breeding

**Pollen grains** (the male gametes) are carried by the wind or insects to the **stigma** of another flower. This is called **pollination**. Plant breeders can transfer the pollen that they want to the stigma that they choose, sometimes using a paintbrush.

A pollen grain grows a **pollen tube** down through the **style** and into the **ovary**, where it meets an **ovule**. It grows into the ovule and meets an ovum (egg cell). The nucleus from the pollen grain goes into the ovum and fuses with its nucleus. This is **fertilisation**.

Many of the characteristics that plant breeders choose are visible (e.g. fruit size, **yield**) but some are not visible (e.g. **disease resistance**).



## Genetic modification

Scientists can insert a **gene** from one organism into another to create new **breeds** and **varieties** quickly.

## Variation caused by the environment

Some characteristics vary due to an organism's surroundings (**environment**). This is called **environmental variation**. For example, plants growing in different areas of a field may be different heights depending on the amount of light, water and mineral salts that they get. These things are all physical **environmental factors**.

## Cloning

Many plants can use **asexual reproduction**, which is reproduction that needs only one parent. All the offspring are **clones**. Taking a cutting is a form of **cloning**. Scientists now have ways in which they can clone animals. Cloning allows the numbers of an organism to be increased quickly.