Polymorphism

D.2.10: Describe one example of transient polymorphism

- **Polymorphism** is when two or more forms of a phenotype are represented in high enough frequencies to be readily noticeable.
- Usually the result of a mutation

Polymorphisms

- Transient polymorphism
- Balanced polymorphism

Transient Polymorphism

- One that is changing in frequency over time.
- In transient polymorphism, one form is gradually being replaced by another.
- As the name implies, it represents a temporary situation as a by-product of directional natural selection

Transient Polymorphism

- Peppered Moth Example: Industrial Melanism (Kettlewell)
- 1848 – pre-industrial revolution, most peppered moths were nearly white, matching the light-colored lichen (England)
- By 1948 – post-industrial revolution, soot killed the lichen, revealing darker tree bark underneath…and the frequency of dark moths near London far exceeded the light variety

Peppered (grey) form

Melanic (black) form

Transient polymorphism

- Industrial melanism
  - factory pollution changing the population of peppered moths

Transient Polymorphism

- The Clean Air Act resulted in the population of peppered moths return
- Since the change was only temporary, it is transient polymorphism

Balanced Polymorphism

- When two or more alleles within a population are not transient and changing but are stabilized by natural selection, this is called balanced polymorphism.

Balanced Polymorphism

- If natural selection eliminates individuals with detrimental phenotypes from a population, then why do harmful mutant alleles persist in a gene pool?
- A disease can remain prevalent when heterozygotes have some other advantage over individuals who have two copies of the wild type allele.

Balanced Polymorphism

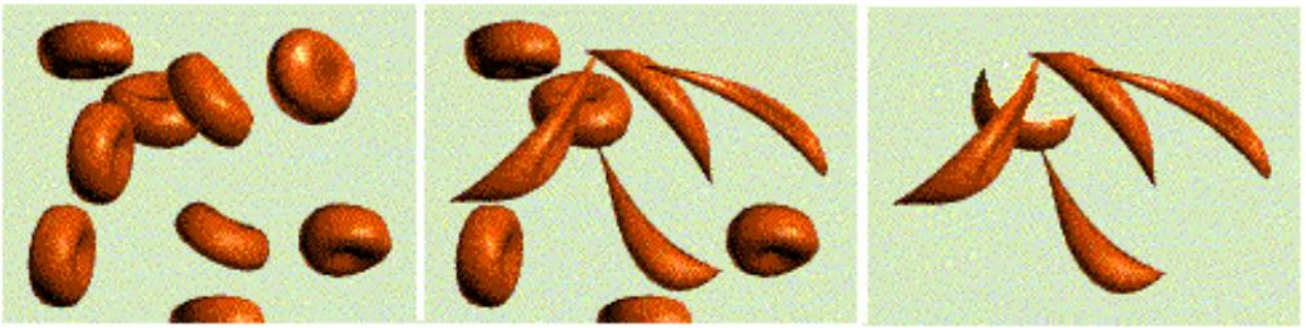
- When carriers have advantages that allow a detrimental allele to persist in a population, balanced polymorphism is at work.
- This form of polymorphism often entails heterozygosity for an inherited illness that protects against an infectious illness.

Balanced Polymorphism

- Two alleles are maintained and stabilized by natural selection
- Heterozygote has selective advantage

Sickle Cell Disease

- Autosomal recessive
- Carrier resistant to malaria
- Balanced polymorphism



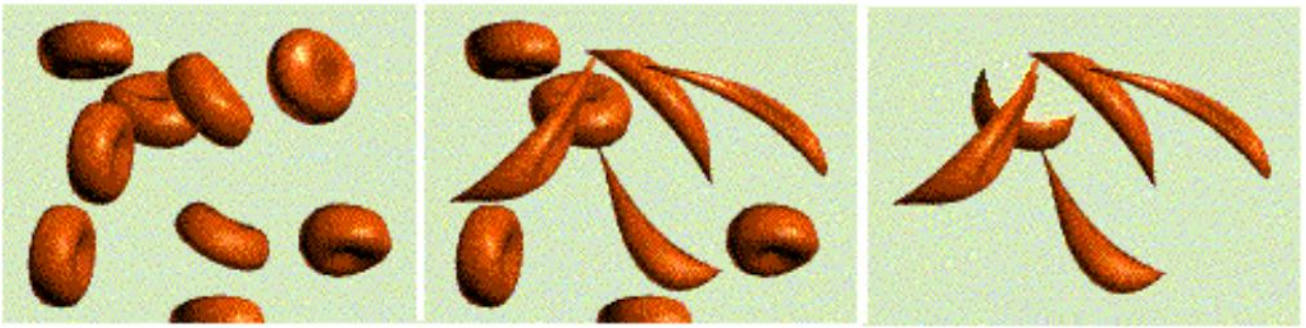
AA
Susceptible to Malaria

Aa
Resistant to Malaria but may have sickel cell disease occassionally

aa
Resistant to Malaria but has fatal sickel cell disease

Sickle Cell Disease

- Most people homozygous Hb^AHb^A
- SCD heterozygous trait Hb^AHb^A
  - Some sickle-shaped cells and some normal
  - Don't suffer from malaria



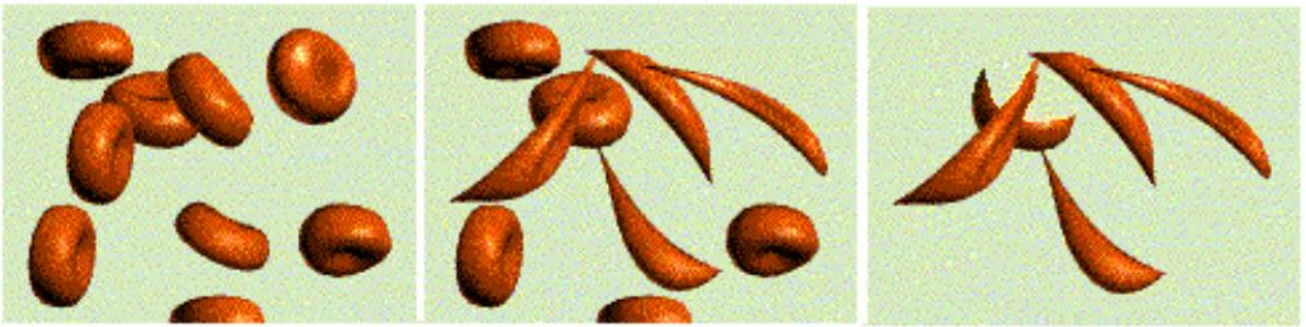
AA
Susceptible to Malaria

Aa
Resistant to Malaria but may have sickel cell disease occassionally

aa
Resistant to Malaria but has fatal sickel cell disease

Sickle Cell Disease

- Homozygous for SCD Hb^SHb^S
  - Only have sickle shape cells
- Allele frequency for these are relatively stable and show balanced polymorphism



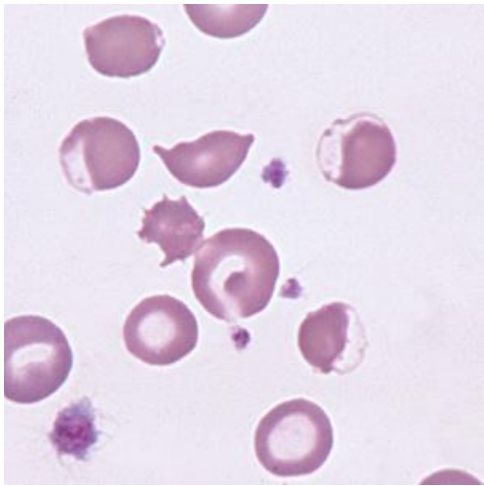
AA
Susceptible to Malaria

Aa
Resistant to Malaria but may have sickel cell disease occassionally

aa
Resistant to Malaria but has fatal sickel cell disease

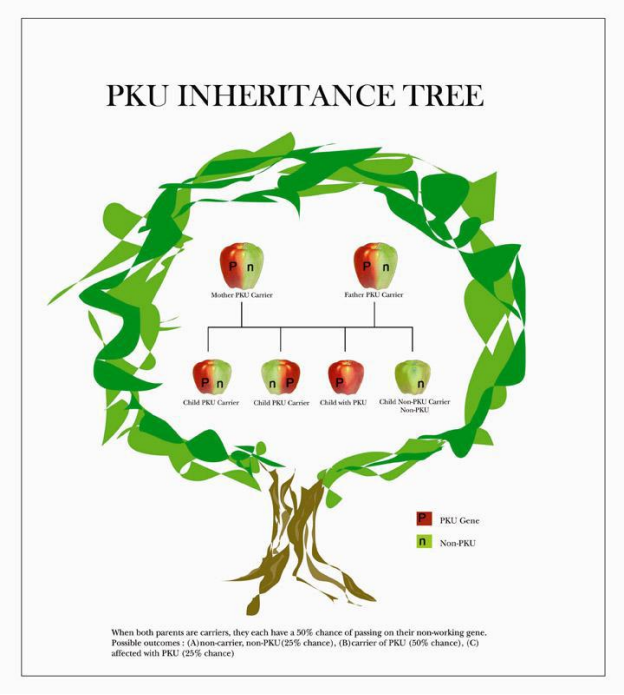
Glucose-6-Phosphate Dehydrogenase Deficiency

- Sex linked causing hemolytic anemia
- Autosomal recessive
- Balanced polymorphism
- Heterozygous female
- Develops only under specific conditions
- Protects against malaria



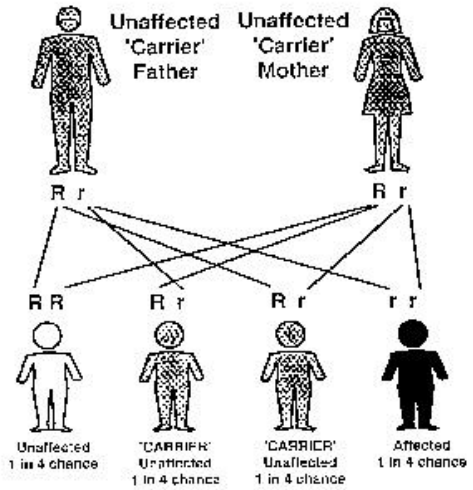
PKU

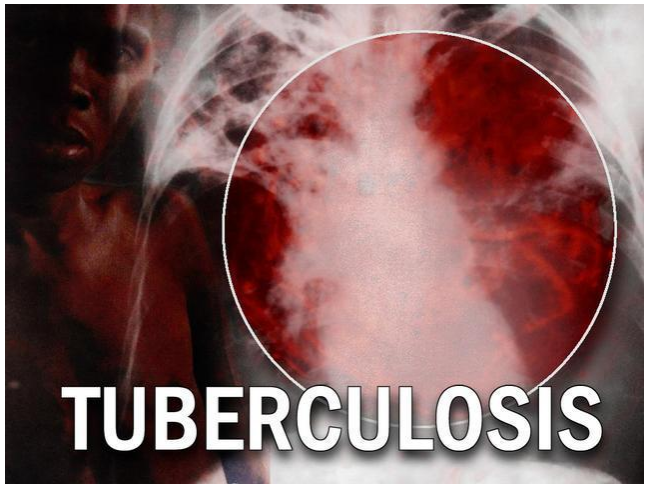
- Effects nervous system and miscarriage
- Carrier
- Protection against fungal toxin (Ireland)
- Heterozygote
- Autosomal recessive



Tay-Sachs Disease

- Protects against TB (Jewish pop.)
- Carrier
- Heterozygote advantage





Cystic Fibrosis

- Balanced polymorphism
- Opens channel proteins (NaCl)
- Protects against cholera
- Selective advantage