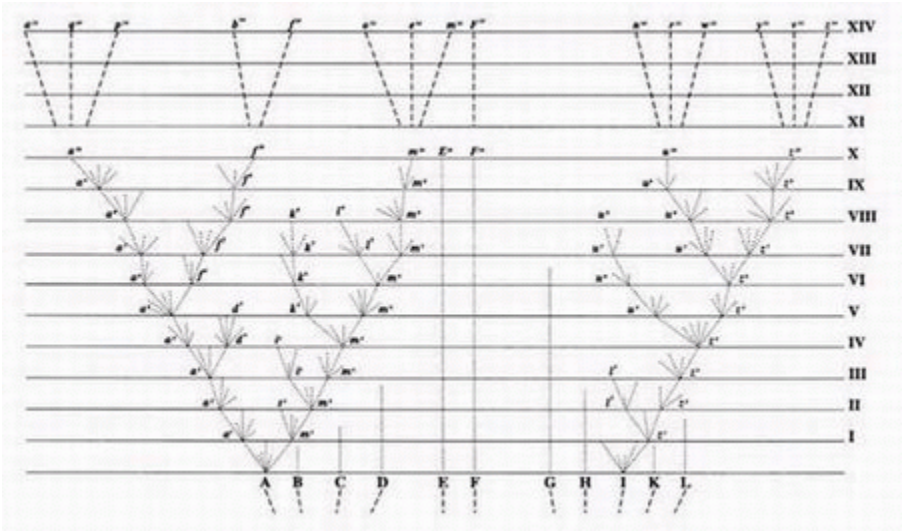
Darwinian theory

- Obviously first thing is to try to get clear about what the Darwinian theory ("theory of natural selection") says
- Everyone agrees that the flora and fauna of the earth have changed/evolved over time'
- The disputed – and interrelated - questions are
- (a) how? (that is by what mechanisms?) and
- (b) how extensively?

Darwinian theory

- EVOLUTIONARY THEORY:
- Concerning (b) : Darwin claims, contrary to Creationism, that (i) one kind (species) of organism can have descendants that belong to a different kind (species) and in fact (ii) all currently different kinds (species) have common ancestors.
- Indeed Darwin was committed to the view that life evolved at most a very few times, maybe only once in which case all currently living things would have one common ancestor (there would be one ‘tree of life’)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Darwinian theory

- Again, although inconsistent with Creationism, these claims are shared by a number of theories
- What makes Darwin's theory distinctive is that it sees NATURAL SELECTION as the main (though not exclusive) cause of evolutionary change.
- Lamarck versus Darwin (the corny giraffe case)
- "...the individuals which were the highest browsers and were able, during [droughts], to reach even an inch or two above the others, will often have been preserved.... By this process long-continued... combined no doubt in a most important manner with the inherited effects of increased use of parts, it seems to me almost certain that any ordinary hoofed quadruped might be converted into a giraffe."

Darwinian theory

- Every species is fertile enough that if all offspring survived to reproduce the population would grow.
- Despite periodic fluctuations, populations remain roughly the same size.
- Resources such as food are limited and are relatively stable over time.
- Therefore, a struggle for survival ensues.
- Individuals in a population vary significantly from one another.
- Much of this variation is inheritable.
- Individuals less suited to the environment are less likely to survive and less likely to reproduce; individuals more suited to the environment are more likely to survive and more likely to reproduce and leave their inheritable traits to future generations, which produces the process of natural selection.
- This slowly effected process results in populations changing to adapt to their environments, and ultimately, these variations accumulate over time to form new species.

Darwinian theory

- So what makes a species?
- Basically: a group of organisms capable of interbreeding and producing offspring that are themselves fertile
- ‘Working definition’ – adequate for most purposes

Darwinian theory

- So differences in members of species occur naturally
- (Independently of whether or not they are beneficial)
- ‘mutations’
- Some of these differences in traits produce a better fit with the environment and make their bearers more likely to have more offspring
- ‘natural selection’: the frequency of the trait in question increases within the population and may indeed in some cases become universal.

Darwinian theory

- Clearly in order for natural selection to increase the incidence of some trait over generations two independent requirements must be met:
- (a) having the trait in question must give the organism an advantage within its environment so that it is able to have more offspring than con-specifics that do not bear the trait; AND
- (b) the trait must be *heritable*

Darwinian theory

- How?
- Think of the ‘first’ long necked giraffe!
- Won’t the trait get lost over generations?
- Indeed Darwin’s own preferred theory of inheritance was ‘blending inheritance’
- But this doesn’t solve the problem, but rather underlines it!

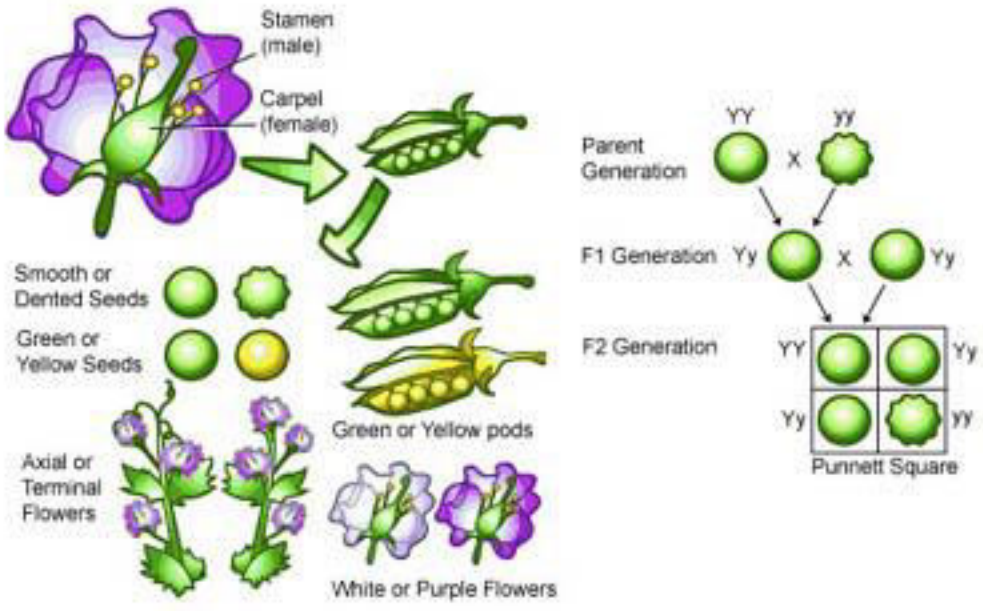
Mendel to the rescue

- Entirely reasonable objection at the time
- But we have come across this type of issue before – in fact it is entirely to be expected (cp Copernicus)
- And although reasonable to see it as a problem needing a solution, not reasonable to see it as a reason for outright falsification/rejection

Mendel to the rescue

- Mendel's theory solves the problem – at least in some cases
- A (pea-like) case - eye colour
- I have blue eyes
- My wife has brown
- Of our children Michael has brown eyes and Anna blue
- What's going on?
- Mendel explained

Mendel to the rescue



Mendel to the rescue

- **The 'Law' of Segregation:** every individual possesses a pair of alleles(assuming diploidy) for any particular trait and that each parent passes a randomly selected copy (allele) of only one of these to its offspring.
- **The 'Law' of Independent Assortment:** which allele an offspring gets from one parent is independent (probabilistically) of the allele they get from the other.

Mendel to the rescue

- Genes/alleles
- homozygotes/ heterzygotes
- Dominant/recessive
- Mendel observed the F_2 phenotypes and found very close agreement to the 1:3 ratio that his theory predicts
- So in the eye colour case in my family: my wife must be a blue/brown heterozygote
- (I exhibit the regressive trait and so must be homozygotic for blue.)

Mendel to the rescue

- COMPLICATIONS:
- 1. Most traits do not follow Mendel's simple laws. Instead most are *polygenic* – that is, affected by more than one gene transmitted independently (height is a well known example).
- 2. *Pleiotropy* – most genes contribute to the development of more than one characteristic.
- 3. *Gene/environment interaction* – genes do NOT *determine* characteristics, instead they should be thought of functionally: they map possible environments onto (generally different) phenotypic features.

Mendel to the rescue

- Nonetheless by producing a *particulate* theory of inheritance that worked very successfully in some cases, Mendel showed that the characteristics favoured in the enviroment in one generation could be passed on to the next without ‘mixing’