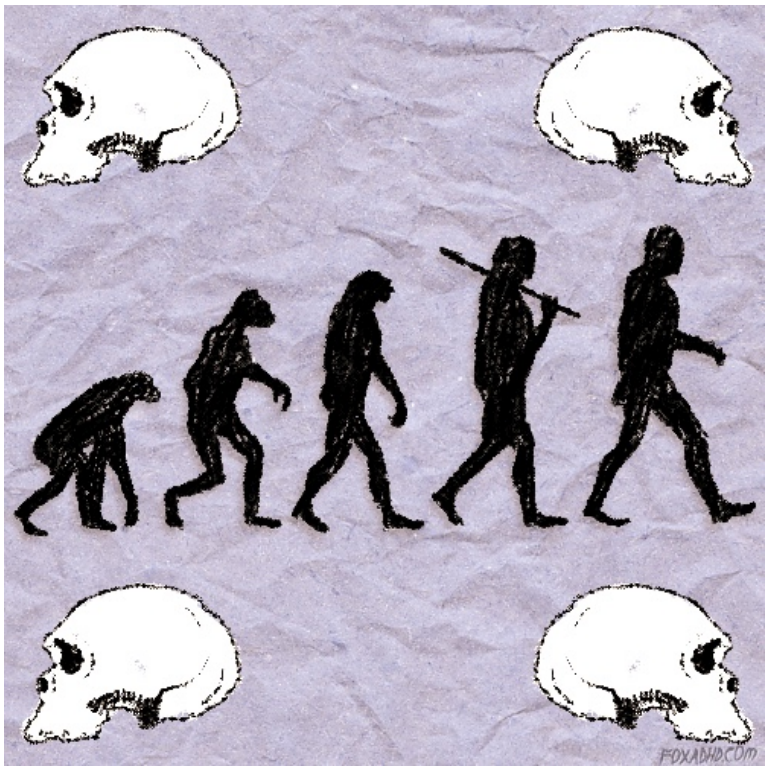
Evolutionary biology by Yale



LUX ET VERITAS

YALE

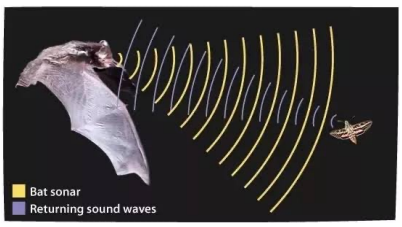
YALE

LECTURE 1 introduction

① species are competetion for anything that send their gene to next generation

② there will always be variation in reproductive sucess like height, weight, skin colour.

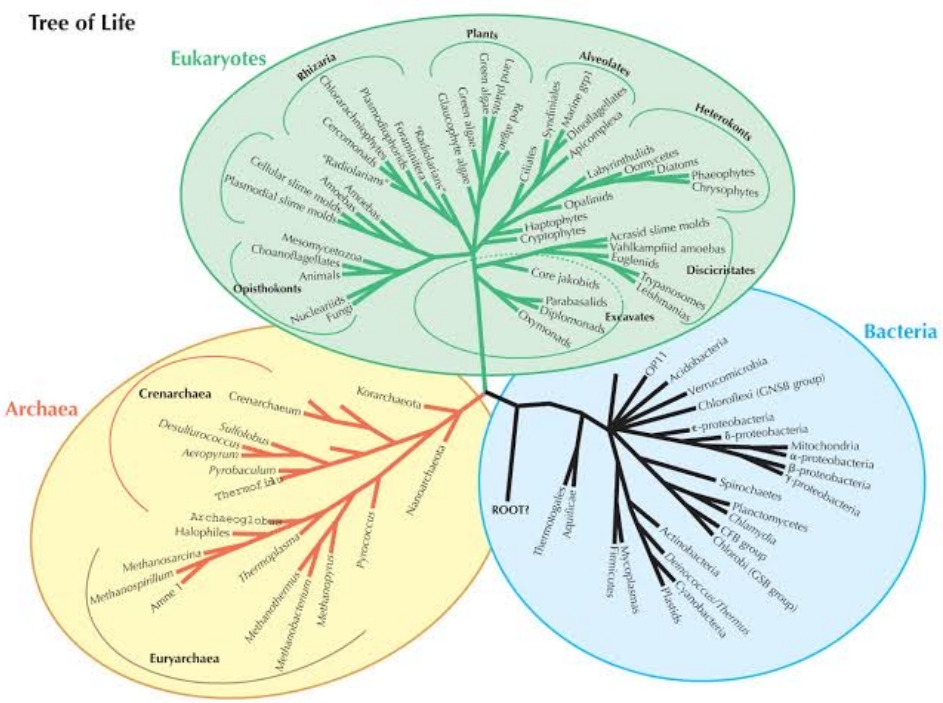
⇒ How Bat hunt in Dark ?



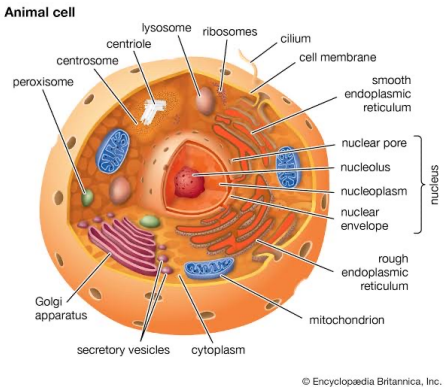
Macro evolution :

everything on this planet has a common element except viruses

mocking birds are moving around on different island with different style

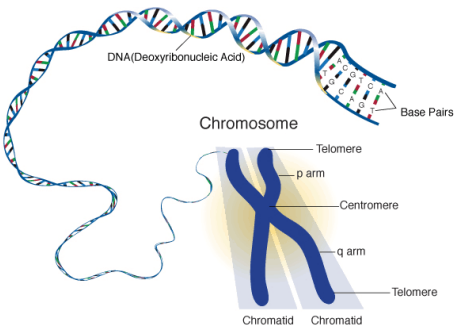


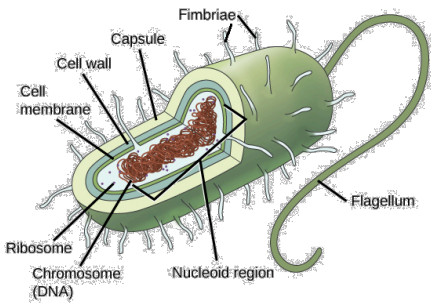
LECTURE Basic transmission genetics



Eukaryotes = organisms with cells containing a nucleus. The DNA resides in a muliple linear chromosomes in the cell nucleus

chromosoms are long structure consisting of a central scaffold around which the DNA molecule is wrapped together with associated proteins.





uncellular organisms lacking a nucleus (e,g bacteria) The DNA forms a continuous loop. called a circular chromosome.

genes are found in a specific location & come in different forms

Locus: specific site at which a gene is located on a chromosome.

A gene can occur in different varants called alleles, which differs in nucleotide sequence

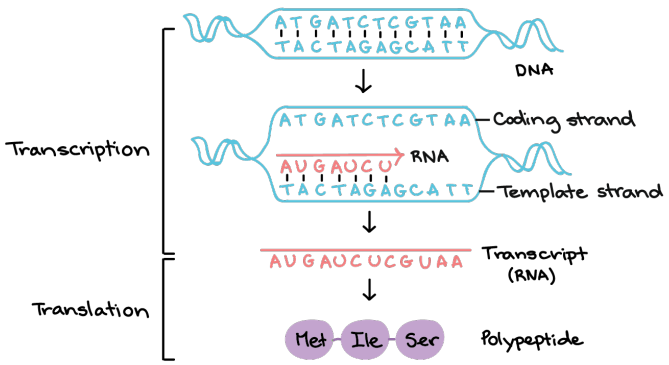
An organism carrying two diffrent alleles for the same gene is called heterozygous

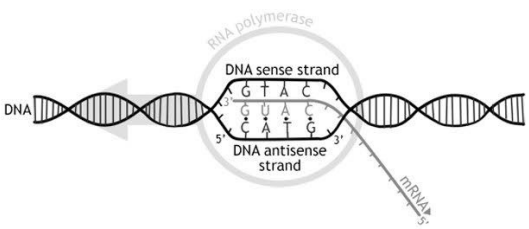
organism carrying two identical alleles is called homozygous.

Structure of Gene

The beginning of a typical eukaryotic gene is marked by a signal in the DNA, a **start codon**.
Its end is marked by another signal, the **stop codon**.

Between the start and the stop codon, the DNA sequences that code for protein - the **exons** - are interrupted by DNA sequences that do not code for protein - the **introns**.





The Central Dogma

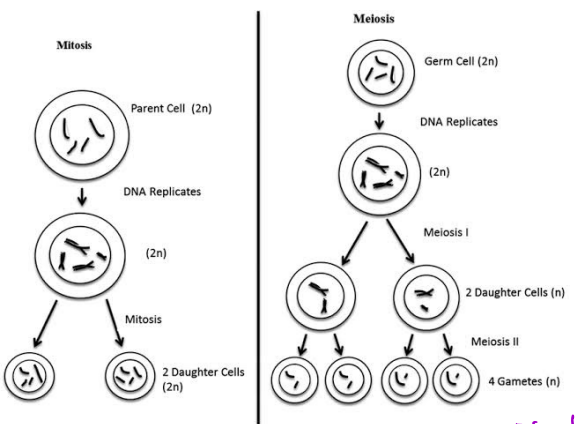
DNA ⟶ RNA ⟶ Proteins.

Transcription (DNA → mRNA) copies the DNA sequence of a gene onto a single-stranded **messenger RNA (mRNA)**.

Transcription is done by complementary pairing: Thymine (T) is replaced in RNA by Uracil (U).

Introns are cut out and discarded;
exons are spliced together.

mRNA is then **translated** into protein in the ribosome.



2 daughter gets complete sets of cromosoms

Dominant and Recessive
(T = Tall & t = short
Cross: Tt x Tt

	T	t
T	TT	Tt
t	Tt	tt

Genotypic ratio: 1 : 2 : 1 (TT=25% Tt=50% tt=25%)
Phenotypic ratio: 3 : 1 (Tall=75% Short=25%)

↳ it takes deployed parent & from it takes haployed gaymet

The meaning of Hardy-Weinberg

If the assumptions are fulfilled, then gene frequencies stay the same from one generation to the next.

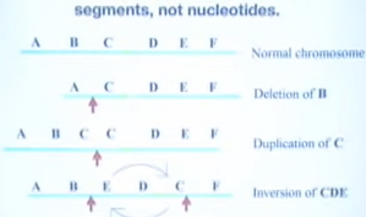
Replication is fair and accurate at the level of the population just as it is for DNA.

That makes evolution - changes in gene frequencies - possible because because it guarantees that information can accumulate from generation to generation.

And it minimizes conflict among genes about who gets into the next generation.

Common chromosomal mutations:

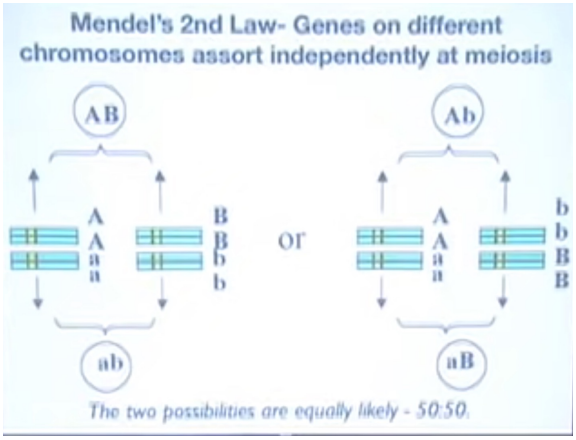
The letters signify entire genes or larger segments, not nucleotides.

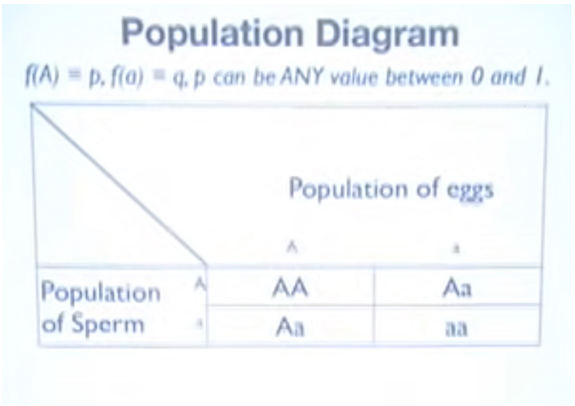


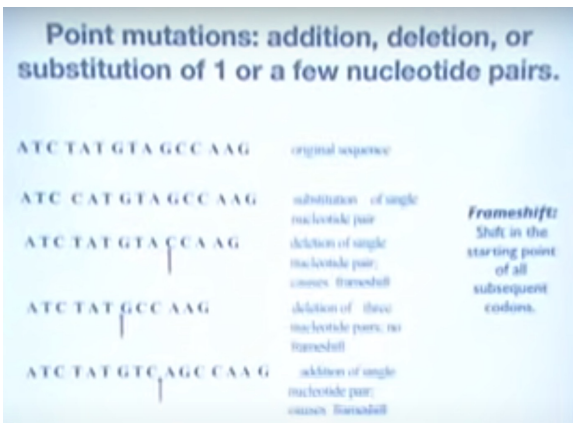
So what does this all mean??

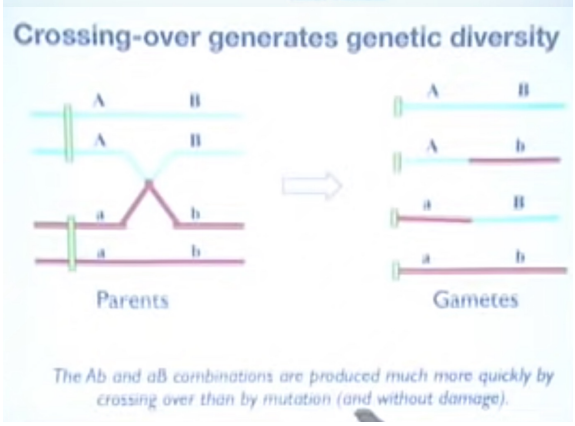
In one generation, the gamete frequencies are
$f(A) = p$, $f(a) = q$,
$p+q = 1$
Then the gametes make zygotes, with frequencies
$f(AA) = p^2$,
$f(Aa) = 2pq$,
$f(aa) = q^2$
$p^2 + 2pq + q^2 = (p+q)^2 = 1$
And in the next generation the gamete frequencies are
$f(A) = p$, $f(a) = q$: **NO CHANGE**

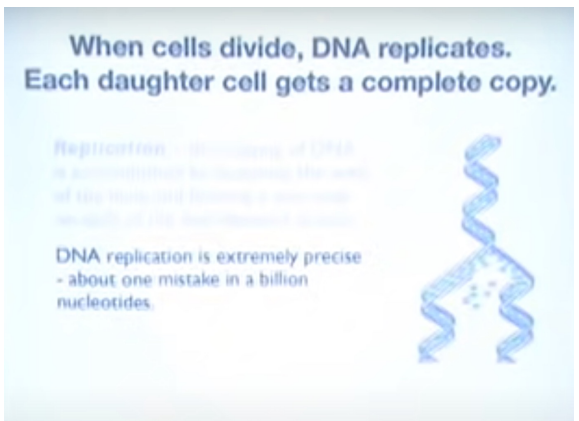
(This is the Hardy-Weinberg "law".)

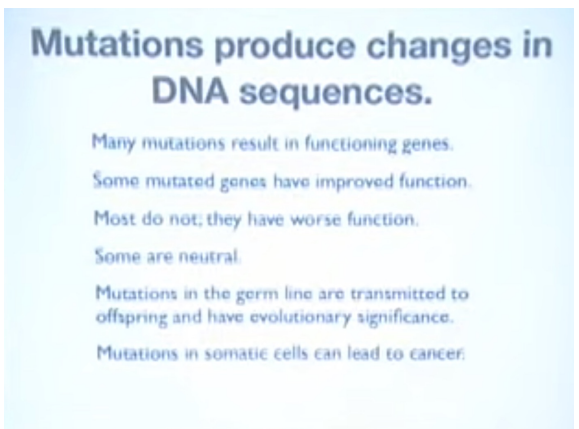


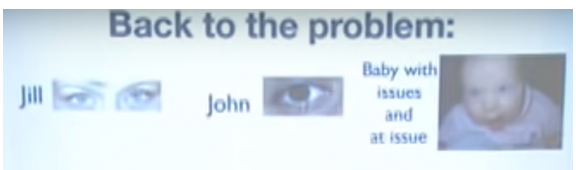












— jill with blue eye is married to jhon who has brown eyes. all the other men she knows have blue eyes.

— jill has a blue eyed baby. what is the probabilities that john is not the father? should he be worried simply on genetic grounds?

- Assume that brown eyes are dominant to blue & the eye color is determined by a single gene.
- John comes from an island where 1% of the people are blue eyed.
- Hint - we assume that John genotype is a random simple of those on the island where we note that $q^2 = 0.01$

LECTURE-3

adptive evolution, Natural selection

evolution can be adaptive (shaped by natural selection)
netural (dominated by drift)
maladaptive

evolution doesn't always makes things which are right, it can also make things which are wrong

adaptive evolution isn't sirvival of the fittest. it's about design for reproductive sucess.

there are 2 question in this lecture!

1. what will happen if directional selection continues for a long time?
2. How can we explain entalectual tools to be able to handel that cause even though evolution is extremly extremly fast, some times it doesn't happen millions of years.

Some rates of evolution in haldanes

Fast:

Trinidadian guppies	
Spot number	+0.74
Spot area	+0.68
Galapagos finches	
Body weight (1976–1978)	+0.71
Body weight (1984–1987)	-0.38

Slow:

Hawaiian Honeycreeper	
Lower mandible length	- 0.003
Columbia river sockeye salmon	
Migratory timing	- 0.07

Hospital-acquired infections

Estimated at more than 2 million per year in the US.

CDC estimates **90,000** per year die of such infections in the US (AIDS - 17,000; influenza - 37,000; breast cancer - 40,000).

Most such deaths are caused by bacterial strains ***resistant*** to antibiotics.

The economic burden of antibiotic resistance is estimated at about **$80 billion** annually in the US.

Resistance is caused by *strong directional natural selection that elicits a rapid evolutionary response.*

Rapid experimental evolution in natural habitat: Guppies in Trinidad

Life-history traits responded rapidly to a change in predation (guppies were moved from streams with predators to streams without predators).

The fastest rates of evolution were measured in traits expressed early in life.

With higher predation, guppies matured earlier and had more, smaller offspring; males were less colorful and displayed more discretely.

LECTURE 12

Questions about Sex Allocation

(1) What is the equilibrium sex ratio for organisms with separate sexes?

(2) For sequential hermaphrodites, as what sex should the organism be born and how old and large should it be when it changes sex?

(3) What should be the allocation to male and female function in simultaneous hermaphrodites?

(4) When should differential investment in offspring of each sex depend on social status?

mendals law in evolution

Ronald fisher's Sex ratio theory