Lecture 5 – Sex Determination and genes influenced by sex (7/08/17)

Antigen – antibody reaction

- Any molecule which induces an immune response is called an antigen (antibody generator)
- Antibodies = immunoglobulins

A and B antigens

- the alleles determine the presence or absence of an antigen on the surface of the red blood cell
- the antigen is a glycoprotein embedded in the red blood cell membrane

ABO Blood Group

- One gene locus on chromosome 9, 3 alleles, 6 geno., 4 pheno.
- I A and IB are codominant
- I A and IB are dominant to i o

Phenotypes and genotypes of the ABO system

Genotype	Phenotype	Antigen present on red blood cell
I^AI^A I^Ai^o	Type A	A
I^BI^B I^Bi^o	Type B	B
I^AI^B	Type AB	AB
i^oi^o	Type O	neither A or B

Antibodies in ABO system

unique system because of the presence of antibodies in the plasma

Phenotype	Antigen present	Antibody present
Type A	A	B
Type B	B	A
Type AB	A and B	neither A or B
Type O	neither A or B	Both A and B

Agglutination – red blood cells coming together in clumps. E.g. if antigen A and antibody B are in the same body = no agglutination

Blood typing

- Use antisera containing antibodies:
  - Type A, Type AB agglutination with anti A
  - Type B, Type AB agglutination with anti B
  - Type O no agglutination anti A or B

Transfusion

- Key factor is the antigen on the surface of the red blood cells (rbcs) of the donor
- If the rbcs of the donor have the antigen for which the recipient has the antibody - agglutination will result

Blood Donations

- Type O is the universal donor
- Type AB is the universal recipient

Blood Donations

Phenotype	Antibody present	Can receive blood from
Type A	B	A, O
Type B	A	B, O
Type AB	-	A, B, O, AB
Type O	A and B	O

No antigens to transfer

Type O is the universal donor
Type AB is the universal recipient

Lecture 7 – Autosomal linkage (16/08/17)

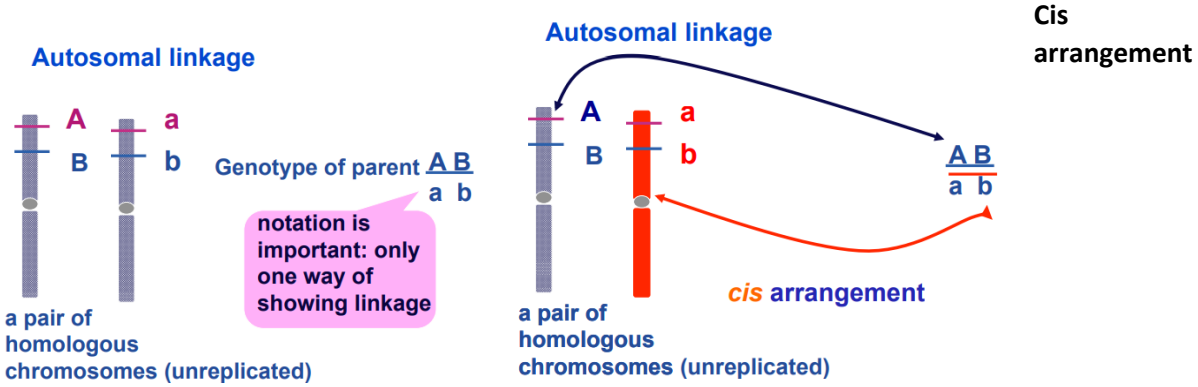
Types of crosses

- **Reciprocal crosses** tell you if a gene is sex linked
    - Male Phenotype A x female phenotype B
    - Male phenotype B x female phenotype A
- A **test cross is a cross to a homozygous recessive individual** can tell you if a gene is assorting independently or autosomally linked
- A **back cross** is an offspring back to a parent. Usually when you know the genotype of the parent

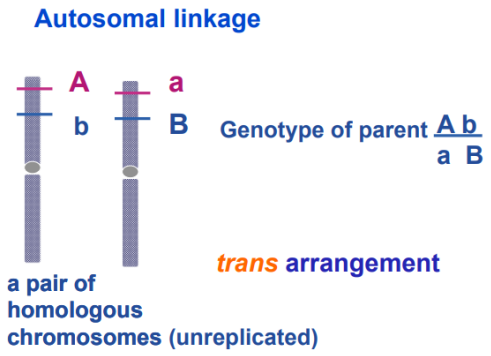
Linkage

- Many more genes exist than chromosomes
- Several genes must exist on the same chromosome
- Consequently independent segregation of the alleles of these genes may NOT occur

Cis arrangement



Trans arrangement



*During meiosis CROSSING OVER (CHIASMA) takes place and EXCHANGE (or RECOMBINATION) of maternal and paternal chromatids occurs

* Note recombination is the recombining of maternal and paternal alleles you do not get recombination between sister chromatids although they can crossover and exchange pieces

* Non-recombinant or parental offspring occur more frequently than recombinant offspring Recombinant offspring only occur if there is a cross over between the loci being considered

*There will be less recombinant offspring than non-recombinant

Lecture 9 – Mutation and genetic variation (23/08/17)

Genetic variation and Phenotype e.g. Albinism

- Pigmented – "functional gene product"
- Albino – mutant gene product = non-functional

Genetic variation and mutations

- **Genetic variations –** are different forms of a DNA sequence
- **Mutations –** are the alterations of a DNA sequence

* In other words, mutations give rise to genetic variation → may or may not be differences within a gene, change its function or cause a phenotypic change

The consequences of mutations

- Dependent on:
  - Cell/tissue type where mutation occurs (germline or somatic)
  - Extent of genome affected
  - Nature of the mutation and where it occurs

2 forms of mutation

- **Spontaneous mutation:** errors occuring during DNA replication (can change gene function)
- **Induced mutations:** e.g. exposure to radiation (and X-rays), chemicals that disrupt the mitotic/meiotic spindle and UV damage

Mutations can occur in somatic cells

- Somatic changes are associated with sporadic (non-inherited) cancers e.g. skin, breast or lung cancer

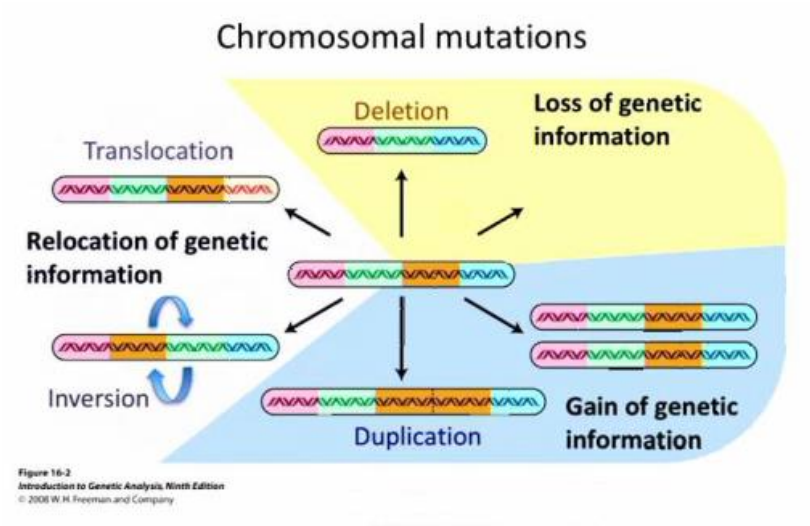
Germ-line mutations can be inherited

- Homeotic genes – determine the differentiation of body parts

Extent of genome affected

- Mutations can be small or large-scale:
  - Single base pair substitution
  - Deletion or insertion of several base pairs
  - Major alteration in chromosome number or structure

Chromosomal mutations



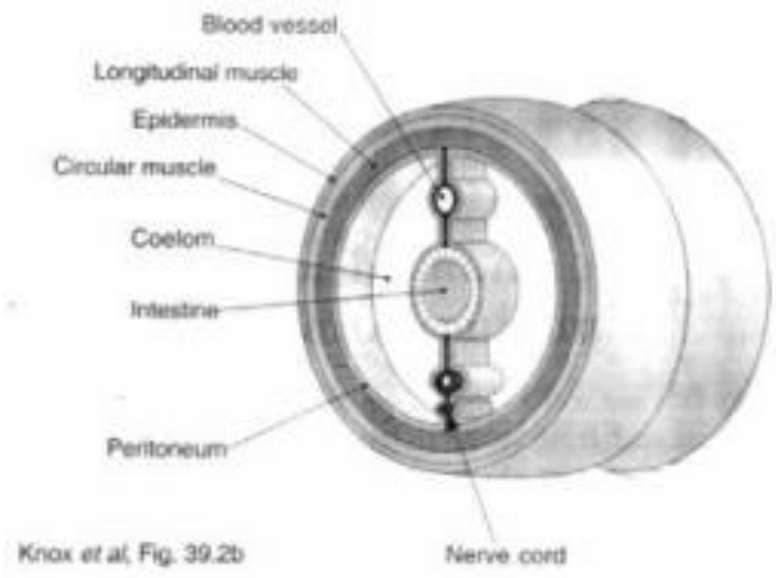
Lecture 12 – Animal Diversity: from Worms to molluscs (4/09/17)

Classifications

- Symmetry:
  - Bilateral
  - Radial (can cut vertical, horizontal, diaganol)
- Germ layers: layer of embryo cells that develops into body features
  - Diploblastic
  - Triploblastic (Ectoderm, mesoderm, endoderm, gut
- Coelom absent = ACOELOMATE, Coelom present = COELOMATE
  - Importance of the coelom:
    - Fluid-filled so can be used as internal support
    - Seperation
    - Allows transport of fluids (circulatory and excretory systems)
    - Provides space for development of internal organs
    - Enables increased body size
  - Germ layers in the Blastula
    - Blastula = early developmental stage when cells begin to differentiate (balls of cells = morula)
- Fate of the blastopore:
  - PROTOSTOME ('mouth first') → blastopore becomes the mouth, spiral cleavage and determinate development
  - DEUTEROSTOME ('anus first') → radial cleavage, indeterminate development
- Segmentation

Phylum: Annelida

- Bilaterally symmetrical
- Triploblastic
- Coelomate (unlike flatworms)
- Protostomes
- Body segmentation – serial repetition of functional units (compare with flatworms)
- **Coelom –** acts as a fluid-filled (hydrostatic) skeleton
- **Closed vascular system –** transport vital gases, food and excretory products
- **Ventral nervous system –** nerve cord
- **Movement –** antagonsistic circular and longitudinal muscles



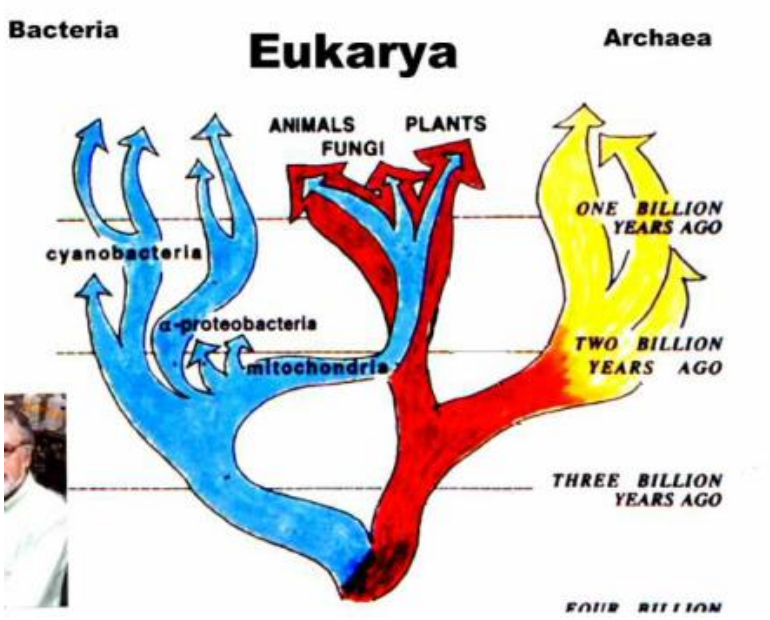
Knox *et al*, Fig. 39.2b

- Class: Polychaeta
  - Free-swimming and sedentary (Marine worms)
  - Have unjointed leg-like 'parapodia' on every body segment
  - Reproduction – mostly sexual via spawning or hypodermic impregnation; some species hermaphroditic
  - Trocophore larvae – free swimming cilliated larva

Lecture 18 – Diversity (18/09/17)

Three super kingdoms

- Bacteria, Archaea and Eukaryotes (Eukaryotes can be Protista, Plantae, Fungi, Animalia)



How did eukaryotic cells evolvle?

- Nuclear membrane
- Endomembrane (invagination)
- Complexity of genome

Prokaryotes vs Eukaryotes

DNA	Circular (single)	Linear (multiple)
Histone proteins with DNA	+/-	+
Nuclear envelope & ER	×	✓
Multicellular	×	✓
Cell size	<10µm	3µm to 10mm
Genome	$<10^6$ bases (GACT)	10^7 to 10^{10} bases (GACT)
Genes	~4000 genes	6000 - 35000 genes

The Protists

- The first Eukaryotic cells to evolve were protists and they are an extremely diverse group of organisms

When do Eukaryotic cells first appear in the fossil record?

- Precambrian acritarch fossils are the first known of eukaryotic cells – max 2 billion years old
- Multicellular (filamentous), eukaryotic organisms appear about 1.4bn years ago

Lecture 21 – Plants invade the Land (4/10/17)

*****Animals established their body plans PRIOR to colonisation of the land

*Land plants developed their body plans AFTER they colonised terrestrial environments

Why are the Charaphyte green algae believed to be the closest relatives of Land Plants

- Coleochaete (fresh water pond algae) → meiosis and cell wall formation makes it related to green plants

Living on Land (Or out of water)

- Water balance (land plants need greater rainfall capturing mechanisms)
- Gas exchange (CO_2 dissolved in water vs gaseous air exchange which is drier)
- Water transport (land plants need systems to move water from roots to everywhere else)
- Structural Support (algae derive support from buoyancy – nothing structural, land plants need structure)
- Reproduction (water plants release sperm cells into water to reach egg cell, land plants need different mechanisms)

What key adaptations did plants make in order to invade the land?

- *Cuticle*
  - Barrier against pathogens, UV absorbent (sunscreen), hydrophobic
- *Stomata; gas exchange*
  - Air in and out
- *Vascular tissue; xylem, lignin cell walls*
  - Water transport
- *Stems, roots, leaves*
  - Division of labour
- *Secondary growth*
  - Increase vascular transport (rings expand out). Vascular cambium allowed the evolutionary of shrubs and trees
- *Egg protected on female*
- *Embryo protected in seed*
- *Sporophyte dominance*
- *Pollination*
  - Bee/butterfly/bird relationship with pollinating plants

Rynia

- Early land plant fossil

Evolution of Land Plants

- Liverworts and Mosses are the most primitive Land Plants

What features characterise the Mosses?

- No vascular tissue (therefore small plants)
- No roots
- Thin cuticle
- Stomata