

Cell Division in Plants & Animals

Sexual reproduction usually involves two individual organisms. The offspring that are produced from this union have genetically different characteristics, half from one parent and the other half from the other parent - making a unique offspring. During sexual reproduction, the specialized sex cells (gametes) unite to form a zygote, which develops into the new organism. When a male gamete and a female gamete unite, meiosis takes place. **Meiosis** is a type of cell division that produces cells with only half the DNA of a normal cell. This process involves two cell divisions, not one.

Offspring Unlike Either Parent - More than one gene location and more than one allele may be responsible for specific traits. As a result, the complex mixing of the possible combinations for that particular trait may account for the variation of traits an offspring has.

The Science of Genetics

To reproduce organisms with only the most preferred traits, allow only those organisms with the desirable traits to reproduce. This method is not always successful, but over time (trial and error), this practice of controlled breeding enabled scientists to determine which alleles were responsible for specific traits.

Patterns of Inheritance

Incomplete dominance occurs because the dominant-recessive pattern does not always prevail. When the alleles are neither dominant, nor recessive, an intermediate trait will occur (combining the two traits).

Purebred vs Hybrid

To produce purebred organisms, choose pure bred parents, those parents whose ancestors have produced only the desired characteristic they want (**true-breeding**). If a breeder chooses two different 'true-breeds' then a hybrid would be produced.

Dominant vs Recessive Traits

Crossbreeding two different true-breeds will result in all of the offspring having the same characteristic, that is, the **dominant** trait. Only the DNA instructions for the dominant trait will be carried out. When crossbreeding hybrids, the average results will produce 75% of the offspring with the dominant trait and 25% of the offspring with the recessive trait, because there are only 4 possible combinations. One trait is recessive and therefore the allele is recessive. A **recessive** trait only appears in the offspring if two recessive alleles are inherited. [Punnett Squares] **Environmental Factors** can also determine how DNA is interpreted and developed. Fetal alcohol syndrome can be a direct result of alcohol consumption during the developing stages of the offspring. The 'normal' DNA is affected by the alcohol and will not develop normally. Taking drugs can also affect the DNA during normal development and defects in the organism can occur. (Thalidomide)

Biodiversity Reduction

Stresses of urbanization and habitat intrusion by farming and industry have resulted in a decline in genetic, species and ecosystem diversity. Extinction, population decreases and degradation of ecosystems reduces biodiversity.

Extinction is the disappearance of every individual of a species from the entire planet. It is a natural part of the Earth's history. 99% of species that have ever existed on the Earth are now extinct (many by mass extinction - sudden environmental change, like the Ice Age). Most extinctions take place over long periods of time, but the rate of extinctions is rising, and this is reducing the biological diversity of our planet.

Extirpation is a local extinction, or the disappearance of a species from a particular area.

Causes of Extinction and Extirpation

Natural selection is a slow process. Even if there is a lot of variation within a species, sometimes the changes in the environment are so drastic that and so quick, that none of the individuals within a species can survive.

Most extinctions, in the past, were due to: catastrophic events (volcanic eruptions, earthquakes, floods, fire)

- lack of food (due to overpopulation)
- disease

Not all extinctions happened millions of years ago. Diseases and natural events occur all the time and when they do, a species, within a particular area, can be extirpated very quickly.

Habitat destruction - as a result of - Urbanization, Construction, Agricultural Development, Logging, Damming of rivers, Pollution, Pesticides, Herbicides and Fertilizers.

Introduction of Non-Native Species

Introduced species use the same resources, as the native species, the competition will cause a decline in the numbers of native species. The non-native species has no natural predators to limit its population and will take over from the native species.

Over-Hunting

This was the major cause of the decline and eventual extirpation of the plains Bison, as well as the extinction of the passenger pigeon. Sometimes species are hunted to deliberately extirpate them. The black-tailed prairie dogs were considered a pest in the 1930's and were hunted to reduce their numbers.

Effects of Extinctions and Extirpations

Extinctions and extirpations reduce biological diversity. When an organism disappears locally or globally, many other species are affected. The cycle of life is adversely affected.

Artificial Selection

The process of selecting and breeding individuals with desirable traits to produce offspring with the desired traits. Only those individuals, with the desired trait, will be allowed to reproduce. This selection process also applies to plants, which can be bred to possess desirable traits. The main difference between 'natural' selection and 'artificial' selection is that, humans control the artificial selection process.

Biotechnology

The process of intervention to produce more desirable organisms has been going on for some time. This process takes a long time to see results - usually many generations. Farmers, dog and horse breeders, along with scientists can now speed up the artificial selection process by using 'low-tech' or 'high-tech' technologies, such as; **cloning** (made from cells) **artificial insemination** (artificially joining the male and female gametes) **in vitro fertilization** (male and female gametes are selected and then allowed to fertilize in a controlled setting) **genetic engineering** (directly altering the DNA of an organism)

Biotechnology and Society

Beneficial or *detrimental* to society? That is one of the pressing questions that many humans are struggling with, when it comes to biotechnology. There are many good things that can be produced, but what about the problems, including:

- risks in animals (reducing genetic variation within a specific population, less resistance to disease, birth defects and other abnormalities)
- risks in plants (resistance to herbicides)

Reducing Impact on Biodiversity

Preserving global biological diversity is a challenge that is receiving much attention. A Biodiversity Strategy is created to preserve biodiversity worldwide. It will be done through the cooperation of many levels of government, along with many groups, agencies and individuals, who are dedicated to preserving our bio-diverse future.

Protected Areas (National Parks, Provincial Parks, game preserves, natural areas)

Restoration Programs for Ecosystems and Species (purchase land for species habitat renewal, individual landowners giving habitat back - in the form of a naturally protected area)

Resource Use Policies (Laws - *National Accord for the Protection of Species at Risk - Species at Risk Act - Wildlife Act, 1998*)

Controlling the Introduction and Spread of Exotic Species (Information & teaching, penalties and fines, as well as loss of desirable areas for recreational purposes)

Conservation of Genetic Resources (*Ex-situ conservation* refers to conservation of biodiversity outside of a natural habitat.

- The collection and storage of genetic resources, such as seeds (IPGRI)
- Zoos (captive breeding programs)
- Sperm and Egg Banks
- Human Genome Project