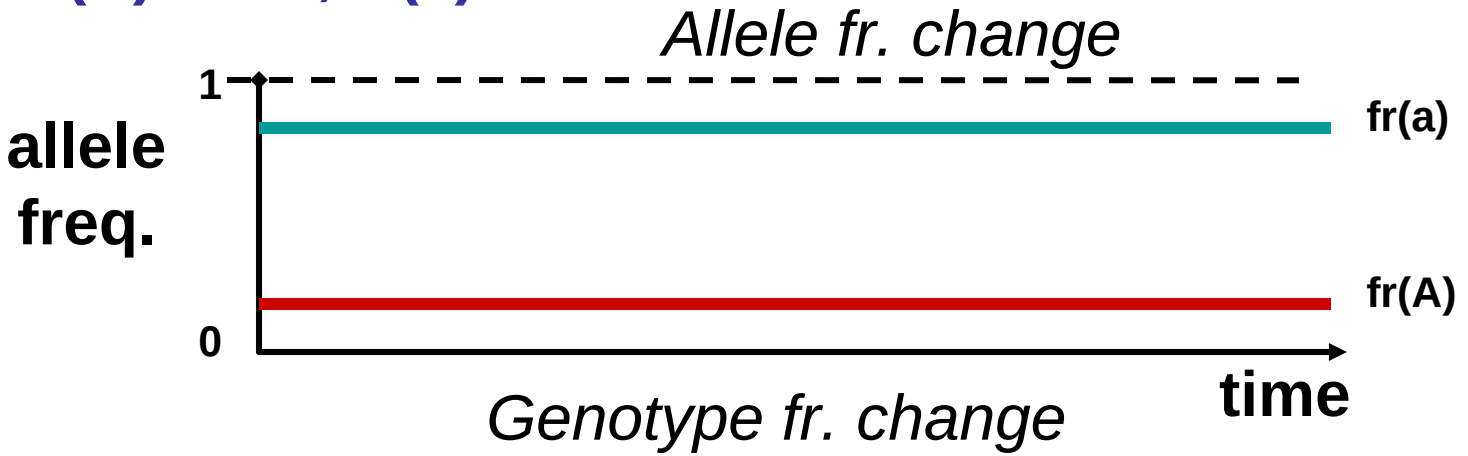
Hardy-Weinberg theorem

Why is Hardy-Weinberg population said to be at an equilibrium?

fr(A) = 0.2, fr(a) = 0.8



Genotype fr. change

fr(AA) = 0.04, fr(Aa) = 0.32, fr(aa) = 0.64

Forces of evolution – ***any factors that change ALLELE frequency in a population***

1. ***Natural Selection***
2. ***Genetic drift***
3. ***Gene flow (~ migration)***
4. ***Mutations***

Microevolution = allele frequency change in a population

Natural Selection

Fitness is the proportion of the individual's genes in the gene pool of the next generation.

Relative fitness (w): $1 \geq w \geq 0$

Selection coefficient (s) $w + s = 1;\ w = 1 - s$

	AA	Aa	aa
fitness:	$1-s_1$	1	$1-s_2$

equilibrium: allele frequencies no longer change

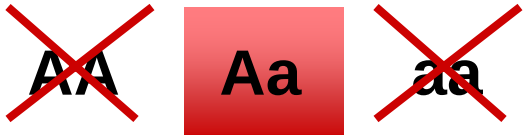
$\hat{q}$ **= frequency of *a* allele at equilibrium**

Modes of Natural Selection

1. Directional selection for the dominant phenotype

2. Directional selection for the recessive phenotype

3. Balancing selection



4. Selection against heterozygotes, disruptive

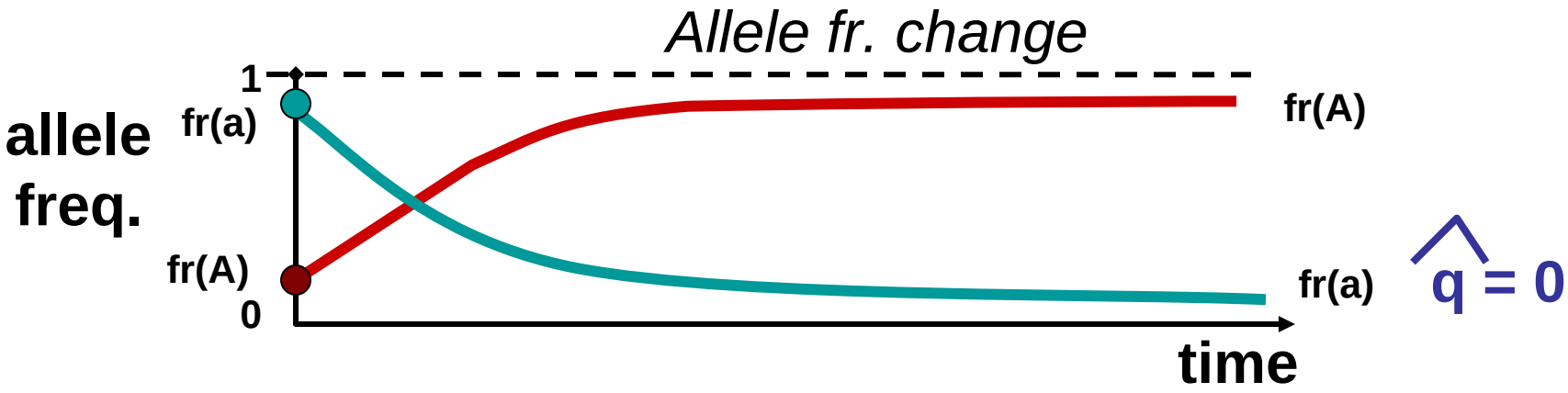
5. Frequency dependant selection

1. Directional selection for the dominant phenotype

AA Aa ~~aa~~

Examples:
recessive genetic disorders
Phenylketonuria (pp);
Maple syrup urine disease (mm)
Thalassemia (tt)

fr(A) = 0.2, fr(a) = 0.8

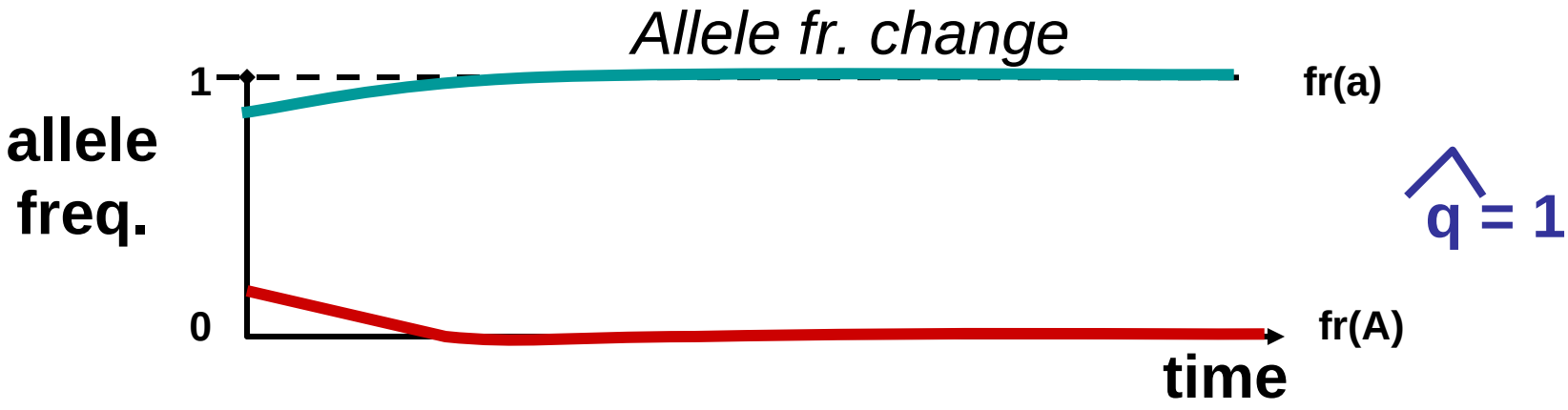


Recessive alleles never disappear completely

Recessive allele “hides” in heterozygous individuals

2. Directional selection for the recessive phenotype

~~AA~~ ~~Aa~~ **aa**



Dominant alleles are rapidly eliminated

Directional selection for the recessive phenotype

Examples:

achondroplastic Dwarfism (D)

von Willebrand disease (coagulation disorder)

Porphyria

Albinism among Hopi of Arizona and Zuni of New Mexico

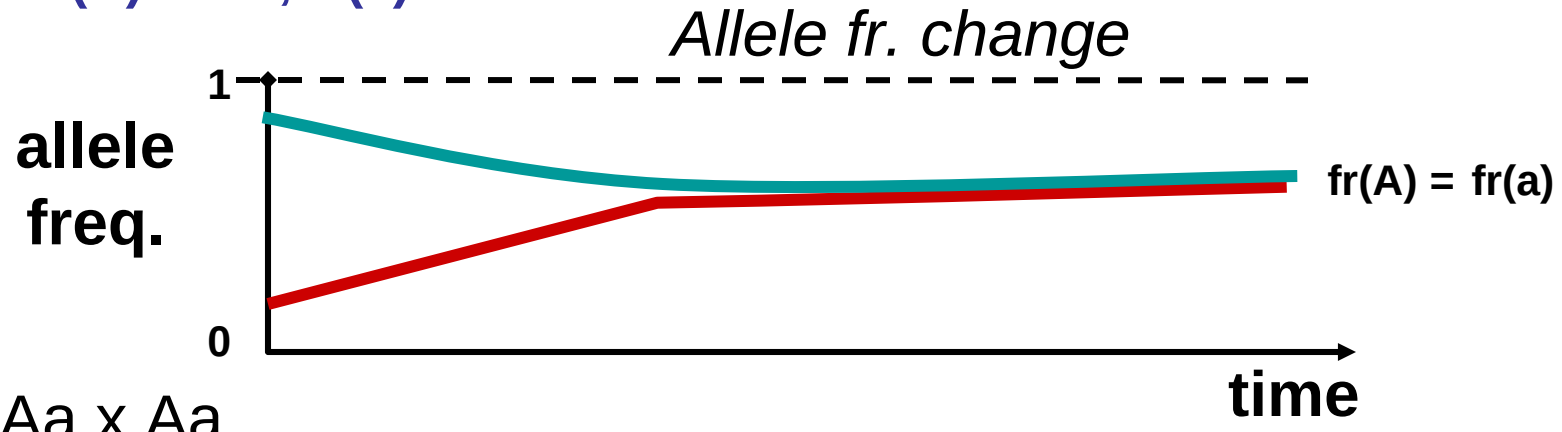
selection for albinos

Color blindness

3. Balancing selection

~~AA~~ **Aa** ~~aa~~

fr(A) = 0.2, fr(a) = 0.8



Aa x Aa

	A	a
A	AA	Aa
a	Aa	aa

Genotype fr. change

fr(AA) → = 0.25

fr(Aa) → = 0.5

fr(aa) → = 0.25

Balancing selection leads to *polymorphism*

3. Balancing selection

Example: sickle cell anemia in malaria risk areas

HH

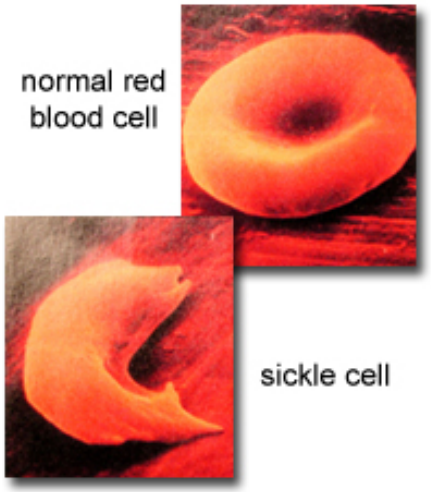
might die from malaria

Hs

resistant to malaria no anemia

ss

dies from anemia



Plasmodium falciparum **is a protozoan parasite transmitted by mosquito**