

Genetic Terms & Examples

ALLELE: alternative forms (i.e., different DNA sequences) of a gene or genetic marker.

Ex: The gene for seed shape in pea plants exists in two forms, the dominant gene for round seed shape and the recessive gene for wrinkled seed shape. Seed shape, round (R) or wrinkled (r), is the trait, or physical expression of allele combinations, inherited from the parental line. Thus, crossing parents with two dominant alleles for seed shape (RR) x two recessive alleles (rr) will produce all progeny with Rr alleles that express the dominant round trait (R is expressed over r). Conversely, crossing parents with Rr x rr will produce two progeny with Rr genotype that have round seeds, and two progeny with rr genotype that have wrinkled seeds, or 50% that are round and 50% that are wrinkled.

FITNESS: a measure of reproductive success; how many offspring an individual contributes to the next generation. It requires both survival of an individual and the ability for that individual to successfully produce offspring. For example, a fish may survive to reproductive maturity, but if it fails to reproduce progeny that enter the population (i.e. passing on its genetic traits to the subsequent generations) it will have zero fitness.

GENE FLOW: the level of genetic exchange between populations. Sometimes called migration, but the genetic use of the term implies movement to and successful reproduction in a new population (as opposed to the mass movements of populations, like the spring and fall migrations of geese). In other words, a fish that simply moves from one lake to another has migrated into and contributed to the total number within the population (one more individual in lake). While that individual has contributed to the population (total number of fish), if it does not successfully reproduce and pass on its genetic traits to offspring within the new lake then it does not contribute to gene flow.

GENETIC MARKERS (MOLECULAR): molecular tools used to analyze DNA and infer the genotype of an organism. They “mark” or reveal underlying variation in DNA sequences. Used to produce DNA fingerprints because different alleles (i.e., different DNA sequences) can occur in the pair of chromosomes in an individual, between individuals, and among populations.

GENOTYPE: the alleles found in an individual at one or more genes or genetic markers. An individual has two allele copies for each gene or genetic marker, one for each chromosome. Each chromosome is inherited from a parent; one allele is inherited from the female parent and one from the male parent.

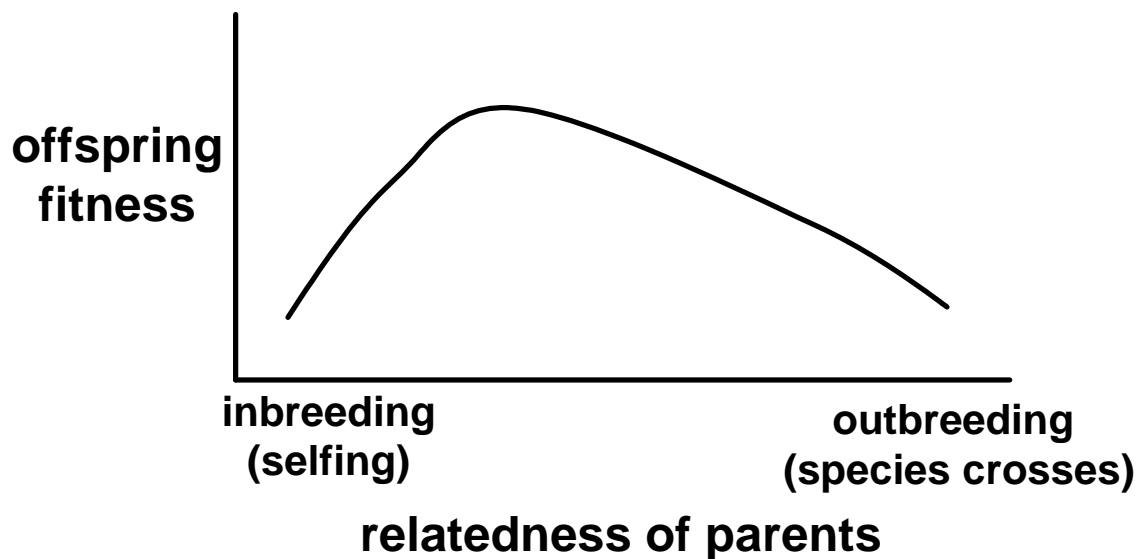
INBREEDING DEPRESSION: a reduction in fitness or vigor due to inbreeding (mating of close relatives). Close relatives tend to share alleles and when they mate detrimental recessive traits are exposed.

Ex: albinism is often caused by having two copies of a recessive dysfunctional pigmentation gene. If an individual “carries” one recessive allele of the gene, its relatives are also likely to be carriers. If two carriers of a recessive trait mate, some of their offspring are likely to get two copies of the dysfunctional allele, and they will be albinos. Albinism is likely to result in poor survival in the wild for many species.

LOCAL ADAPTATION: increased fitness by populations in their native environment due to natural selection. Individuals from these populations may not be as successful in non-local locations or dissimilar environments.

Ex: White-tailed deer native to southern North America (e.g. Texas) are much smaller than their northern counterparts (e.g. Minnesota or Saskatchewan), and each sub-population is locally adapted to their respective environment. While both northern and southern deer are the same species and have the ability to cross successfully (e.g. give birth to live fawns), progeny would have a very low likelihood of survival in either environment – fawns would succumb to heat stress in the south and cold temperatures in the north. This would also be an example of outbreeding depression where two dissimilar strains of a species, or locally adapted types, are crossed and the progeny are unsuccessful at surviving and/or reproducing because they have lower genetic fitness than the offspring from locally adapted parents.

OUTBREEDING DEPRESSION: a reduction in fitness in offspring of matings between genetically dissimilar individuals. Often used in reference to matings between individuals from different populations of the same species. Caused by reduced local adaptation to the environment or genetic incompatibilities.



Ex: Offspring fitness is affected by the relatedness of parents. Mating of close relatives (inbreeding) often causes reduced fitness (inbreeding depression) due to increased detrimental recessive traits. At the other extreme, parents that are too different genetically may also have reduced fitness (outbreeding depression). An extreme example is the tiger muskie, a sterile hybrid cross between northern pike and muskies. Crosses between genetically distinct populations of the same species can also experience outbreeding depression. Consequences of outbreeding could include poor survival because of disrupted adaptation to the environment or fecundity problems due to genetic incompatibilities. Maximum fitness is expected from crosses of non-related parents from the same or genetically similar populations. This is why the DNR prefers genetic similarity between source and recipient populations when stocking fish.

POPULATION: a group of organisms that freely interbreed. Genetic markers can be used to infer population divisions (reproductive isolation, or a lack of gene flow, between populations).

RECESSIVE TRAITS: Traits that only appear when an individual has two copies of the recessive allele at a gene. Individuals that have two copies of the dominant allele, or one copy each of the dominant and recessive alleles (these individuals are known as carriers), will show the dominant trait.

Ex: Individuals with one or two dominant copies of a pigmentation gene will have normal hair, skin and eye color, while those with two recessive copies will be albinos.