

TOPIC 3.2: CHROMOSOMES

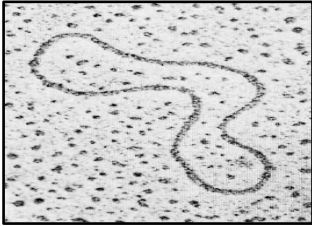
Chromosomes

Prokaryotes

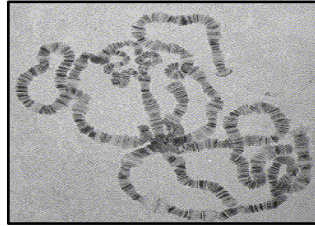
- Have a single circular molecule made of naked DNA
- May have additional plasmids (autonomous DNA units)

Eukaryotes

- Multiple linear DNA molecules packaged with histones
- Do not have plasmids (unless genetically modified)



Prokaryotic DNA



Eukaryotic DNA

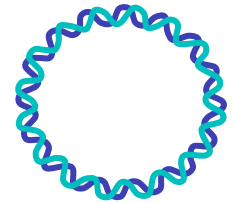
Autoradiography

John Cairn pioneered a technique for measuring the length of DNA molecules while uncoiled (via autoradiography)

- Radioactive thymidine is incorporated into a cell's DNA
- Chromosomes were fixed to a photographic surface and treated with silver bromide (AgBr)
- Radiation converts silver ions into insoluble grains that is visible via electron microscopy when a film is developed



Autoradiograph



Interpretation

Diploid versus Haploid

Sexually reproducing organisms receive genetic material from both parents

- **Diploid** = 2 sets of chromosomes (i.e. body cells)

To reproduce, these organisms only pass on half their genetic material

- **Haploid** = 1 set of chromosomes (i.e. sex cells / gametes)

When haploid sex cells fuse, the diploid cell can grow into a new organism

Homologous Chromosomes

Homologous chromosomes are the paired chromosomes inherited from both parents (maternal and paternal) in sexually reproducing animals

Homologous chromosomes have the same genes at identical loci positions

- However the specific alleles for each gene may be different

Sex Determination

Humans have 23 pairs of chromosomes

- Diploid number ($2n$) = 46 chromosomes

22 pairs are homologous **autosomes**

- Each pair has identical genes and loci
- Alleles may differ (one from each parent)

The 23rd pair are the **sex chromosomes**

- Females have two X chromosomes (XX)
- Males have X and Y chromosomes (XY)

The Y chromosome is responsible for the development of male sex characteristics

- Hence, the father always determines sex

Karyotyping

Chromosome number is a characteristic feature of members of a species

- **Karyotypes** identify the number and types of chromosomes in a cell

Karyotyping is performed pre-natally to identify the sex of offspring or diagnose potential chromosome abnormalities (e.g. aneuploidies)

Amniocentesis

- Cells are collected from the amniotic fluid of the pregnant mother
- Conducted at ~16 weeks with a slight risk of miscarriage (~0.5%)

Chorionic Villi Sampling

- Cells are collected directly from the placental tissue
- Conducted at ~11 weeks with a higher risk of miscarriage (~1%)

Karyograms

A karyogram shows the chromosomes of a cell in homologous pairs of decreasing length

Female: Down Syndrome (Trisomy 21)

