The Logic of Chuck's Argument

1) **Populations exhibit variation for a range of traits**

2) **Not all offspring can survive: populations are capable of geometrical rates of increase**

   e.g. $2^{40} = 1{,}099{,}511{,}627{,}776$

3) **Variation is heritable: offspring resemble parents**

4) **Survival is influenced by the heritable traits. On average offspring with favorable traits will leave relatively more offspring in the next generation**

EVOLUTION AND POPULATION GENETICS

Evolution

A change in gene frequencies in a population over time.

Main Forces of Evolution:

Natural Selection: Evolution due to differential reproductive success of individuals

Gene flow: Evolution due to migration

Genetic Drift: Evolution due to sampling error. Changes in gene frequencies due to genetic drift are random. It is especially important small populations.

Sources of Variation

Mutation. A heritable change in the genetic material.

Sexual reproduction. Causes novel genotypes in offspring. It does not, in itself, cause directional changes in gene frequencies.

TERMS USED FOR STUDYING POPULATIONS:

Gene: a segment of DNA that influences a heritable trait

Allele: The generic term used to describe alternative forms of a gene

Genotype: The combination of alleles carried by an individual

Phenotype: The actual traits expressed by an individual

$$P = G + E$$

Gene frequencies: frequency of alleles in a population regardless of how they are apportioned among indiv. (G g)

Genotype frequencies: frequency of alleles as they are expressed in pairs in a genotype (GG Gg gg)

Phenotype frequencies: frequency of traits as they appear in a population (green, white)

Hardy Weinburg Equations: Equations used to estimate the genetic structure (gene and genotype frequencies) of a population. Estimates should be valid for populations in Hardy Weinburg equilibrium (static, not evolving).

Equation 1: to estimate genotype frequencies:

$$p^2 + 2pq + q^2 = 1$$
$$(GG)\ \ (Gg)\ \ (gg)$$

where p^2 = the expected genotype frequency of GG
$2pq$= the expected genotype frequency of Gg
q^2 = the expected genotype frequency of gg

Equation 2: to estimate gene frequencies:

$$p + q = 1$$
$$(G)\ \ (g)$$

where p = the expected gene frequency of G
q = the expected gene frequency of g

Example: 21 green mucks, 4 white mucks