**Natural selection** is the differential survival and reproduction of individuals due to differences in [phenotype](https://en.wikipedia.org/wiki/Phenotype" \o "Phenotype). It is a key mechanism of [evolution](https://en.wikipedia.org/wiki/Evolution" \o "Evolution), the change in the [heritable](https://en.wikipedia.org/wiki/Heredity" \o "Heredity) [traits](https://en.wikipedia.org/wiki/Phenotypic_trait" \o "Phenotypic trait) characteristic of a [population](https://en.wikipedia.org/wiki/Population" \o "Population) over generations. [Charles Darwin](https://en.wikipedia.org/wiki/Charles_Darwin" \o "Charles Darwin) popularised the term "natural selection", contrasting it with [artificial selection](https://en.wikipedia.org/wiki/Selective_breeding" \o "Selective breeding), which is intentional, whereas natural selection is not.

[Variation](https://en.wikipedia.org/wiki/Genetic_diversity" \o "Genetic diversity) of traits, both [genotypic](https://en.wikipedia.org/wiki/Genotype" \o "Genotype) and [phenotypic](https://en.wikipedia.org/wiki/Phenotype" \o "Phenotype), exists within all populations of [organisms](https://en.wikipedia.org/wiki/Organism" \o "Organism). However, some traits are more likely to facilitate [survival](https://en.wikipedia.org/wiki/Survival" \o "Survival) and [reproductive successs.](https://en.wikipedia.org/wiki/Reproductive_success" \o "Reproductive success) Thus, these traits are passed onto the next generation. These traits can also become more [common within a population](https://en.wikipedia.org/wiki/Allele_frequency" \o "Allele frequency) if the environment that favours these traits remain fixed. If new traits become more favored due to changes in a specific [niche](https://en.wikipedia.org/wiki/Ecological_niche" \o "Ecological niche), [microevolution](https://en.wikipedia.org/wiki/Microevolution" \o "Microevolution) occurs. If new traits become more favored due to changes in the broader environment, [macroevolution](https://en.wikipedia.org/wiki/Macroevolution" \o "Macroevolution) occurs. Sometimes, [new species can arise](https://en.wikipedia.org/wiki/Speciation" \o "Speciation) especially if these new traits are radically different from the traits possessed by their predecessors.

The likelihood of these traits being 'selected' and passed down are determined by many factors. Some are likely to be passed down because they [adapt](https://en.wikipedia.org/wiki/Adaptation" \o "Adaptation) well to their environments. Others are passed down because these traits are actively preferred by mating partners, which is known as [sexual selection](https://en.wikipedia.org/wiki/Sexual_selection" \o "Sexual selection). Female bodies also prefer traits that confer the lowest cost to their reproductive health, which is known as [fecundity selection](https://en.wikipedia.org/wiki/Fecundity_selection" \o "Fecundity selection).

Natural selection is a cornerstone of modern [biology](https://en.wikipedia.org/wiki/Biology" \o "Biology). The concept, published by Darwin and [Alfred Russel Wallace](https://en.wikipedia.org/wiki/Alfred_Russel_Wallace" \o "Alfred Russel Wallace) in a [joint presentation of papers in 1858](https://en.wikipedia.org/wiki/On_the_Tendency_of_Species_to_form_Varieties;_and_on_the_Perpetuation_of_Varieties_and_Species_by_Natural_Means_of_Selection" \o "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection), was elaborated in Darwin's influential 1859 book *[On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life](https://en.wikipedia.org/wiki/On_the_Origin_of_Species" \o "On the Origin of Species)*. He described natural selection as analogous to artificial selection, a process by which animals and plants with traits considered desirable by human breeders are systematically favoured for reproduction. The concept of natural selection originally developed in the absence of a valid theory of heredity; at the time of Darwin's writing, science had yet to develop modern theories of genetics. The union of traditional [Darwinian evolution](https://en.wikipedia.org/wiki/Darwinism" \o "Darwinism) with subsequent discoveries in [classical genetics](https://en.wikipedia.org/wiki/Classical_genetics" \o "Classical genetics) formed the [modern synthesis](https://en.wikipedia.org/wiki/Modern_synthesis_(20th_century)" \o "Modern synthesis (20th century)) of the mid-20th century. The addition of [molecular genetics](https://en.wikipedia.org/wiki/Molecular_genetics" \o "Molecular genetics) has led to [evolutionary developmental biology](https://en.wikipedia.org/wiki/Evolutionary_developmental_biology" \o "Evolutionary developmental biology), which explains evolution at the molecular level. While [genotypes](https://en.wikipedia.org/wiki/Genotype" \o "Genotype) can slowly change by random [genetic drift](https://en.wikipedia.org/wiki/Genetic_drift" \o "Genetic drift), natural selection remains the primary explanation for [adaptive evolution](https://en.wikipedia.org/wiki/Adaptation" \o "Adaptation).

The term *natural selection* is most often defined to operate on heritable traits, because these directly participate in evolution. However, natural selection is "blind" in the sense that changes in phenotype can give a reproductive advantage regardless of whether or not the trait is heritable. Following Darwin's primary usage, the term is used to refer both to the evolutionary consequence of blind selection and to its mechanisms.[[28]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-origin-28)[[38]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-fisher-38)[[52]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-nomenclature1-52)[[53]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-53) It is sometimes helpful to explicitly distinguish between selection's mechanisms and its effects; when this distinction is important, scientists define "(phenotypic) natural selection" specifically as "those mechanisms that contribute to the selection of individuals that reproduce", without regard to whether the basis of the selection is heritable.[[54]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-nomenclature2-54)[[55]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-55)[[56]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-56) Traits that cause greater reproductive success of an organism are said to be *selected for*, while those that reduce success are *selected against*.[[57]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-57)

Natural selection can act on any heritable [phenotypic trait](https://en.wikipedia.org/wiki/Phenotypic_trait" \o "Phenotypic trait),[[74]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-75) and selective pressure can be produced by any aspect of the environment, including sexual selection and [competition](https://en.wikipedia.org/wiki/Competition_(biology)" \o "Competition (biology)) with members of the same or other species.[[75]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-76)[[76]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-ArnqvistRowe2005-77) However, this does not imply that natural selection is always directional and results in adaptive evolution; natural selection often results in the maintenance of the status quo by eliminating less fit variants.[[58]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Michigan-58)

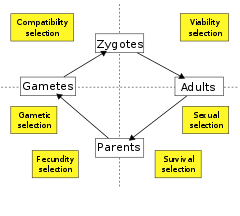
Selection can be classified in several different ways, such as by its effect on a trait, on genetic diversity, by the life cycle stage where it acts, by the unit of selection, or by the resource being competed for.

### **By effect on a trait**

Selection has different effects on traits. [Stabilizing selection](https://en.wikipedia.org/wiki/Stabilizing_selection" \o "Stabilizing selection) acts to hold a trait at a stable optimum, and in the simplest case all deviations from this optimum are selectively disadvantageous. [Directional selection](https://en.wikipedia.org/wiki/Directional_selection" \o "Directional selection) favours extreme values of a trait. The uncommon [disruptive selection](https://en.wikipedia.org/wiki/Disruptive_selection" \o "Disruptive selection) also acts during transition periods when the current mode is sub-optimal, but alters the trait in more than one direction. In particular, if the trait is quantitative and [univariate](https://en.wikipedia.org/wiki/Univariate" \o "Univariate) then both higher and lower trait levels are favoured. Disruptive selection can be a precursor to [speciation](https://en.wikipedia.org/wiki/Speciation" \o "Speciation).[[58]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Michigan-58)

### **By effect on genetic diversity**

Alternatively, selection can be divided according to its effect on [genetic diversity](https://en.wikipedia.org/wiki/Genetic_diversity" \o "Genetic diversity). [Purifying or negative selection](https://en.wikipedia.org/wiki/Negative_selection_(natural_selection)" \o "Negative selection (natural selection)) acts to remove genetic variation from the population (and is opposed by *[de novo](https://en.wikipedia.org/wiki/Mutation" \l "By_inheritance" \o "Mutation)*[mutation](https://en.wikipedia.org/wiki/Mutation" \l "By_inheritance" \o "Mutation), which introduces new variation.[[77]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-78)[[78]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-79) In contrast, [balancing selection](https://en.wikipedia.org/wiki/Balancing_selection" \o "Balancing selection) acts to maintain genetic variation in a population, even in the absence of *de novo* mutation, by negative [frequency-dependent selection](https://en.wikipedia.org/wiki/Frequency-dependent_selection" \o "Frequency-dependent selection). One mechanism for this is [heterozygote advantage](https://en.wikipedia.org/wiki/Heterozygote_advantage" \o "Heterozygote advantage), where individuals with two different alleles have a selective advantage over individuals with just one allele. The polymorphism at the human [ABO blood group](https://en.wikipedia.org/wiki/ABO_blood_group" \o "ABO blood group) locus has been explained in this way.[[79]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-80)

[](https://en.wikipedia.org/wiki/File:Life_cycle_of_a_sexually_reproducing_organism.svg)Different types of selection act at each [life cycle stage](https://en.wikipedia.org/wiki/Biological_life_cycle" \o "Biological life cycle) of a sexually reproducing organism.[[80]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Christiansen1984-81)

### **By life cycle stage**

Another option is to classify selection by the [life cycle](https://en.wikipedia.org/wiki/Biological_life_cycle" \o "Biological life cycle) stage at which it acts. Some biologists recognise just two types: [viability (or survival) selection](https://en.wikipedia.org/wiki/Natural_selection" \l "Types_of_selection), which acts to increase an organism's probability of survival, and fecundity (or fertility or reproductive) selection, which acts to increase the rate of reproduction, given survival. Others split the life cycle into further components of selection. Thus viability and survival selection may be defined separately and respectively as acting to improve the probability of survival before and after reproductive age is reached, while fecundity selection may be split into additional sub-components including sexual selection, gametic selection, acting on [gamete](https://en.wikipedia.org/wiki/Gamete" \o "Gamete) survival, and compatibility selection, acting on [zygote](https://en.wikipedia.org/wiki/Zygote" \o "Zygote) formation.[[80]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Christiansen1984-81)

### **By unit of selection**

Selection can also be classified by the level or [unit of selection](https://en.wikipedia.org/wiki/Unit_of_selection" \o "Unit of selection). Individual selection acts on the individual, in the sense that adaptations are "for" the benefit of the individual, and result from selection among individuals. [Gene selection](https://en.wikipedia.org/wiki/Gene_selection" \o "Gene selection) acts directly at the level of the gene. In [kin selection](https://en.wikipedia.org/wiki/Kin_selection" \o "Kin selection) and [intragenomic conflict](https://en.wikipedia.org/wiki/Intragenomic_conflict" \o "Intragenomic conflict), gene-level selection provides a more apt explanation of the underlying process. [Group selection](https://en.wikipedia.org/wiki/Group_selection" \o "Group selection), if it occurs, acts on groups of organisms, on the assumption that groups replicate and mutate in an analogous way to genes and individuals. There is an ongoing debate over the degree to which group selection occurs in nature.[[81]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-82)

### **By resource being competed for**

[](https://en.wikipedia.org/wiki/File:Pavo_cristatus_in_Barbados_Wildlife_Reserve_12.jpg)The [peacock](https://en.wikipedia.org/wiki/Peafowl" \o "Peafowl)'s elaborate plumage is mentioned by Darwin as an example of [sexual selection](https://en.wikipedia.org/wiki/Sexual_selection" \o "Sexual selection),[[82]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-DarwinSexualSelection-83) and is a classic example of [Fisherian runaway](https://en.wikipedia.org/wiki/Fisherian_runaway" \o "Fisherian runaway),[[83]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Greenfield-84) driven to its conspicuous size and [coloration](https://en.wikipedia.org/wiki/Animal_coloration" \o "Animal coloration) through [mate choice](https://en.wikipedia.org/wiki/Mate_choice" \o "Mate choice) by females over many generations.

*Further information: [Sexual selection](https://en.wikipedia.org/wiki/Sexual_selection" \o "Sexual selection)*

Finally, selection can be classified according to the [resource](https://en.wikipedia.org/wiki/Resource_(biology)" \o "Resource (biology)) being competed for. Sexual selection results from competition for mates. Sexual selection typically proceeds via fecundity selection, sometimes at the expense of viability. [Ecological selection](https://en.wikipedia.org/wiki/Ecological_selection" \o "Ecological selection) is natural selection via any means other than sexual selection, such as kin selection, competition, and [infanticide](https://en.wikipedia.org/wiki/Infanticide_(zoology)" \o "Infanticide (zoology)). Following Darwin, natural selection is sometimes defined as ecological selection, in which case sexual selection is considered a separate mechanism.[[84]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-85)

Sexual selection as first articulated by Darwin (using the example of the [peacock](https://en.wikipedia.org/wiki/Peafowl" \o "Peafowl)'s tail)[[82]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-DarwinSexualSelection-83) refers specifically to competition for mates,[[85]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-86) which can be *intrasexual*, between individuals of the same sex, that is male–male competition, or *intersexual*, where one gender [chooses mates](https://en.wikipedia.org/wiki/Mate_choice" \o "Mate choice), most often with males displaying and females choosing.[[86]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Hosken2011-87) However, in some species, mate choice is primarily by males, as in some fishes of the family [Syngnathidae](https://en.wikipedia.org/wiki/Syngnathidae" \o "Syngnathidae).[[87]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Eens-88)[[88]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Barlow-89)

Phenotypic traits can be [displayed](https://en.wikipedia.org/wiki/Signalling_theory" \o "Signalling theory) in one sex and desired in the other sex, causing a [positive feedback](https://en.wikipedia.org/wiki/Positive_feedback" \o "Positive feedback) loop called a [Fisherian runaway](https://en.wikipedia.org/wiki/Fisherian_runaway" \o "Fisherian runaway), for example, the extravagant plumage of some male birds such as the peacock.[[83]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Greenfield-84) An alternate theory proposed by the same [Ronald Fisher](https://en.wikipedia.org/wiki/Ronald_Fisher" \o "Ronald Fisher) in 1930 is the [sexy son hypothesis](https://en.wikipedia.org/wiki/Sexy_son_hypothesis" \o "Sexy son hypothesis), that mothers want promiscuous sons to give them large numbers of grandchildren and so choose promiscuous fathers for their children. Aggression between members of the same sex is sometimes associated with very distinctive features, such as the antlers of [stags](https://en.wikipedia.org/wiki/Deer" \o "Deer), which are used in combat with other stags. More generally, intrasexual selection is often associated with [sexual dimorphism](https://en.wikipedia.org/wiki/Sexual_dimorphism" \o "Sexual dimorphism), including differences in body size between males and females of a species.[[86]](https://en.wikipedia.org/wiki/Natural_selection" \l "cite_note-Hosken2011-87)